REVIEW OF RESEARCH SCHEMES AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2013-14

A. Report by the Head of the Department

I. Name of the Department : Agricultural Economics

II. Salient Research Findings of the Department during the Period under Report (2012-13)

- Implementation of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) has resulted in reduction of labour availability i.e. supply by 32.51 per cent at farmers' field for performing different agricultural operations.

- The wage rates for different agricultural operations have witnessed tremendous increase ranging from 50 per cent to 140 per cent owing to implementation of MGNREGS.

- Hisar district is sharing 18.61 per cent of state total households who were benefited under MGNREGS and 23.83 per cent of the state total expenditure incurred in the scheme.

- Gender wise working hours per household per season in different agricultural operations indicated that maximum time was spent by female members in picking of cotton (102.16 hours), followed by cutting green fodder (50 hours in *kharif* and 57.44 hours in *rabi*).

- Male members spent maximum time per season in preparation of fields i.e. ploughing etc. (60.70 hours), harvesting (48.95 hours) and hoeing (48.30 hours) in *kharif* season. In *rabi* season, they dominated in harvesting (94.51 hours) followed by plant protection (85.69 hours) per household.

- Female members as compared to males were mainly involved more in all the livestock activities except breeding.

- Active working age, illiteracy, small size of land holding and lower income strata were found having significant relationship with female participation in harvesting, picking, hoeing and threshing operations.

- Farmers were benefited to the tune of Rs. 900 to 1200 per quintal by withholding their paddy basmati for 2-3 months due to market advisory given by Agricultural Marketing Intelligence Centre (AMIC), Department of Agricultural Economics CCSHAU, Hisar during 2012-13.

III. Emerging/Thrust Areas

1. Economic analysis of diversification, marketing, processing and value addition in agriculture sector.
2. Economics of various agricultural enterprises.
3. Farm financial analysis and management.
4. Live stock economics and management.
5. Input use efficiency in different agro-climatic conditions.
6. Economic analysis of emerging agricultural problems.

IV. Action taken report of the last year's proceedings (2012-13)

Sr. No.	Observation/Suggestions made	Action Taken
1	The income, saving, investment and consumption pattern studies undertaken in various districts be complied in a single document.	Needful done and final report is submitted to Directorate of Publication (Press Manager) for printing. Copy of the report submitted to Director of Research.
2	The ρ value for size of land holding in Table 1 at page 12 may be corrected.	Has been corrected in final report.
3.	The studies on "Impact of MGNREGS" should be carried out in 2 villages of each block of Hisar district. The observations on various parameters be taken before and after implementation of MGNREGS. The resource use studies be also taken in this project and for this purpose Dr. V. P. Mehta be associated as an investigator.	Needful done as suggested. The study was conducted in 2 villages of each block and observations on different parameters were taken both before and after implementation of MGNREGS. Dr. V. P. Mehta was associated in resource use study.
4.	In experiment on "Study on gender wise participation in agriculture in Hisar district of Haryana" the number of blocks should be increased.	Needful done as directed, study was conducted in four blocks.

V. List of research projects (both from state as well as outside agencies) in operation along with sanctioned budget (2013-14)

Sr. No	Number and name of the scheme	Sanctioned Budget (Rs.)
A.	**State Funded Schemes**	
1.	**C(a)Econ.1 Plan (Agri.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	1,45,17,350
B.	**Other Agencies:**	
2.	**Govt. of India C(c) Econ.1 (CS)** Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana.	1,79,00,000

VI. Research projects completed during 2012-13 and the tangible conclusions drawn.

- Price forecast of eight agricultural commodities viz., basmati paddy, cotton, gram, mustard, potato, tomato, brinjal and green peas for pre-sowing and post harvesting periods were made. The validity of price forecast was observed 85 to 95 per cent.
- Price forecasts were disseminated through print and electronic media and voice SMS by IFFCO Kisan Sanchar Ltd.
- Organized 20 farmers and 14 Agricultural Officials trainings (50 participants in each) at different district headquarters in collaboration with KVKs and DDAs during 2010-11 to 2012-13 for capacity building and dissemination of market intelligence.
- Organized National Level Post-Kharif Workshop of the project on 5-8th October, 2012 in Department of Agricultural Economics, CCSHAU, Hisar in which 33 delegates from ten participating centres across different states attended the workshop.
- Published two commodity reports on basmati paddy and mustard.
- Farmers were benefited to the tune of Rs. 700 to Rs. 1200 per quintal by withholding the sale of their produce (basmati paddy) for two to three months due to advisory issued by Agricultural Market Intelligence Centre (AMIC), Department of Agricultural Economics, CCSHAU, Hisar during 2010-11 to 2012-13.

- The condition of minimum export price (MEP) of basmati rice should be need based keeping in view the international prices and policy of Pakistan being main competitor.
- The minimum support price (MSP) may also be extended to basmati paddy to provide remunerative prices to the growers.

VII. Research projects sanctioned during 2012-13

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VIII. Recommendations generated for field application

- Keeping in view the reduction in availability of agricultural labour owing to implementation of MGNREGS in the district, there is a need to link MGNREGS with agriculture through suitable policy interventions.
- There is a need to develop cost effective farm machinery and adoption there of suitably at different size of land holdings in agriculture sector to overcome the labour scarcity for different operations and to bring efficiency in resource use.
- Custom hiring of machines may be provided to the farmers at reasonable rates.
- Farmers should be provided remunerative prices through higher MSP than cost of production.

IX. Patent filed if any: **Nil**

B. Details of Each Research Scheme(s) for Review:

i) Scheme No. & **: C (a) Econ-1 Plan (Agri.)**
Title **: Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming**
ii) Year of Start **:** 2002-2003
iii) Location **:** Haryana
iv) Objective (s) **:**

1. To analyse the resource use efficiency in Haryana farming.
2. To carry out studies into different marketing aspects of major farm inputs and products.
3. To study the possible agricultural diversification in different zones of Haryana.

v) Any need to modify the objectives as per the need of the state

No change is required at present, it covers all the aspects

vi) Staff provided in the scheme including name of the faculty members

Sr. No.	Sanctioned posts	Status	Designation
1.	Economist(FM) -1	Vacant	Superannuation
2.	Assistant Scientist (Agri. Econ) - 6	1. Dr. R.K.Khatkar	Sr. Scientist & Head
		2. Dr. J.C.Karwasra	Sr. Scientist
		3. Dr. V. K. Singh	Sr. Scientist
		4. Dr. V.P. Mehta	Sr. Scientist
		5. Dr. K.K. Kundu	Scientist
		6. Vacant	VRS of Dr. R.S. Khatry
3.	Assistant Scientist (Sociology) - 1	1. Dr. (Mrs.) Deep Punia	Sr. Scientist (Sociology)
4.	Assistant Scientist (Statistics) - 1	Vacant	Transfer
5.	Research Associate (Rural Sociology)-1	Dr. (Mrs.) Baskaur	Research Associate w. e. f. 28.5.2012

vii) Budget for the year 2012-13 (head-wise sanctioned and expenditure details)

(in Rs.)

Sub Head	Allotment	Expenditure	Budget 2013-14
Pay	71,60,160	71,60,095	75,80.640
ADA	43,05,300	43,05,235	53,61,070
CPF/GPF	5,70,000	5,69,975	5,28,140
Gratuity	10,00,000	10,00,000	10,00,000
OE & Others	17,600	17,443	18,000
TA	4,820	4,820	13,500
M & S	2,800	2,692	3,000
Other Charges	4,000	3,975	5,000
POL	nil	nil	8,000
Total	**1,30,64,680**	**1,30,64,235**	**1,45,17,350**

viii) Achievements in bullet form (telegraphic language)

- Among MGNREGS workers about 13 per cent and 87 per cent of the selected respondents were belonged to general and other caste categories respectively.
- Scheduled caste workers dominated both in MGNREGS and agricultural sector employment with more than 50 per cent share.
- The wage rates of different agricultural operations have increased from Rs.125-200 in 2008-09 to Rs.250-400 per man day in 2012-13 mainly due to scarcity of labour caused by implementation of MGNREGS. While the wage rates in MGNREGS has increased from Rs.137 per man day in 2008-09 to Rs. 191 per man day in 2012-13.
- In district as a whole the increase in employment generation under MGNREGS was observed 526.46 per cent during the corresponding period.
- The higher dose of nitrogenous fertilizer application was observed in case of all the crops and P_2O_5 in case of mustard, gram, barley and bajra.
- The higher yield Gap-I in paddy, Bt. cotton, wheat and gram indicated the technological inefficiencies and Gap-II in case of bajra, mustard and barley has shown presence of alloactive inefficiencies.
- Illiterate farm women from age group of 18 -45 years, from general castes, joint families, small and medium farm size having lower per capita annual income were having highest participation in agricultural operations viz., harvesting, cutting green fodder, threshing, picking and hoeing.

ix) Justification for continuation of the scheme

Objectives of the scheme are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems in Haryana.

x) Constraints, if any nil

xi) TECHNICAL PROGRAMME FOR THE YEAR – 2012-13

Sub-Project I: "Impact of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) on Agriculture in Hisar District of Haryana (South-western zone)"

ii. Objectives:

1. To examine the present status of income and employment of farm households and land less agricultural labourers working under MGNREGS.
2. To study the impact of the scheme on availability of agricultural labour, wages and crop profitability.
3. To suggest suitable strategies to improve labour supply in agriculture.

iii. Year of Start **:** 2012-13

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Dr. R. K. Khatkar	Planning, execution, analysis of data and report writing.
Dr. J.C. Karwasra	Development of schedule, data collection, compilation, analysis of data and report writing.
Dr. V. K. Singh	Selection of respondents, data collection, compilation, analysis of data and report writing.
Dr. V.P.Mehta	Analysis of data and report writing of resource use study

v. Collaborator: Dr Jitender Bhatia , Asstt. Professor
Dr. Gurnam Singh, DES (FM), KVK, Fatehbad

vi. Method of Study:

The study was conducted in Hisar district (south-western zone) of Haryana. Two villages from each block i.e Sadalpur and Bhodia Bishnoian from Adampur; Siwani Bolan and Kuleri from Agroha; Gaibipur and Khedar from Barwala; Mahjad and Bhatla from Hansi-I; Badala, Bhatol Jatan from Hansi-II; Mangali and Dhaya from Hisar-I; Gawar and Chaudhariwas from Hisar-II; Budana and Petwar from Narnaund and Uklana and Mugalpura from Uklana block were selected randomly from all the nine blocks of the district. Then 5 beneficiary respondents from each selected village were randomly selected and equal number of farmers were selected randomly and categorized into small, medium and large categories on the basis of cumulative total to frequency of land holding. The primary data pertaining to number of days employed under MGNREGS, wages, income earned by selected households were collected for the year 2012-13 as well for the year before implementation of MGNREGS by survey method. Similarly from the selected farmer households the data pertaining to availability of labour in peak agricultural periods, wage rates and impact of MGNREGS scheme on profitability as well as resource use of crops were collected by survey method. Simple tabular analysis technique was applied to analyse the data.

To ascertain the technical and allocative efficiency in the study area of Hisar district of Haryana, the yield gap in major crops were estimated. Yield Gap-I is the difference between potential research farm yield and potential farm yield (farm trial yield or average yield on top 10 farms in the locality, here in this study the top ten farm yield was used as on farm trial yield due to its non-availability).The Yield Gap-II indicates the difference between potential farm yield and actual average farm yield. Gap-I arises due to technical inefficiencies and Gap-II due to allocative inefficiencies. The Total Yield Gap is the sum of these two gaps.

viii. Results achieved during 2012-13:

- Average operational holding varies between 1.05 ha to 5.44 ha on small and large category of farms. Leased in land was more on large farms (0.71ha), followed by medium (0.34 ha) and small category of farms (0.25 ha). On an average rental value of land was found Rs. 51320 per hectare (Table 1).
- Average size of family was higher on farmer households (6.52) as compared to MGNREGS worker households (5.49). The adult members constituted 70.09 per cent on farmer households and 55.19 per cent on MGNREGS worker category of households, the rest were children (Fig. 1 & 2).

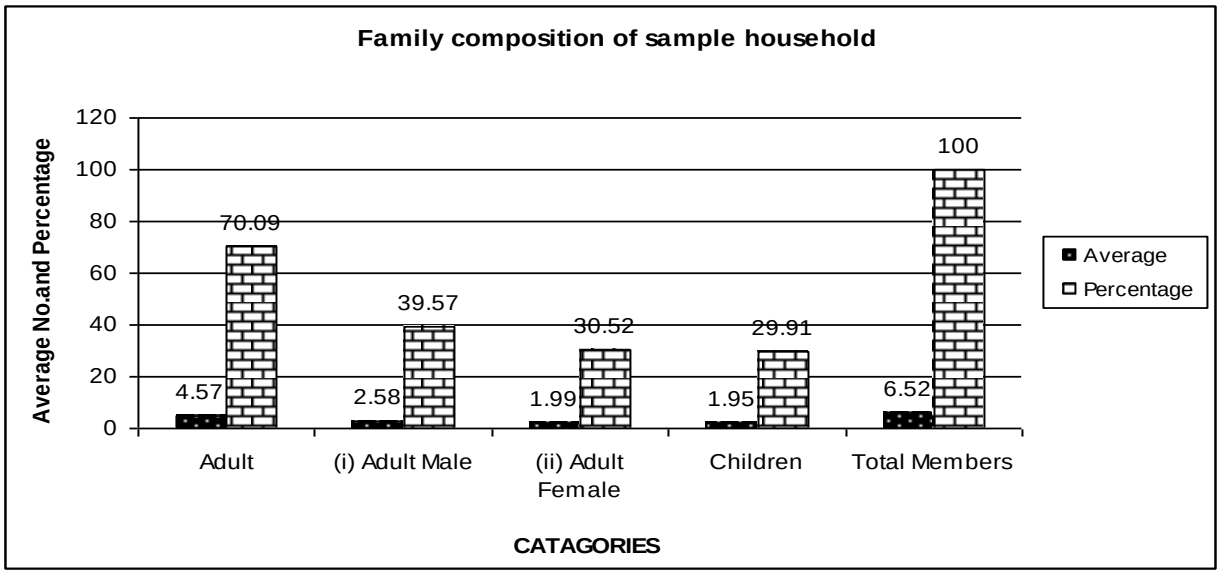

Fig. 1 Family composition of farm households

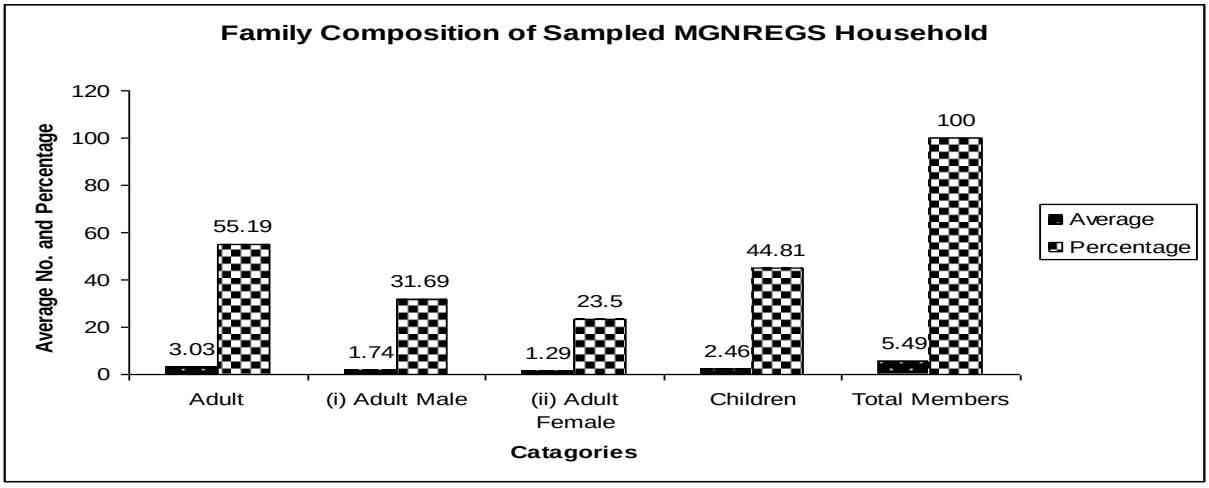

Fig. 2: Family composition of MGNREGS households

- Literacy was also found higher in case of farmer households (85.56 per cent) in comparison to (56.67 per cent) in sampled MGNREGS worker households. Majority of the literate respondents were educated up to senior secondary level (76.67 per cent) in case of farmer households and 50.00 per cent in case of MGNREGS worker households. Higher education was obtained only by 8.89 per cent in case of farmer households and 6.67 per cent in case of MGNREGS worker households (Fig. 3).

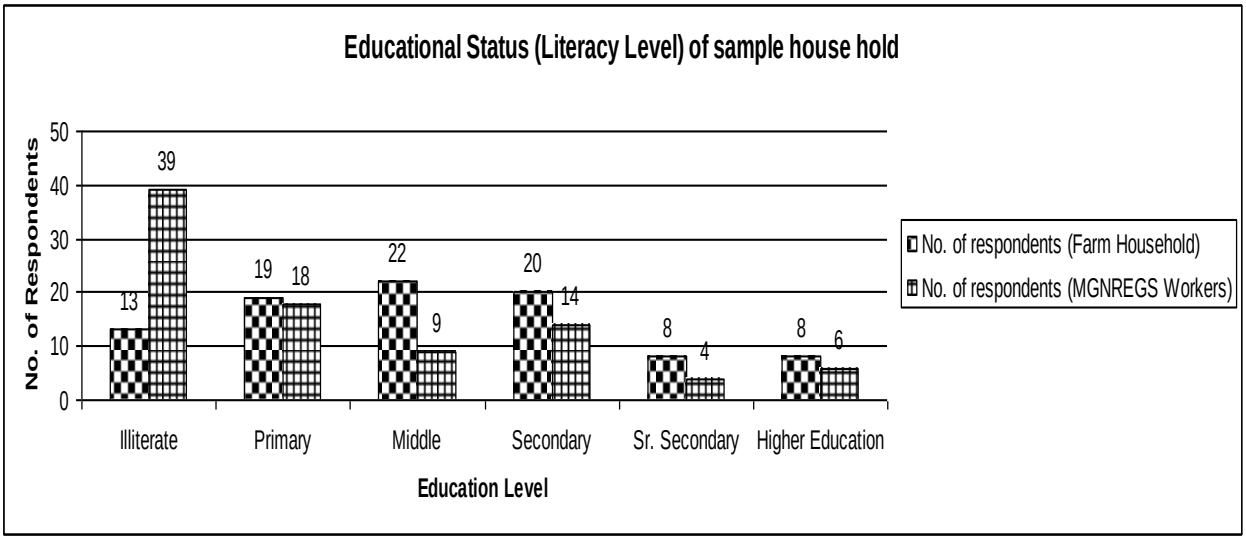

Fig 3. Educational status of respondents

- About 72.54 per cent irrigated areas were having both tube-well and canal irrigation on overall farms and only 27.46 per cent was un-irrigated. Highest irrigated area was observed on medium sized farms 74.91 per cent and lowest on small category of farms 70.48 per cent (Table 2).
- Large category of farms were having larger herd size of livestock (5.39) followed by medium (4.46) and small (3.07). On an average about 40 per cent were milch animals, 32 per cent heifers and 21 per cent draft animals. While in case of MGNREGS workers were having about 33 per cent milch animals, 52 per cent heifers and 14 per cent draft animals.

- The highest area was occupied by cotton (32.43 per cent) followed by guar (29.73 per cent) and paddy (10.36 per cent) in *kharif* season. In *rabi* season the highest area was allocated under wheat (50.86 per cent) followed by mustard (28.02 per cent) and gram (8.19 per cent). Almost same pattern was observed on all the categories of farm. In the study area the cropping intensity was observed 187.18 per cent which was found highest on small farm (194.17 per cent) and lowest on medium farms 182.04 per cent (Table 3).

- About one fifth share of employment provided to workers as well expenditure incurred under MGNREGS in the state was constituted by Hisar district (Table 4). This has resulted in labour scarcity in agriculture sector in the study area.

- The growth of expenditure made under MGNREGS has shown 4 to 23 times increase across different blocks of Hisar district. In all it increased by 711.13 per cent in the district during 2012-13 over 2009-10. The per cent increase was observed ranging from 335.78 per cent in Uklana block and 2213.78 per cent in Agroha block (Table 5).

- The highest growth of employment under MGNREGS was observed in Agroha block (1694.07 per cent) followed by Hansi-II (747.99 per cent) and Hansi-I (702.32 per cent) during 2012-13 over 2009-10. In this way employment in the scheme has grown about 3 to 18 times across different blocks (Table 6).

- About 60 per cent employment in MGNREGS was obtained by the worker of age group of 18 to 40 years, 26.94 per cent of the age group of 40 -50 years, 8.37 per cent of 50-60 years and merely 4.50 per cent was provided to above 60 years age group (Table 7).

- In all 463 households completed hundred days employment under MGNREGS in Hisar district in 2009-10 which increased to 5540 households in 2012-13 and have shown about 6 to 90 times growth in various blocks during the period under reference (Table 8).

- The wage rates for different agricultural operations have witnessed tremendous increase ranging from 50 per cent in harvesting of mustard to 140 per cent in spraying (chemical application) in 2012-13 over 2008-09. The construction wage rate also increased by 133.33 per cent during the corresponding period. The wage rate under MGNREGS has also shown rise of 39.41 per cent in 2012-13 over 2008-09. This has shown that implementation of MGNREGS has caused very high rise in wage rates for different agricultural operations and other non-farm activities (Table 9).

- The income earning pattern of MGNREGS worker households indicated that they are earning 10.25 per cent of their total annual earning through MGNREGS work, 54.3 per cent through services, non-farm employment and other social welfare schemes, 25.67 per cent through employment in agricultural operations and 9.78 per cent through live stock rearing. On the other hand, the farm households earned 52.7 per cent from crop enterprise, 33.20 per cent through hiring out machinery services etc. and 14.10 per cent through livestock enterprise of their total annual earnings (Table 10).

- The MGNREGS employment was almost equally shared by men (52.02 per cent) and women (46.98 per cent) workers. While in agriculture sector, on farm households the men

workers got 62.71 per cent and female workers 37.29 per cent of the total employment. Scheduled caste workers dominated both in MGNREGS and agricultural sector employment with more than 50 per cent share. Non BPL households got larger share i.e. 52.23 per cent in total men days employed under MGNREGS while BPL households got 47.77 per cent employment. The agriculture wage earning dominated the scene by providing more than 66 per cent of their total wage earning in all categories of workers (Table 11).

- Implementation of MGNERGS has caused lower labour supply in agriculture sector. It has decreased by 33.17 per cent in *kharif* season and 31.54 per cent *rabi* season. Overall decrease in the supply of agriculture labour for performing different agricultural operations was observed 32.51 per cent owing to the implementation of social employment scheme (Table 12).

- The work scenario undertaken as well as completed under MGNREGS indicated that rural connectivity (earth work) dominate the scene followed by micro irrigation and water conservation as well as water harvesting works (Fig. 4).

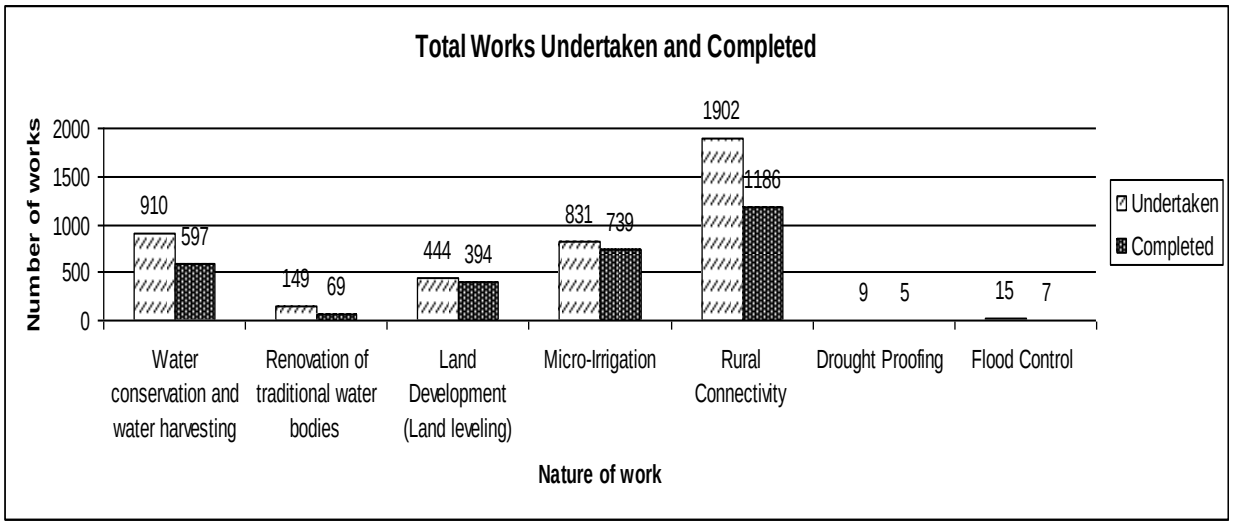

Fig. 4: Type of works undertaken and completed under MGNREGS

- The farm household responded regarding the possible impact of MGNREGS in agriculture sector. More than 70 per cent highlighted that MGNREGS has caused higher wage rates, scarcity of hired labour for agricultural operations in peak season. About 50 per cent highlighted that this scheme has reduced profitability of crops due to increase in wage rates thereby inflating the cost of production. However, about 87 per cent of the respondents pointed out that this scheme is beneficial to farming community provided labour is employed in cleaning of irrigation structures including channels (Table 13).

- More than 80 per cent sampled farmers responded that there is a need to develop low cost machines for transplanting paddy and picking of cotton, custom hiring of all sort of machines at reasonable prices be provided and there is a need of linking of MGNREGS works with agricultural operations, if it is possible the MGNREGS works wages can be shared on 50 : 50 basis by the implementing agency and farmers in peak seasons. More than 70 per cent farmers opined that there is a need to suspend MGNREGS works during the peak agricultural seasons and there is a need to create basic amenities at panchayat level for migrated labourers (Table 14).

- The seed quantity used by the sample farms was found lower than the recommended dose in paddy and mustard. The nitrogenous fertilizer application was found more than recommended level in case of all the crops. Similarly the use of phosphatic fertilizer was found higher than the recommended level in case of mustard, bajra and barley. While the application of phosphatic fertilizers was found almost at par in case of paddy and wheat crops. The potash application was found nil and zinc application was also found either lower than recommendation in wheat and no application except in paddy where it was found as per recommendation. The number of irrigations applied was found almost at par with the recommended level in all the crops except in case of paddy where farmers applied large number of irrigations. The plant protection expenses incurred were found at higher side in case of paddy as well wheat. The yield realized was found lower than the potential level in all the crops (Table 15).

- It is apparently clear from the data depicted in Table 16 that the Yield Gap-I was found higher in paddy, Bt cotton, wheat and gram. This indicated that the technology developed could not be replicated even by the top ten farmers in the study areas; hence there is a presence of technical inefficiency. While the higher relative share of Yield Gap-II in case of bajra, mustard and barley indicated the higher prevalence of allocative inefficiencies between top ten farms (proxy for demonstration plots) and the actual farm situation. Here, the technology developed was replicated on top ten farms but other farmers could not reap the benefits of the technology developed. On the basis of findings it may be concluded that there is lack of adoption of available technology and mismanagement of resources as well as their utilization in the study area.

- The variable cost has increased ranging from 40.44 per cent in wheat to 82.42 per cent in BT. cotton due to increase in labour wage rate by 125 per cent owing to implementation of MGNREGS and also other input price rise. The decline in profitability (net returns) in case of paddy and wheat may be attributed to rise in cost of production and decline in yield in 2012-13 over 2008-09 (Table 17 & 18).

Table 1: Average size of land holding of selected farm household respondents (ha /farm)

Farm Size Category	Owned	Leased in	Total Operational Holding	Land Rent (Rs. / ha)
Small	0.8	0.25	1.05	49450
Medium	2.50	0.34	2.84	50980
Large	4.73	0.71	5.44	56595
overall	2.08	0.37	2.45	51320

Table 2: Sources-wise average area irrigated on sample farms (ha/ Farm)

Farm Size Category	Irrigated (Canal/T W)	Unirrigated	Total Operational Holding
Small	0.74 (70.48)	0.31 (29.52)	1.05 (100.00)
Medium	2.12 (74.91)	0.71 (25.09)	2.83 (100.00)
Large	3.93 (72.24)	1.51 (27.76)	5.44 (100.00)
Overall	1.77 (72.54)	0.67 (27.46)	2.44 (100.00)

Figures in parentheses show per cent to the total operational holding

Table 3: Average cropped area on selected farms (ha/ Farm)

Crop	Small	Medium	Large	Overall
Paddy	0.09(9.28)	0.25(9.92)	0.55(11.00)	0.23(10.36)
Cotton	0.34(35.05)	0.85(33.73)	1.51(30.20)	0.72 (32.43)
Bajra	0.08 (8.25)	0.34(13.49)	0.56 (11.20)	0.25(11.26)
Guar	0.30 (30.92)	0.65(25.79)	1.60 (32.00)	0.66(29.73)
Moong	0.07(7.22)	0.25(9.92)	0.45(9.00)	0.20(9.01)
Jowar	0.09 (9.28)	0.18(7.14)	0.33(6.60)	0.16(7.20)
Kharif	**0.97(100.00)**	**2.52(100.00)**	**5.00 (100.00)**	**2.22 (100.00)**
Wheat	0.48 (46.60)	1.41(53.21)	2.66(51.85)	1.18 (50.86)
Gram	0.07(6.80)	0.17(6.42)	0.53(10.33)	0.19(8.19)
Mustard	0.31(30.09)	0.71(26.79)	1.41(27.49)	0.65(28.02)
Barley	0.07 (6.80)	0.22(8.30)	0.36 (7.02)	0.17(7.33)
Berseem	0.10 (9.71)	0.14(5.28)	0.17(3.31)	0.13(5.60)
Rabi	**1.03 (100.00)**	**2.65(100.00)**	**5.13(100.00)**	**2.32(100.00)**
Total cropped area	2.00	5.17	10.13	4.54
Total cultivable area	1.05	2.84	5.44	2.45
Cropping intensity	**194.17**	**182.04**	**186.21**	**187.18**

Figures in parentheses show per cent to the total cropped area in respective season

Table 4: Progress of MGNREGS in study area 2012-13

Particulars	Hisar	Haryana	Share of District in state (per cent)
Employment provided to household (lakhs)	0.54	2.91	18.61
Employment provided in person days (lakhs)	26.79	126.72	21.14
i. SCs	17.93	64.30	27.88
ii. STs	0	0.04	0.00
iii. Others	8.87	62.38	14.22
Women person days (lakhs)	11.78	50.55	23.30
Total fund released (in crore rupees)	92.16	405.73	22.71
Total expenditure (in crore rupees)	90.26	378.84	23.83
Total works taken up (number)	4330	21261	20.37
Works completed (number)	1771	6642	26.66
Works in Progress (number)	2559	14619	17.50

Table 5: Block wise growth of expenditure under MGNREGS **(Rs. in lakh)**

Block/Year	2009-10	2010-11	2011-12	2012-13	Per cent Change in 2012-13 over 2009-10	Multiple increase from 2009-10 to 2012-13
Adampur	85.15 (13.29)	277.71 (13.96)	391.40 (10.69)	701.00 (13.49)	**723.25**	**8.23**
Agroha	28.15 (4.39)	134.46 (6.76)	346.97 (9.48)	651.33 (12.53)	**2213.78**	**23.13**
Barwala	68.90 (10.76)	197.91 (9.95)	453.96 (12.40)	619.29 (11.92)	**798.82**	**8.98**
Hansi-I	64.27 (10.03)	233.38 (11.74)	523.96 (14.31)	671.15 (12.92)	**944.27**	**10.44**
Hansi-II	30.18 (4.71)	88.21 (4.44)	241.67 (6.60)	327.42 (6.30)	**984.89**	**10.84**
Hisar-I	97.54 (15.23)	312.48 (15.71)	434.45 (11.87)	709.24 (13.65)	**627.13**	**7.27**
Hisar-II	80.91 (12.63)	309.07 (15.54)	388.64 (10.62)	485.01 (9.33)	**499.44**	**5.99**
Narnaund	82.58 (12.89)	228.39 (11.48)	444.34 (12.14)	587.15 (11.30)	**611.01**	**7.11**
Uklana	102.13 (15.95)	207.04 (10.41)	435.50 (11.90)	445.06 (8.56)	**335.78**	**4.35**
Total	**640.51 (100.00)**	**1988.64 (100.00)**	**3660.89 (100.00)**	**5196.64 (100.00)**	**711.33**	**8.11**

Figures in parentheses show per cent to total

Table 6: Block wise growth of employment generated in MGNREGS (in man days)

Block/Year	2009-10	2010-11	2011-12	2012-13	Per cent Change in 2012-13 over 2009-10	Multiple increase from 2009-10 to 2012-13
Adampur	57339 (13.36)	160727 (13.99)	216462 (10.69)	360335 (13.40)	**528.43**	**6.28**
Agroha	18760 (4.37)	78652 (6.84)	193271 (9.54)	336568 (12.52)	**1694.07**	**17.94**
Barwala	45662 (10.64)	113967 (9.92)	249292 (12.31)	321642 (11.96)	**604.40**	**7.04**
Hansi-I	43414 (10.12)	135045 (11.75)	289322 (14.29)	348320 (12.95)	**702.32**	**8.02**
Hansi-II	20184 (4.70)	51100 (4.45)	133942 (6.61)	171159 (6.37)	**747.99**	**8.47**
Hisar-I	65213 (15.19)	182197 (15.85)	237888 (11.75)	360112 (13.39)	**452.21**	**5.52**
Hisar-II	54799 (12.77)	176692 (15.38)	215303 (10.63)	253185 (9.42)	**362.02**	**4.62**
Narnaund	55334 (12.89)	130681 (11.37)	247699 (12.23)	306106 (11.38)	**453.20**	**5.53**
Uklana	68498 (15.96)	120110 (10.45)	242137 (11.96)	231346 (8.60)	**237.74**	**3.37**
Total	**429203 (100.00)**	**1152351 (100.00)**	**2025316 (100.00)**	**2688773 (100.00)**	**526.46**	**6.26**

Figures in parentheses show per cent to total

Table 7:Age-wise pattern of employed person in MGNREGS in 2012-13

Age group	No. of person employed	Per cent to total
18-30	36722	30.07
30-40	36774	30.11
40-50	32898	26.94
50-60	10220	8.37
Above 60	5499	4.50
Total	**122113**	**100.00**

Table 8: Block wise growth of household completed 100 days under MGNREGS

Block/Year	2009-10	2010-11	2011-12	2012-13	Per cent Change in 2012-13 over 2009-10	Multiple increase from 2009-10 to 2012-13
Adampur	67 (14.47)	286 (18.24)	287 (8.72)	791 (14.28)	**1080.60**	**11.80**
Agroha	13 (2.81)	89 (5.68)	264 (8.02)	1175 (21.21)	**8938.46**	**90.38**
Barwala	46 (9.94)	103 (6.57)	328 (9.97)	498 (8.99)	**982.61**	**10.82**
Hansi-I	38 (8.21)	151 (9.63)	550 (16.72)	499 (9.01)	**1213.16**	**13.13**
Hansi-II	30 (6.48)	96 (6.12)	252 (7.66)	247 (4.46)	**723.33**	**8.23**
Hisar-I	64 (13.82)	263 (16.77)	426 (12.95)	839 (15.14)	**1210.94**	**13.10**
Hisar-II	61 (13.17)	345 (22.00)	272 (8.27)	542 (9.78)	**788.52**	**8.88**
Narnaund	76 (16.41)	132 (8.42)	506 (15.38)	563 (10.16)	**640.79**	**7.40**
Uklana	68 (14.69)	103 (6.57)	405 (12.31)	386 (6.97)	**467.65**	**5.67**
Total	**463 (100.00)**	**1568 (100.00)**	**3290 (100.00)**	**5540 (100.00)**	**1096.54**	**11.96**

Figures in parentheses show per cent to total

Table 9: Comparative wage rates under MGNREGS and agricultural operations (Rs. /man day)

S. No.	Agricultural operations	2008-09	2009-10	2010-11	2011-12	2012-13	Per cent Change in 2012-13 over 2008-09	Multiple increase from 2009-10 to 2012-13
1	Harvesting of Wheat	200	250	250	300	350	75.00	1.75
2	Picking of cotton	200	250	300	300	320	60.00	1.60
3	Cutting of Mustard	200	200	225	250	300	50.00	1.50
4	Threshing of Crops	150	200	250	300	350	133.33	2.33
5	Irrigation	125	150	200	200	250	100.00	2.00
6	Fertilizer application	125	150	200	200	250	100.00	2.00
7	Chemical application	125	150	200	250	300	140.00	2.40
8	Weeding- hoeing	150	180	225	250	300	100.00	2.00
9	Construction	150	180	300	300	350	133.33	2.33
10	Water channel cleaning	125	150	200	250	300	140.00	2.40
	MGNREGS wages	**137**	**151**	**167**	**179**	**191**	**39.41**	**1.39**

Table 10: Farm family income of MGNREGS workers household and farm household 2012-13

(in Rs.)

S. No.	Source of Income	MGNREGS Workers Household	Farm household
1	Agriculture	-	-
i.	Crop enterprise	-	169573 **(52.70)**
ii.	Agricultural wages	31568 **(25.67)**	-
2	Livestock Rearing	12022 **(9.78)**	45349 **(14.10)**
3	MGNREGS wages	12606 **(10.25)**	-
4	Other sources (Hiring out machinery, services, Govt. welfare schemes)	66789 **(54.30)**	106825 **(33.20)**
	Total	**122985 (100.00)**	**321747 (100.00)**

Figures in parentheses show per cent to total

Table 11: Average annual wage income earned by different classes of respondents 2012-13.

Particulars		MGNREGS Man days employed	Agricultural Man days employed	MGNREGS Wages Income (Rs.)	Agricultural Wages Income (Rs.)	Total wage income (Rs.)
Gender	Men	34.33 (52.02)	74.31 (62.71)	6557 (24.88)	19796 (75.12)	**26353 (100.00)**
	women	31.67 (47.98)	44.19 (37.29)	6049 (33.94)	11772 (66.06)	**17821 (100.00)**
Caste	SC/ST	35.90 (54.39)	68.17 (57.52)	6857 (27.41)	18160 (72.59)	**25017 (100.00)**
	Others	30.10 (45.61)	50.33 (42.48)	5749 (30.01)	13408 (69.99)	**19157 (100.00)**
Poverty	BPL Household	31.53 (47.71)	62.60 (52.82)	6022 (26.53)	16676 (73.47)	**22698 (100.00)**
	Non-BPL Household	34.47 (52.23)	55.90 (47.18)	6584 (30.84)	14892 (69.34)	**21476 (100.00)**
	Total	**66 (100.00)**	**118.50 (100.00)**	-	-	-

Figures in parentheses show per cent to total

Table 12: Labour supply in agriculture in study area **(man days)**

Labour availability in man days	Before MGNREGS	After MGNREGS	Decreased Participation	Decreased (per cent)
Kharif	122.7	82	40.7	33.17
Rabi	81.8	56	25.8	31.54
Total	**204.5**	**138**	**66.5**	**32.51**

Table 13. Category wise response of respondents w. r. t. impact of MGNREGS (number)

S. No.	Particulars	Small	Medium	Large	Overall Total
1.	Higher wages	34 (73.91)	25 (96.15)	15 (83.33)	65 (72.22)
2.	Reluctance of labour to work in agriculture	42 (91.30)	22 (84.62)	10 (55.55)	74 (82.22)
3.	Scarcity of agricultural labour	29 (63.04)	23 (88.46)	13 (72.22)	74 (82.22)
5.	Impact on profitability	19 (41.30)	15 (57.69)	11 (61.11)	45 (50.00)
6.	Impact on timely completion of agricultural operations	16 (34.78)	10 (38.46)	9 (50.00)	35 (38.88)
7.	Beneficial impact on agriculture (cleaning of irrigation structures etc.)	42 (91.30)	21 (80.77)	16 (88.88)	79 (87.77)

Figures in parentheses show per cent to total

Table14: Per cent response of respondents regarding suggestions for suitable strategies to overcome scarcity of labour

Sr. No.	Suggestion	Per cent Response
1.	Development of low cost machines for transplanting paddy and picking of cotton	84.40
2.	Custom hiring of all sort of machines at reasonable prices (for ploughing, transplanting,leveling combine harvesting, picking, threshing etc.	82.22
3.	Linking of MGNREGS works with agricultural operations shared on 50: 50 basis.	80.00
4.	Suspension of MGNREGS works during the peak agricultural season	78.88
5.	Creation of basic amenities at panchayat level for migratory labour	77.77

Table 15: Actual and recommended use of critical inputs in cultivation of important crops on sample farms 2012-13 (Kg./ acre)

Crop		Seed	N	P_2O_5	Potash	$ZnSo_4$	No. of Irrigation	Plant Protection Expenditure (Rs.)	Yield q/acre
Paddy	**A**	5.72	73	23		10	22.85	1951	22.6
	R	**6-7**	**60**	**24**	**24**	**10**	**18**	**900**	**27-28**
Wheat	**A**	43.75	64.2	23	-	6	5.19	564	16.23
	R	**40-50**	**60**	**24**	**12**	**10**	**5-6**	**200**	**21**
Cotton Bt	**A**	0.926	55	23		10	4.21	1578	9.77
	R	**0.850**	**70**	**24**	**24**	**10**	**5**	-	**16**
Mustard	**A**	1.24	27.5	11.50	-	-	2.78	665	9.41
	R	**2**	**24**	**8**	-	**10**	**2**	-	**10**
Gram	**A**	20.22	-	11.5	-	-	-	-	6.72
	R	**15-18**	**6**	**16**	**35**	-	**1**	-	**10**
Barley	**A**	37.68	29.3	16.10		-	1.58	316	16.42
	R	**35-45**	**24**	**12**	**6**	-	**2**	-	**18**
Bajra	**A**	1.79	27.5	11.5	-	-			11.21
	R	**1.5-2.0**	**16**	**8**	-	-	**1-2**	-	**15**

A-Actual **R**-Recommended

Table 16: Yield gap on agricultural farms

Crop	Potential q/acre	Actual q/acre	Top five farms/trial q/acre	Gap 1 (col.2-4)	Gap II (col. 4-3)	Total gap (col. 5+6)	per cent Gap 1 (col. 5/3)*100	per cent Gap II (col. 6/3)* 100
1	2	3	4	5	6	7	8	9
Paddy	28	22.6	23.40	4.60	0.80	5.40	20.35	3.54
Cotton Bt	16	9.77	10.64	5.36	0.87	6.23	54.86	8.90
Bajra	15	11.21	13.60	1.40	2.39	3.79	12.49	21.32
Wheat	21	16.23	18.10	2.90	1.87	4.77	17.87	11.52
Gram	10	6.72	7.20	2.80	0.48	3.28	41.66	7.14
Mustard	10	9.41	10.40	-.40	0.99	0.59	-4.25	10.52
Barley	18	16.42	18.20	-.20	1.78	1.58	-1.22	10.84

Table 17: Per cent change in cost and returns of major crops after implementation of MGNREGS in 2012-13 over 2008-09

Crop	VC	TC	Yield	GR	ROVC	NR	CP	MSP
Paddy dwarf	70.51	78.89	-12.91	5.29	-20.20	-99.66	105.41	47.06
Bajra hybrid	62.33	61.58	3.80	78.79	92.84	249.93	55.67	39.88
Bt Cotton	82.42	88.03	11.66	50.93	37.14	16.56	68.40	44.00
Wheat	40.44	62.86	-9.43	16.24	1.45	-89.06	79.82	25.00
Mustard	47.54	51.39	6.33	101.93	126.09	185.48	42.38	63.93
Gram	73.15	22.06	25.61	73.85	74.18	336.65	-2.82	67.63

VC-variable cost; TC-total cost; GR-gross returns; ROVC-return over variable cost; NR-net returns; CP-cost of production and MSP-minimum support prices

Table 18: Cost and returns per acre of major crops in the study area during 2008-09 and 2012-13

(in Rs./acre)

Crop	VC	TC	Yield (q)	GR	ROVC	NR	CP/q	MSP/q
2008-09								
Paddy dwarf	8982	18785	25.95	31958	22976	13173	724	850
Bajra hybrid	4454	8789	10.8	9673	5219	884	814	840
Cotton Bt	9785	15450	8.75	32125	22340	16675	1766	2500
Wheat	8776	16030	17.92	23126	14350	7096	895	1080
Mustard	5412	10965	8.85	17598	12186	6633	1239	1830
Gram	3777	9845	5.35	11785	8008	1940	1840	1730
Barley	6325	10845	15.83	15843	9518	4998	685	680
2012-13								
Paddy dwarf	15315	33605	22.6	33650	18335	45	1487	1250
Bajra hybrid	7230	14201	11.21	17294	10064	3093.35	1267	1175
Cotton Bt	17850	29051	9.77	48487	30637	19436	2973	3600
Wheat	12325	26106	16.23	26883	14558	777	1609	1350
Mustard	7985	16600	9.41	35536	27551	18936	1764	3000
Gram	6540	12017	6.72	20488	13948	8471	1788	2900
Barley	8718	17522	16.42	22584	13865.6	5061.6	1067	980

x. Programme of work for Current Year 2013-14

Sub-Project I: "Impact of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) on Agriculture in Haryana (North-eastern zone)"

i. Objectives:

1. To examine the present status of income and employment of farm households and land less agricultural labourers working under MGNREGS.
2. To study the impact of the scheme on availability of agricultural labour, wages and crop profitability.
3. To suggest suitable strategies to overcome the labour scarcity in agriculture.

ii. Year of Start **:** 2013-14

iii. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Dr. R. K. Khatkar	Planning, execution, analysis of data and report writing.
Dr. J.C. Karwasra	Development of schedule, data collection, compilation, analysis of data and report writing.
Dr. V. K. Singh	Selection of respondents, data collection, compilation, analysis of data and report writing.
Dr. V. P. Mehta	Analysis of data and report writing

iv. Collaborators:

Dr. Jitender Kumar Bhatia, Asstt. Professor (data collection, compilation and analysis)
Dr. Gurnam Singh, DES (FM), KVK Fatehbad (data collection, compilation & anlaysis)

v. Method of Study:

The study will be conducted in Karnal district (North-eastern zone) of Haryana. Two villages from each of all six blocks will be selected randomly. Then 5 beneficiary respondents from each selected village will be randomly selected and equal number of farmers will be selected randomly and categorized into small, medium and large categories on the basis of cumulative total to frequency of land holding. The primary data pertaining to number of days employed under MGNREGS, wages, income earned by selected households will be collected for the year 2012-13 by survey method. Similarly from the selected farmer households the data pertaining to availability of labour in peak agricultural periods, wage rates and impact of MGNREGS scheme thereof and production of crops will be collected by survey method. Suitable statistical techniques will be applied to analyse the data.

Title of Sub-project II: Pattern and extent of crop diversification in Haryana

i. Objectives

1. To study cropping pattern of the state
2. To examine the extent of crop diversification in different zones of Haryana
3. To analyze factors affecting crop diversification

ii. Year of Start **:** 2013-14
iii. Period of study **:** 2013-2015

The study will be spread for a period of two years. In the first year data will be collected from various sources and tabulation work will be done. In the second year statistical analysis and report writing wok will be completed

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Dr. R. K. Khatkar	Planning, execution, analysis of data and report writing.
Dr. J.C. Karwasra	Data collection, compilation, analysis of data and report writing.
Dr.V.K. Singh	Data collection, compilation, analysis of data and report writing.

v. Collaborators: Dr. Jitender Bhatia, Asstt. Professor (data collection, compilation and analysis)

vi. Methodology and data collection

The study will be conducted in different agro-climatic zones of the state. It will be based on secondary data collected from various published sources and officials of related departments. Data on all the factors effecting crop production like irrigated area, rainfall, area under HYVs, cropping pattern etc. will be collected and analyzed by using suitable statistical techniques.

Title of Sub-project-II: "To Study the Gender wise Participation in Agriculture in Hisar District of Haryana (South-western zone)"

i. Objective(s) :

1. To examine the gender wise participation in different agricultural activities on farm.
2. To analyse relationship between different socio-economic factors of farm women and their extent of participation in different agricultural activities.

ii. Name (s) of collaborator(s) : N.A.

iii. Year of Start : 2012-13

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Dr. (Mrs.) Deep Punia	Development of schedule, data collection, compilation, analysis of data and report writing.
Dr. R. K. Khatkar	Planning and execution
Dr. V.P. Mehta	Compilation and analysis of data.
Dr. K.K. Kundu	Compilation and analysis of data.
Dr. (Mrs.) Baskaur (RA)	Review of literature, development of schedule, collection, compilation and analysis of data.

v. Method of Study:

The present study was conducted in Hisar district of Haryana. Four villages namely Chirod from Hisar-I block, Bherian from Hisar-II block, Thurana from Hansi-II block and Kanoh from Agroha block were selected randomly from the selected district. From each village 30 farm working women from small, medium and large categories were randomly selected making a total sample of 120. The primary data pertaining to gender participation in agricultural activities and livestock activities for the last year 2011-12 were collected with the help of well structured pre-tested interview-schedules from those 120 households in which both husband and wife were involved in agriculture. The extent of rural women participation in agricultural activities and livestock activities was measured by using a three point continuum namely always, seldom & never. First of all, activity-wise time allocation of selected women was assessed for kharif and rabi seasons. All the activities were listed under the heads- *kharif* and *rabi* to know (1) in which of these activities the respondents were participating (2) how many days in the last season they devoted to that particular activity and (3) how many hours in a day they devoted to that particular activity in last season. From this information total hours in the *kharif* and *rabi* seasons for each activity were calculated. Contribution of males and females in hours per family household in *kharif* and *rabi* seasons was calculated. Out of total time devoted, relative percentage of males and females was worked out. The Chi-square test was applied to test the relationship between active working age, literacy, size of land holding and income strata with female participation in different agricultural operations.

viii. Results achieved during 2012-13

- In *kharif* season it was observed that maximum time was spent by family males only in irrigation (254.57 hours), pre-sowing irrigation (55.50 hours) and plant protection (54.74 hours) operations. Similarly in *rabi*, they spent maximum time in irrigation (197.84 hours) followed by pre-sowing irrigation (53.95 hours) and fertilizer application (34.88 hours) per household.

- Further it was found that maximum time was spent by males as compared to females in preparation of fields (60.70 hours), harvesting (48.95 hours) and hoeing (48.30 hours) in *kharif*, whereas least time was devoted in picking (1.75 hours), packaging (2.50 hours) and weeding (2.86 hours).

- On the other hand, maximum time was devoted by females as compared to males in picking (102.16 hours), cutting green fodder (50 hours), hoeing (29 hours) and harvesting (24.35 hours). Whereas least time was given by them in packaging (0.14 hours), weeding (0.36 hours) and loading (0.55 hours).

- In *rabi* season, maximum time was spent by males as compared to females in harvesting (94.51 hours) followed by plant protection (85.69 hours), shifting at threshing floor (31.18 hours) & threshing (30.62 hours). Least time was devoted in cutting green fodder (11.91 hours) and storage of dry fodder (14.75 hours).

- On the other hand, females as compared to males devoted maximum time in cutting green fodder 57.44 hours (82.83per cent). Hoeing was almost equally performed by males 17.46 hours (52.34per cent) and females 15.90 hours (47.66per cent). Least time was given by women in plant protection 1.42 hours (Table 19).

Table 19: Gender-wise participation in agricultural operations during kharif and rabi season (hours/household)

Agricultural Activities	Kharif			Rabi			Total		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)	Time spent (hours)
Harvesting	48.95 (66.78)	24.35 (33.22)	73.30 (100.00)	94.51 (63.63)	54.03 (36.37)	148.54 (100.00)	143.46 (64.67)	78.38 (35.33)	221.84 (100.00)
Cutting green fodder	9.00 (15.25)	50 (84.75)	59 (100.00)	11.91 (17.17)	57.44 (82.83)	69.35 (100.00)	20.91 (16.29)	107.44 (83.71)	128.35 (100.00)
Threshing	7.34 (81.82)	1.63 (18.18)	8.97 (100.00)	30.62 (83.50)	6.05 (16.50)	36.67 (100.00)	37.96 (83.15)	7.69 (16.85)	45.65 (100.00)
Picking	1.75 (1.68)	102.16 (98.32)	103.91 (100.00)	-	-	-	1.75 (1.68)	102.16 (98.32)	103.91 (100.00)
Hoeing	48.30 (62.48)	29 (37.52)	77.30 (100.00)	17.46 (52.34)	15.90 (47.66)	33.36 (100.00)	65.77 (59.42)	44.91 (40.58)	110.68 (100.00)
Shifting at threshing floor	10.03 (71.54)	3.99 (28.46)	14.02 (100.00)	31.18 (74.80)	10.50 (25.20)	41.68 (100.00)	41.21 (73.98)	14.49 (26.02)	55.70 (100.00)
Preparation of fields	60.70 (81.05)	14.19 (18.95)	74.89 (100.00)	20.94 (80.29)	5.14 (19.71)	26.08 (100.00)	81.64 (80.86)	19.33 (19.14)	100.97 (100.00)
Storage of grains	6.60 (81.18)	1.53 (18.82)	8.13 (100.00)	17.54 (84.94)	3.11 (15.06)	20.65 (100.00)	24.14 (83.85)	4.65 (16.15)	28.79 (100.00)
Plant Protection	38.54 (80.16)	9.54 (19.84)	48.08 (100.00)	85.69 (98.37)	1.42 (01.63)	87.11 (100.00)	124.23 (91.90)	10.96 (8.10)	135.19 (100.00)
Loading	10.00 (94.79)	0.55 (5.21)	10.55 (100.00)	6.87 (99.56)	0.03 (0.44)	6.90 (100.00)	16.88 (96.73)	0.57 (03.27)	17.45 (100.00)
Packaging	2.50 (94.70)	0.14 (05.30)	2.64 (100.00)	5.31 (96.90)	0.17 (3.10)	5.48 (100.00)	7.82 (96.31)	0.30 (03.69)	8.12 (100.00)
Weeding	2.86 (88.82)	0.36 (11.18)	3.22 (100.00)	18.22 (84.55)	3.33 (15.45)	21.55 (100.00)	21.08 (85.10)	3.69 (14.90)	24.77 (100.00)

Figures in parentheses denote percentages.

- The participation in livestock activities showed that maximum time per household in a year was spent by females in feeding of animals (189.95 hours) followed by churning of milk (171.62 hours), fetching of fodder (171.55 hours), preparing dung cakes (155.69 hours), watering of animals (141 hours), disposal of dung (132.68 hours), milking (122.81 hours), chaffing of fodder (112.56 hours), washing of animals (110.93 hours) etc. Least time was devoted by them in purchasing concentrates (0.73 hours), maintaining sale records of milk and milk products (1.18 hours) and deworming of animals (1.78 hours).

- On the other hand, maximum time was spent by family male members in fetching of fodder 68.13 hours followed by purchasing concentrates (63.84 hours), chaffing of fodder (50.34 hours) and grinding of concentrates (25.26 hours). They devoted least time in washing of animals (0.33 hours), cleaning and grooming (0.58 hours) and care of sick animals (1.81 hours) (Table 20).

Table 20: Gender-wise participation in various livestock activities (hours/year/household)

Livestock Activities	Males		Females	
	Time spent (hours/year)	Percentage	Time spent (hours/year)	Percentage
Fetching of fodder	68.13	28.43	171.55	71.57
Chaffing of fodder	50.34	30.90	112.56	69.10
Feeding of animals	3.16	1.64	189.95	98.36
Watering of animals	2.00	1.40	141.00	98.60
Washing of animals	0.33	0.30	110.93	99.70
Cleaning & Grooming	0.58	8.23	6.47	91.77
Care of new born animals	3.92	10.72	32.65	89.28
Care of sick animals	1.81	29.43	4.34	70.57
Deworming of animals	0.35	16.43	1.78	83.57
Milking	3.55	2.81	122.81	97.19
Churning of milk	2.00	13.33	171.26	86.67
Grinding of concentrates	25.26	40.79	36.67	59.21
Purchase of concentrates	63.84	98.87	0.73	01.13
Construction of shed	5.25	49.67	5.32	50.33
Maintaining sale records of milk and milk products	2.22	65.29	1.18	34.71

Socio-Economic Factors Influencing Women Participation:

Working age of farm women and extent of participation in picking were found highly significantly associated (χ^2= 33.26**). Illiteracy of farm women was highly significantly associated with their extent of participation in harvesting (χ^2 = 6.97**) and threshing (χ^2 = 15.75**). Smaller farm size and women participation in harvesting and threshing were significantly associated at 1per cent level of probability (χ^2 = 9.78** and χ^2= 18.46** respectively). Whereas for picking significant association was at 5per cent level of probability (χ^2 = 6.92*). It was non-significant in case of

hoeing. Lower per capita annual income and women participation in harvesting (χ^2 = 10.20**), picking (χ^2 = 6.26**), hoeing (χ^2 = 12.66**) and threshing (χ^2= 8.55**) were highly significantly associated at 1 per cent level of probability (Table 21).

Table 21: Relationship between socio-economic factors of farm women and their extent of participation in agricultural activities

Socio Economic Factors	**Agricultural Activities**			
	Harvesting	**Picking**	**Hoeing**	**Threshing**
Active working age	χ^2= 0.7836 NS	χ^2=33.26**	χ^2= 3.01 NS	χ^2= 1.3416 NS
Illiteracy	χ^2= 6.97**	χ^2= 1.94 NS	χ^2= 0.0455 NS	χ^2 = 15.75**
Farm size	χ^2= 9.78**	χ^2= 6.92*	χ^2 = 3.32 NS	χ^2= 18.46**
Per capita annual income	χ^2= 10.20**	χ^2= 6.26**	χ^2= 12.66**	χ^2= 8.55**

*** Significant at 5per cent prob. level; **Significant at 1per cent prob. Level; NS-Non-significant**

ix. Programme of Work for the Current Year (2013-14)

Title of Sub-project-III: "Decision Making Pattern of Farm Women in Performing Socio-Economic Activities in Hisar District of Haryana "

i. Objective(s) :

1. To examine the personal and socio-economic profile of the farm women.
2. To study the extent of women participation in decision making in socio-economic activities.
3. To identify the constraints perceived by the farm women in decision making.

ii. Year of Start : 2013-14

iii. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Dr. (Mrs.) Deep Punia	Data collection, compilation, analysis of data and report writing.
Dr. R.K.Khatkar	Planning and execution
Dr. V.P.Mehta	Compilation and analysis of data.
Dr. K.K. Kundu	Compilation and analysis of data.
Dr. (Mrs) Baskaur (RA)	Collection, compilation and analysis of data.

iv. Name (s) of collaborator(s): N.A.

v. Method of Study:

The present study will be conducted in four villages namely Chirod, Bherian, Thurana and Kanoh from Hisar-I, Hisar-II, Hansi-II & Agroha blocks respectively of Hisar district of Haryana. From each village 30 farm working women from small, medium & large categories will be randomly selected making a total sample of 120. The primary data pertaining to decision making pattern of farm women in performing socio-economic activities for the last year will be collected with the help of well structured pre-tested interview-schedules. Suitable statistical techniques will be applied to analyse the data.

B. Other Agencies

Scheme I: "Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana" (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Co-operation, Govt. of India)

No.& Name of the Scheme	C (c) Econ.-I.(CS) Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana
Year of Start	1970
Objective	To provide representative and comparative data on Cost of Cultivation of Principal Crops in Haryana
Period of Study	2012-13
Location	CCS Haryana Agricultural University, Hisar

Staff position in the scheme

Hon. Director-cum- Professor and Head	Dr. R. K. Khatkar
Senior Research Officer/Sr. Scientist	Dr. V.P. Luhach
Senior Scientist	Dr. Kuldeep Kumar
Senior Scientist	Dr. R.S. Pannu
Scientist	Dr. D.P. Malik (on deputation)
Statistician	Mrs. Kiran Kapoor
Computer Assistants	03 (three vacant)
Agriculture Inspectors	26 (four vacant)

Name of Investigators with Activity Profile:

Scientists	**Activity Profile**
Dr. R.K.Khatkar	Planning, execution, overall supervision and verification of data.
Dr V.P. Luhach	Planning, monitoring, supervision, checking and verification of data.
Dr. Kuldeep Kumar	Planning, monitoring, supervision, checking and verification of data.
Dr. R.S. Pannu	Planning, supervision, checking and verification of data.
Dr. D.P. Malik	On deputation in Ministry of Agriculture, GoI for five years.
Mrs. Kiran Kapoor	Compilation, validation and valseas of data

Budget **(in Rupees)**

Particular	**Allotment 2012-13**	**Expenditure 2012-13**	**Budget 2013-14**
Establishment (Salary)	1,53,16,346	1,35,80,150	1,62,00,000
T.A.	5,24,680	3,51,624	7,00,000
Contingency (Recurring and Non-recurring)	7,87,020	6,74,520	10,00,000
Total	**1,66,28,046**	**1,46,06,249,**	**1,79,00,000**

Salient Achievements during 2012-13

The scheme is being financed by Ministry of Agriculture, Govt. of India. Under this scheme, the cost of cultivation data of seven important crops of Haryana state namely, Paddy, Cotton, Bajra, Sugarcane, Wheat, Gram and Rapeseed & Mustard were collected from 30 Centres /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. To maintain the

accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The processed data for the Rabi and Kharif seasons for the year 2011-12 have been submitted in time to the Ministry of Agriculture on C.D. for further analysis, the result of which will be used by the Commission for Agriculture Costs and Prices (CACP) for fixing the minimum support prices of Kharif and Rabi crops at national level.
- Data for Kharif and Rabi seasons of year 2012-13 have been received from the field staff.
- The processing and entry of data for the Kharif season of the year 2012-13 has been completed and validation & valseas for Kharif season data has been done.
- The data for Rabi season for the year 2012-13 is in progress for entry in FARMAP software programme (designed by funding agency) and will be completed well in time for submission to the Ministry of Agriculture and Cooperation, Govt. of India.
- Trainings/meetings of Agriculture Inspectors were organized at department of Agricultural Economics during the year 2012-13 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items and keeping daily operation record.
- The scientists working in the scheme also organized meetings of Agriculture Inspectors working under their supervision at their respective headquarters for checking of data entries in the records.
- The scientists working in the scheme supervised the work of Agriculture Inspectors, discussed with selected farmers about crop operations and inputs used at farm level to maintain the accuracy of data.
- The discrepancies in data as reported by funding agency were checked, corrected and re-submitted again.

Plan of Work for the year 2013-14

- Compilation of data for the year 2012-13 is in progress for all the seven crops and will be submitted to the Ministry of Agriculture, Govt. of India in the month of October 2013.
- The data on cost of cultivation of crops Paddy, Cotton, Bajra, Sugarcane, Wheat, Gram and Rapeseed & Mustard for the year 2013-14 will be collected from 30 clusters located in different Agro-Climatic Zones of the state by cost accounting method.
- Strict supervision of data collection work of Agriculture Inspectors will be done by respective scientist to maintain accuracy in data.
- Information from funding agency as well as discrepancies in data will be disseminated to the Agriculture Inspectors.

Table 22: Cost of production and minimum support prices of major crops in Haryana

Crops	Cost of Production (Rs./q)		Minimum Support Price-MSP (Rs./q)	
	2008-09	**2009-10**	**2008-09**	**2009-10**
Paddy	1021	1150	850	950
Bajra	770	921	840	840
Cotton	2127	2414	2500* 3000**	2500* 3000**
Wheat	717	832	1080	1100
Gram	1968	2693	1730	1760
Rapeseed & Mustard	1251	1556	1830	1830
Sugarcane	92	133	81.18 128#	129.84^

Source: Agricultural statistics at a glance, 2011 & 2012, Directorate of Econ. & Stat. Ministry of Agri. Govt. of India

Cost of production includes all actual expenses in cash and kind incurred in production plus interest on value of owned capital assets (excluding land) plus rental value of owned land plus imputed value of family labour.

* Medium staple cotton (mm) of 24.5-25.5 and micronaire value of 4.3-5.1

** Long staple cotton (mm) of 29.5-30.5 and micronaire value of 3.5-4.3

^ Fair and Remunerative Price (FRP) in case of Sugarcane

Prices given by Govt. of Haryana

- The cost of production per quintal of paddy and gram during 2008-09 & 2009-10 and that of bajra 2008-09 was found higher than minimum support prices (MSP). Similarly cost of production of sugarcane was also found higher than FRP in both the years (Table 22).

Project-I

No. and Title of the project: C (b) Econ. 2-NAIP (ICAR) "Establishing and Networking of Agricultural Market Intelligence Centres in India"

Year of start: 2009-10

Objectives:

i. Providing price forecasts well in advance of sowing of major commodities and during harvesting thus helping the farmers in taking better sowing and selling decisions;

ii. Providing other market intelligence such as product qualities, high price markets for the different commodities etc;

iii. Dissemination of the above market intelligence through different mass media like news papers in English and regional languages, Television, Radio, Agricultural Journals etc. so as to reach the maximum number of farmers;

iv. Training the farmers and officials of agricultural department in various States in use of the above intelligence;

v. Studying the different market intelligence aspects being made available to farmers in different countries and explore possibilities of replicating the same in India; and

vi. Developing commodity market outlook along with NCAP-NAIP for selected commodities at state level besides providing commodity market research reports.

Name of Investigators with activity profile:

Investigators	**Activity Profile**
Dr. R.K.Khatkar (PI)	Planning, execution, analysis, report writing, conducting trainings of farmers/officials and presentation.
Dr. J.C. Karwasra (Co- PI)	Data analysis, report writing and trainings.
Dr. V.K. Singh (Co- PI)	Data collection, analysis, report writing and trainings.
Dr. Jitender Bhatia (SRF)	Collection, compilation, analysis of data, report writing and trainings.
Dr. Gurnam Singh (SRF)	Collection, compilation analysis of data, report writing and trainings.

Budget: **(Rs. in lakhs)**

Items of expenditure	**Allotted amount for 2012-13**	**Expenditure during 2012-13**
A. Recurring Contingencies		
1. TA	0.50000	0.50000
2. Workshops	-	-
3. Contractual services (SRF etc)	4.23032	3.21088
4. Operational costs	1.10000	1.09945
Sub-total of A(1-4)	**5.83032**	**4.81033**
B. HRD Component		
5. Training –National	1.00000	0.86483
6. Consultancy	-	-
Sub-Total B (5-6)	**1.00000**	**0.86483**
C. Non-Recurring		
7. Equipment	-	-
8. Furniture	-	-
9. Works (new/renovation)	-	-
10 Others	-	-
Sub-Total C (7-10)	-	-
Total (A+B+C)	**6.83032**	**5.67516**
D. Institutional Charges*	0.16380	0.16380
Grand Total (A+B+C+D)	**6.99412**	**5.83896**

Salient Achievements during 2012-13:

- Disseminated the price forecast of eight agricultural commodities through print and electronic media by publishing in news papers and broadcasting through one radio and four T.V. telecasts. The price forecast was also disseminated through 1.5 lakh Voice SMS by IFFCO Sanchar Nigam Ltd. Networking, emails, telephonically and hard copies, pamphlets, etc.

- Disseminated the price forecast by organizing four farmers trainings (50 participants in each) in 4 districts of the state in collaboration with KVKs.

- Farmers were benefited to the extent of Rs. 900 to Rs. 1200 per quintal by withholding the sale of Basmati Rice after having the knowledge of price forecast made by AMIC centre of CCS, Haryana Agricultural University.

- 80-90 per cent validation of forecasted prices with actual market prices was observed in all the vegetable crops.

- Organized National Post Kharif Workshop of NAIP project on 5-8 October, 2012 which was attended by 33 participants from 10 participating centres of the project.

Table 23: Trainings organised during 2012-13

Organizer (Name & Address)	Details of Meetings/ Seminars/ Trainings, etc.	Duration (From-To)	No. of Personnel trained
Trainings organized during 2012-13			
AMIC, CCS, HAU, Hisar & KVK Kaithal	Training of farmers at KVK Kaithal on 11.9.2012	9.00 A.M. to 4.00 PM	50
AMIC, CCS, HAU, Hisar & KVK Jhajjar	Training of Farmers at KVK Jhajjar on 17.9.2012	9.00 A.M. to 4.00 PM	50
AMIC, CCS, HAU, Hisar & ADT, Hisar	Training of farmers at ADT, Hisar on 19.9.2012	9.00 A.M. to 4.00 PM	50
AMIC, CCS, HAU, Hisar & KVK Rohtak	Training of farmers at KVK Rohtak on 21.9.2012	9.00 A.M. to 4.00 PM	50

Programme of Work for the Current Year (2013-14): Project terminated on 31.03.2013

Project II

Title of Sub-project: "Study on Impact of Agricultural Credit on Farmers in Haryana" (funded by PNB)

ii. Objective(s) :

1. To analyse the reason of low performance of banks in fresh lending to the beneficiaries of agricultural debt waiver and debt relief scheme (ADWARDS-2008)
2. To analyse the reasons of low performance of banks under debt swap scheme.
3. To identify the reasons of non-commensuration of increase in productivity /production of agriculture with increase in agricultural credit.

iii. Name(s) of Investigator(s) with Activity Profile:

Investigators	**Activity Profile**
Dr. R. K. Khatkar	Planning, development of schedules, execution and report writing.
Dr. J.C.Karwasra	Supervision of data compilation, analysis of data and report writing.
Dr.V.K.Singh	Supervision of data collection work by PG students, analysis of data and report writing.

iv. Name (s) of collaborator(s): Dr. Jitender Bhatia
Dr. Gurnam Singh

v. Year of Start : 2011-12

vi. Method of Study

The study was conducted in four districts viz., Hisar, Rohtak, Rewari and Karnal of Haryana. Two branches from each district viz., Barwala and Narnaund from Hisar, Sampla and Lakhan Majra from Rohtak, Bawal and Khol from Rewari and Assandh and Nilokheri from Karnal district were selected as per the consultation held with respective Lead District Manager. The list of beneficiary farmers was taken from the selected branches of PNB and 100 farmers from each district were selected randomly. The primary data pertaining to loan advanced, utilization, repayment, reasons of low performance of banks under debt swap scheme and low production/productivity in agriculture were collected from the selected farmers as well as from the bank officials of selected branches. Suitable statistical techniques were applied to analyse the data.

Results Achieved during 2012-13

The highest loan by Punjab National Bank was advanced in Karnal district (36.75 per cent), followed by Rohtak (23.77 per cent), Hisar (23.76 per cent) and lowest in Rewari (15.72 per cent). On an average the loan recovery was found 40.20 per cent of the total amount advanced. The best performance in loan recovery was found in Hisar district (51.35 per cent), followed by Karnal (47.46 per cent) and Rohtak (33.32 per cent). The lowest recovery of loan was observed in Rewari district having 16.79 per cent of total amount advanced to the farmers in the district. Keeping in view the less than fifty per cent recovery there is a need to streamline the recovery through suitable measures (Table 24).

Table 24: District wise Status of Loan advanced and repayment in Haryana (in rupees)

Name of District	Loan advanced	Per cent to Grand Total	Amount repaid	Per cent Amount repaid to total advanced
Hisar	19247320	23.76	9883660	51.35
Karnal	29758963	36.75	14122406	47.46
Rewari	12728700	15.72	2137300	16.79
Rohtak	19252660	23.77	641456	33.32
Grand Total	**80987643**	**100.00**	**32557926**	**40.20**

On an average basis the scale of finance in the study areas was found Rs. 2.02 lakh per farmer household and Rs. 66900 per hectare. It varies from Rs. 1.27 lakh per household in Rewari district to Rs. 2.98 lakh in Karnal district. Whereas on per hectare basis the scale of finance varied from Rs. 56422 in Rewari district and Rs. 90646 in Karnal district. Due to introduction of Kisan Credit Card and higher target of finance to agriculture sector there is comfortable position with regard to scale of finance in the study areas (Table 25).

Table 25: Extent of scale of finance in Haryana (in rupees)

Name of District	Per house hold loan advanced	Per hectare loan advanced
Hisar	192473	56928
Karnal	297589	90646
Rewari	127287	56422
Rohtak	192527	60433
Total	202469	66900

Programme of work during 2013-14: The final report will be submitted to PNB.

Scientists Associated with projects operating in other departments:

Name of Scientist	**Name of Project**	**Name of department operating project**
Dr. K.K. Kundu	Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets in Sub-Sahara Africa and South Asia	Bajra Section (Department of Genetics & Plant Breeding)
Dr. V. P. Luhach	Centre of Excellence on Pearl Millets	Food & Nutrition (College of Home Science)

(For official use only)

TECHNICAL PROGRAMME

(2014-15)

DEPARTMENT OF AGRICULTURAL ECONOMICS
CCS HARYANA AGRICULTURAL UNIVERSITY
HISAR – 125 004

REVIEW OF RESEARCH SCHEMES AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2014-15

A. Report by the Head of the Department

I. Name of the Department : Agricultural Economics

II. Salient Research Findings of the Department during the Period under Report (2013-14)

- In Karnal district implementation of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) has resulted in reduction of labour availability at farmers' field by 30.34 per cent.
- During the last four years labour wage rates for different agricultural operations have just doubled owing to implementation of MGNREGS.
- Karnal district is sharing 6.52 per cent of state households who were benefited under MGNREGS and 5.86 per cent of the total state expenditure incurred in the scheme during 2013-14.
- Majority of farm women pre-dominantly decided the home-affairs and livestock related activities which were confined to home fore-walls. They were not involved in the important financial decisions.
- Regarding agricultural activities, farm women were final decision makers in cutting of fodder and storage of agricultural produce only. Their opinions were considered in some of the crop production activities in which women labour force was required.

III. Emerging/Thrust Areas

1. Economic analysis of diversification, marketing, processing and value addition in agriculture sector.
2. Input use efficiency in different agro-climatic conditions.
3. Demand, supply and prices of agricultural commodities.
4. Socio-economic analysis of emerging agricultural problems

IV. Action taken report of the last year's proceedings (2013-14)

S.No.	Observation/Suggestions made	Action Taken
1	In Table 13 at Page 18 the number of respondents is mentioned. The overall total of rows at Sr. no. 1 & 3 is incorrect. The per cent values should be rechecked.**(Action : Concerned Scientist)**	Necessary corrections have been incorporated

2	Efforts should be made to pass on the findings of sub-project 1 to concerned MGNREGS authority/ policy makers of the study area. **(Action: HOD, Agril. Economics)**	Submitted to D.R. vide letter no. 1232+E dated 19.09.2013 for onward transmission to concerned authority.
3.	In table 24 at the page 34, the amount repaid for District Rohtak may be checked and corrected.**(Action : Concerned Scientist)**	Necessary corrections have been incorporated

V. List of research projects (both from state as well as outside agencies) in operation along with sanctioned budget (2014-15)

S. No.	Number and name of the scheme	Sanctioned Budget (Rs.)	Funding Agency
A.	**State Funded Schemes**		
1.	**C(a)Econ.1 Plan (Agri.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	14479000	State
B.	**Other Agencies:**		
2.	**Govt. of India C(c) Econ.1 (CS)** Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana.	20000000	Ministry of Agriculture, GOI

VI. Research projects completed during 2013 -14and the tangible conclusions drawn.

- The study conducted on Impact of MGNREGS on labour supply and wages in agriculture in Hisar district indicated 32.51 per cent reduction of labour availability i.e. supply by at farmers' field for performing different agricultural operations.The wage rates for different agricultural operations have witnessed tremendous increase ranging from 50 per cent to 140 per cent owing to implementation of MGNREGS. The study suggested linking of MGNREGS scheme with agriculture through suitable policy interventions to overcome the labour shortage.
- The study on gender wise participation in agriculture in Hisar district indicated that maximum time was spent by female members in picking of cotton (102.16 hours), followed by cutting green fodder (50 hours in *kharif* and 57.44 hours in *rabi*). Whereas male members spent maximum time per season in preparation of fields i.e. ploughing etc. (60.70 hours), harvesting (48.95 hours) and hoeing (48.30 hours) in *kharif* season. In *rabi* season, they dominated in harvesting (94.51 hours) followed by plant protection/scaring birds and animals (85.69 hours) per household. Females as compared to males were mainly more involved in all the livestock activities except breeding.Active working age, illiteracy, small size of land holding and lower income strata were found having significant relationship with female participation in harvesting, picking, hoeing and threshing operations.

V**II. Research projects sanctioned during 2013-14**

-----Nil---------

VIII. Recommendations generated for field application

- Linking of MGNREGS scheme with agriculture through suitable policy interventions to meet the labour scarcity particularly during the peak sessions.
- Development Departments should specifically develop the programmes for involving farm women for increasing their exposure and knowledge about the new farm technologies & financial institutions.

IX. Patent filed if any: Nil

B. Details of Each Research Scheme(s) for Review:

i) Scheme No. & : C (a) Econ-1 Plan (Agri.)
Title : Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

ii) Year of Start : 2002-2003

iii) Location : Haryana

iv) Objective(s) :

1. To analyse the resource use efficiency in Haryana farming.
2. To carry out studies into different marketing aspects of major farm inputs and products.
3. To study the possible agricultural diversification in different zones of Haryana.

v) Any need to modify the objectives as per the need of the state

No change is required at present, it covers all the aspects.

vi) Staff provided in the scheme including name of the faculty members

S.No.	Sanctioned posts	Status	Designation
1.	Economist(FM) -1	Vacant	-
2.	Assistant Scientist (Agri. Econ) - 6	1. J.C.Karwasra	Sr. Scientist & Head
		2. V.K. Singh	Sr. Scientist
		3. Jitender Bhatia	Assistant Scientist
		4. Dalip Bishnoi	Assistant Scientist
		5. Vacant	Superannuation of R. K. Khatkar on 28.2.2014
		6. Vacant	VRS of R.S. Khatry
3.	Assistant Scientist (Sociology) - 1	1. Mrs. Deep Punia	Sr. Scientist (Sociology)

4.	Assistant Scientist (Statistics) - 1	Vacant	Due to transfer of Kiran Kapoor
5.	Research Associate (Rural Sociology)-1	Vacant	Due to resignation of Mrs. Baskaur on dated-------

vii) Budget for the year 2013-14 (head-wise sanctioned and expenditure details) (in Rs.)

Sub Head	Allotment	Expenditure	Budget 2014-15
Pay	6675640	6305441	7405800
ADA	5300570	5073172	5631100
CPF/GPF	568240	531214	565300
Gratuity	10,00,000	1000000	825000
OE & Others	18000	17978	20000
TA	6500	6110	14000
M & S	700	670	3500
Other Charges	5000	4983	5500
POL	6100	6089	8800
Total	**12946350**	**12945657**	**14479000**

viii) Achievements in bullet form (telegraphic language)

Impact of MGNREGS on Agriculture in Karnal District of Haryana

- With the increase in wage rates under MGNREGS from Rs.151 in 2009-10 to Rs. 214 per man day in 2013-14, the wage rate at farmer'sfield for different agricultural operations have also increased from Rs.125-150 in 2009-10 to Rs.200-300 per man day.
- About 70 percent of MGNREGS worker belongs to other than general category as compared 23 percent of other selected farmer households and majority of them (70 %) were adopted nuclear family.
- Average size of family was higher on farmer households (7.43) as compared to MGNREGS worker households (5.70).
- In Karnal district about 6 per cent share of employment provided to workers as well expenditure incurred under MGNREGS in the state.
- The growth of expenditure made under MGNREGS has shown 4 to 9 times increase across different blocks of Karnal district.
- About 52 per cent employment in MGNREGS was obtained by the workers of age group of 18 to 40 years.
- Implementation of MGNERGS has caused lower labour supply in agriculture sector. It has decreased by 32.84 per cent in kharif season and 26.50 per cent in rabi season.

- More than 70 per cent sampled farmers responded that there is a need to develop low cost machines for transplanting paddy, custom hiring of all sort of machine at reasonable prices be provided and there is a need of linking of MGNREGS works with agricultural operations.

Decision Making Pattern of Farm Women in Hisar District of Haryana

- Majority of farm women pre-dominantly decided the home-affairs activities; they were not involved in the important financial decisions like taking credits/loan, sale/purchase of house/plot.
- Farm women were being consulted and their opinions were considered in deciding education of children (87.50%), household maintenance (80.83%), purchasing food items (77.50%), health care (73.33%), purchasing clothes (67.50%) & jewellery (34.17%) in which their involvement were more.
- An overwhelming majority of farm women decided about the livestock activities. They were least involved in financial decisions like insurance of livestock, selection of breed of animals, sale/purchase of animals, sale/purchase of milk/ghee and other financial matters
- Regarding agricultural activities their opinion was considered in some of the crop production activities in which their labour force was required i.e. storage of fodder (65.83%), hoeing (60.83%), picking of cotton (58.33%), harvesting (55.83%), threshing (35%) etc.
- Majority of the respondents were perceiving constraints very severely in decision making i.e. extensive work load with dual responsibilities, followed by poor access & knowledge to credit institutions for loans/saving/insurance etc., poor technical knowledge, traditional beliefs system in society for women i.e. domination of males etc.

ix) Justification for continuation of the scheme

Objectives of the scheme are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems of Haryana.

x) Constraints, if any nil

xi) TECHNICAL PROGRAMME FOR THE YEAR – 2013-14

i Sub-Project I: "Impact of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) on Agriculture in Karnal District of Haryana (North-Eastern zone)"

ii. Objectives:

1. To examine the present status of income and employment of farm households and land less agricultural labourers working under MGNREGS.

2. To study the impact of the scheme on availability of agricultural labour, wages and crop profitability.
3. To suggest suitable strategies to improve labour supply in agriculture.

iii. Year of Start : 2012-13

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
R. K. Khatkar	Planning, execution, analysis of data and report writing.
J.C.Karwasra	Development of schedule, compilation, analysis of data and report writing.
V.K.Singh	Selection of respondents, data collection, analysis of data & report writing.
Jitender Bhatia	Data collection, compilation, analysis of data and report writing.
Dalip Bishnoi	Data collection, compilation, analysis of data and report writing

iv. Collaborators: None

v. Location of theStudy: The study was conducted in Karnal district (North-Eastern zone) of Haryana. Two villages from each block were selected randomly.

Name of Block	**Name of Village**
Assandh	Kurlan & Alawla
Gharounda	Kutail and Bastara
Indri	Garhi gujran and Bayana
Karnal;	Kunjpura and Neval
Nilokheri	Bir Naraina and Anjanthali
Nissing at Chirao	Shahpur and Sirsi

Then 5 beneficiary respondents from each selected village were randomly selected and equal number of farmers were selected randomly and categorized into small, medium and large categories on the basis of cumulative total to frequency of land holding. The primary data pertaining to number of days employed under MGNREGS, wages, income earned by selected households were collected for the year 2013-14 by survey method.

Similarly from the selected farmer households, the data pertaining to availability of labour in peak agricultural periods, wage rates and impact of MGNREGS scheme on profitability as well as resource use of crops were collected by survey method. Simple tabular analysis technique was applied to analyse the data.

vi. Results achieved during 2013-14:

About 70 percent of MGNREGS worker belongs to other than general category as compared 23 percent of other selected farmer households and majority of them (70 %) were adopted nuclear family.

Table 1: Category wise composition of farm household and MGNREGS workers

Category	General	Others	Total	Joint	Nuclear	Total
Farm Household	46 (77)	14 (23)	**60**	34 (57)	26 (43)	**60**
MGNREGS Workers	9 (15)	51 (85)	**60**	18 (30)	42 (70)	**60**

Figures in parentheses show per cent to the total respondent.

Average size of family was higher on farmer households (7.43) as compared to MGNREGS worker households (5.70). The adult members constituted 67.05 per cent on farmer households and 62.57 per cent on MGNREGS worker category households, the rest were children (Fig. 1& 2).

Table 2: Family composition of sample households in Karnaldistrict

Particulars	Farm household		MGNREGS household	
	Total	Average	Total	Average
Adult	299 (67.05)	4.98	214 (62.57)	3.57
i) Adult male	174 (39.02)	2.90	109 (31.87)	1.82
ii) Adult female	125 (28.03)	2.08	105 (30.70)	1.75
Children	147 (32.95)	2.45	128 (37.43)	2.13
Total	**446 (100.00)**	**7.43**	**342 (100.00)**	**5.70**

Figures in parentheses show per cent to the total respondent.

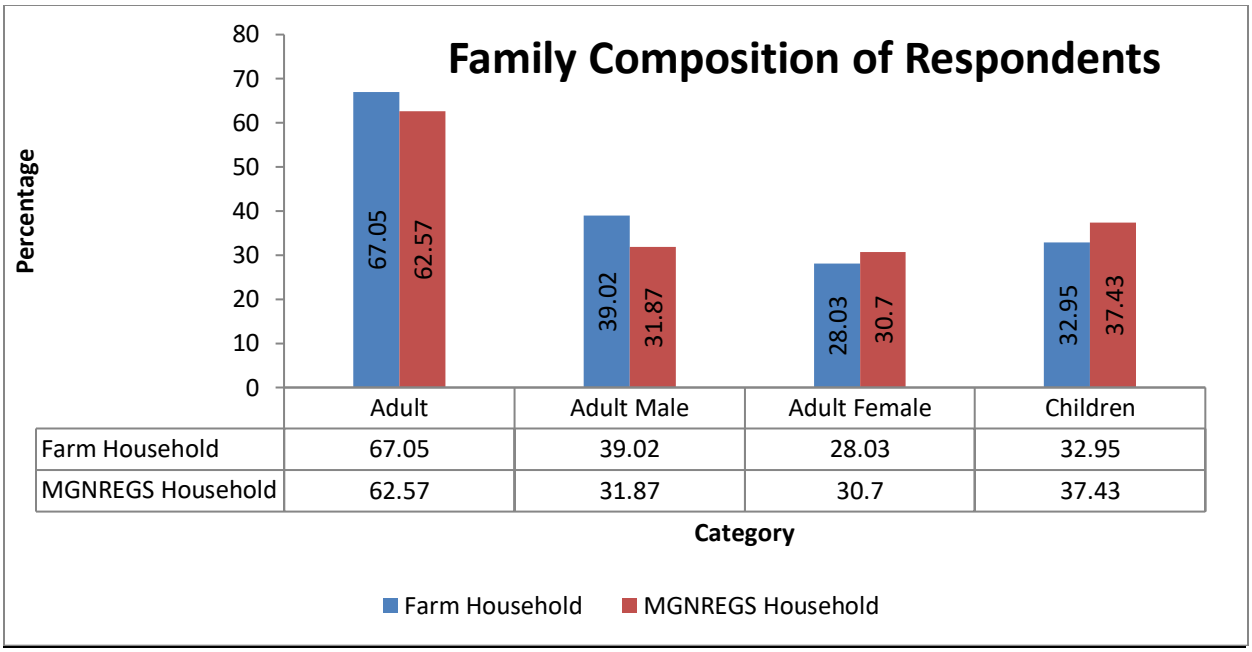

Fig. 1 Family composition of Farm&MGNREGS Household respondents

Literacy was also found higher in case of farmer households (75.00 per cent) in comparison to (46.67 per cent) in sampled MGNREGS worker households. Majority of the literate respondents were educated up to senior secondary level. Higher education was obtained only by 6.67 per cent in case of farmer households and 1.67 per cent in case of MGNREGS worker households (Fig. 3).

Table 3: Educational status of family members per sample households in Karnal district (Number of Households)

	No. of respondents	**No. of respondents**
Educational Status	**Farm Household**	**MGNREGS Workers**
Illiterate	15(25.00)	32(53.33)
Primary	7(11.67)	6(10.00)
Middle	14(23.33)	8(13.33)
Secondary	11(18.33)	7(11.67)
Sr. Secondary	9(15.00)	6(10.00)
Higher Education	4(6.67)	1(1.67)
Total	**60 (100.00)**	**60 (100.00)**

Figures in parentheses show per cent to the total respondent.

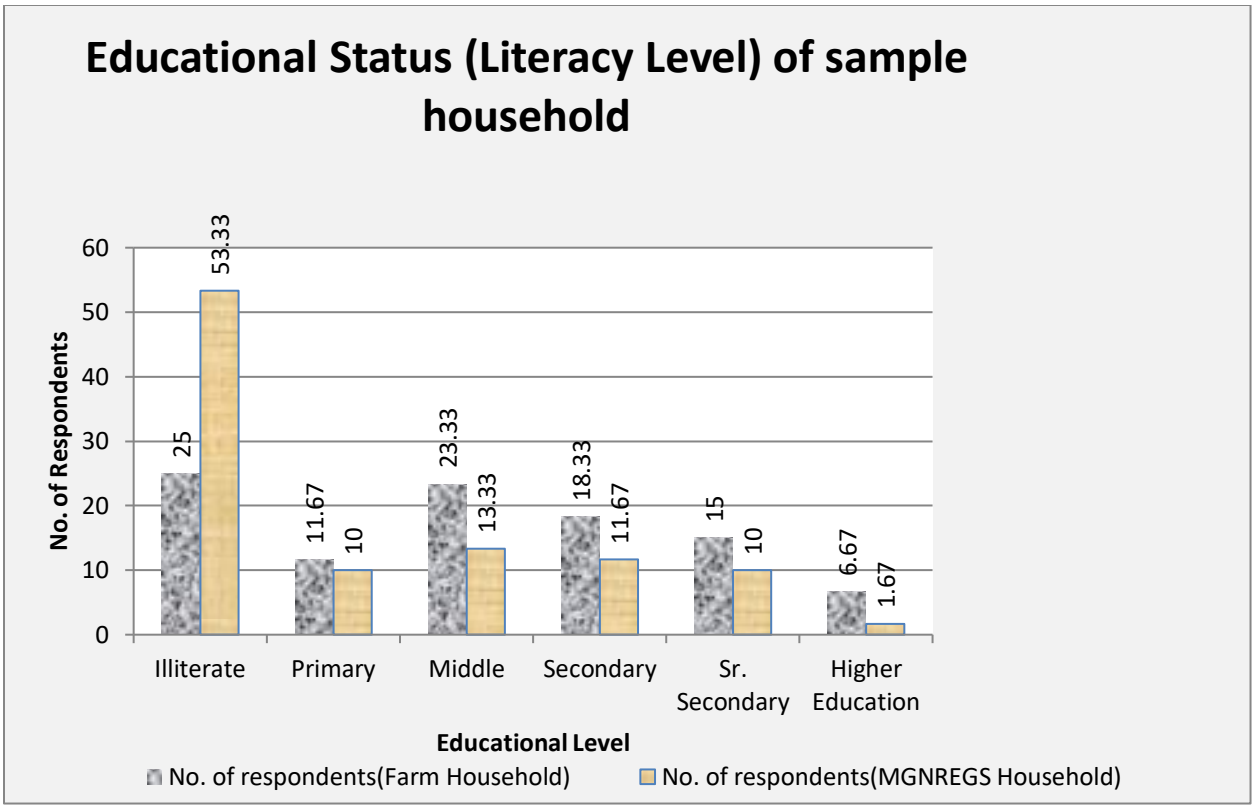

Fig 2. Educational status of respondents

Average operational holding varies between 1.16 ha to 5.97 ha on small and large category of farms. Leased in land was more on large farms (1.12 ha), followed by small (0.29 ha) and medium category of farms (0.19 ha). On an average rental value of land was found Rs. 80175 per hectare (Table 4).

Table 4: Average size of land holding of selected farm household respondents (ha/farm)

Farm Size Category	Numbers	Owned	Leased in	Total Operational Holding	Land Rent (Rs. / ha/annum)
Small (up to 1ha)	28	0.87	0.29	1.16	79,465
Medium (1 to 2ha)	17	2.14	0.19	2.33	80,970
Large (above 2ha)	15	4.85	1.12	5.97	80,600
Overall	**60**	**2.31**	**0.39**	**2.70**	**80,175**

Large category of farms were having larger herd size of livestock (7.87) followed by medium (5.41) and small (4.59). Among the milch animals on an average about 34 per cent were milch buffaloon farm family as compared to MGNREGS workers having about 29 per cent, (Table 5).

Table 5: Average number of livestock maintained on selected household in Karnal district

Livestock	Small	Medium	Large	Overall	Landless MGNREGS workers
Milch cow	0.78 (16.99)	0.82 (15.16)	1.33 (16.90)	0.93 (16.47)	0.42 (19.72)
Milch buffalo	1.39 (30.28)	2.12 (39.19)	2.73 (34.69)	1.93 (34.25)	0.62 (29.11)
Cow heifer	0.54 (11.76)	0.76 (14.05)	0.87 (11.05)	0.68 (12.14)	0.22 (10.33)
Buffalo heifer	0.96 (20.92)	0.71 (13.12)	2.07 (26.30)	1.17 (20.69)	0.57 (26.76)
He buffalo	0.92 (20.04)	1 (18.48)	0.87 (11.05)	0.93 (16.49)	0.30 (14.08)
Total	**4.59 (100.00)**	**5.41 (100.00)**	**7.87 (100.00)**	**5.64 (100.00)**	**2.13 (100.00)**

About 98.52 per cent irrigated areas were having both tube-well and canal irrigation on overall farms and only 1.48 per cent was un-irrigated. Highest irrigated area was observed on large sized farms 98.99 per cent and lowest on small category of farms 98.27 per cent (Table6).

Table 6: Sources-wise average area irrigated on sample farms (ha/ Farm)

Farm Size Category	Irrigated (Canal/TW)	Unirrigated	Total Operational Holding
Small	1.14 (98.27)	0.02 (1.73)	1.16
Medium	2.30 (98.71)	0.03 (1.29)	2.33
Large	5.91 (98.99)	0.03 (1.01)	5.97
Overall	**2.66 (98.52)**	**0.025 (1.48)**	**2.70**

Figures in parentheses show per cent to the total operational holding

The highest area was occupied by Paddy (82.80 per cent) followed by fodder crop i.e. jowar (8.90 per cent) and sugarcane (6.26 per cent) in *kharif* season. In *rabi* season the highest area was allocated under wheat (81.88 per cent) followed by rabi fodder i.e. barseem/oat (8.14 per cent) vegetables (4.18per cent) and sugarcane (2.51 per cent). Almost same pattern was observed on all the categories of farm. In the study area the cropping intensity was observed 215.98 per cent which was found highest on medium farm (217.59per cent) and lowest on small farms i.e. 210.34 per cent (Table7).

Table 7: Average cropped area on sample farms (ha/ Farm)

Crop	Small	Medium	Large	Overall
Kharif				
Paddy	0.92 (79.31)	1.88 (83.19)	4.90 (80.72)	2.19 (80.96)
sugarcane	0.04 (3.45)	0.11 (4.87)	0.54 (8.90)	0.18 (6.87)
Jowar	0.09 (7.76)	0.15 (6.64)	0.40 (6.59)	0.18 (6.86)
Others	0.11 (9.48)	0.12 (5.31)	0.23 (3.79)	0.14 (5.31)
Total	**1.16 (100.00)**	**2.26 (100.00)**	**6.07 (100.00)**	**2.69 (100.00)**
Rabi				
Wheat	1.07 (80.45)	2.20 (83.97)	5.15 (8149)	2.41 (81.98)
Sugarcane	0.05 (3.76)	0.06 (2.29)	0.50 (7.91)	0.17 (5.62)
Berseem/Oats	0.09 (6.77)	0.16 (6.11)	0.48 (7.59)	0.21 (7.05)
Others	0.12 (9.02)	0.20 (7.63)	0.19 (3.01)	0.16 (5.45)
Total	**1.33 (100.00)**	**2.62 (100.00)**	**6.32 (100.00)**	**2.95 (100.00)**
Total cultivable area	1.16	2.33	5.97	2.70
Total cropped area	2.49	4.88	12.39	5.64
Cropping intensity	**214.66**	**209.44**	**207.54**	**208.89**

Figures in parentheses show per cent to the total cropped area in respective season

About 6-7 per cent share of employment provided to workers as well expenditure incurred under MGNREGS in the state was constituted by Karnal district (Table 8). This has resulted in labour scarcity in agriculture sector in the study area in both cases i. e. local as well as migrated labour.

Table 8: Progress of MGNREGS in study area 2013-14

Particulars	Karnal	Haryana	Share of District in state (%)
Employment provided to household (lakhs)	0.21	3.22	6.52
Employment provided in person days (lakhs)	7.15	116.46	6.14
i.) SCs	3.87	56.35	6.87
ii.) STs	0	0.05	0
iii.) Others	3.28	60.09	5.46
Women person days (lakhs)	3.70	48.54	7.62
Total fund released (in crore rupees)	23.03	429.05	5.37
Total expenditure (in crore rupees)	22.08	376.96	5.86
Total works taken up (number)	1587	26157	6.07
Works completed (number)	183	5561	3.29
Works in Progress (number)	1404	20956	6.81

The growth of expenditure made under MGNREGS has shown 4 to 9 times increase across different blocks of Karnal district. Overall it increased by 470 per cent in the district during 2013-14 over 2009-10. The per cent increase was observed ranging from 294 per cent in Nilokheri block and 780 per cent in Indri block (Table9).

Table 9: Block wise growth of expenditure under MGNREGS (Rs. in lakh)

Block/Year	2009-10	2010-11	2011-12	2012-13	2013-14	% Change in 2013-14 over 2009-10	Multiple increase from 2009-10 to 2013-14
Assandh	75.78 (19.98)	124.13 (20.76)	225.69 (14.98)	398.55 (16.51)	378 (17.46)	**399**	**4.99**
Gharounda	53.05 (13.99)	67.97 (11.36)	229.55 (15.24)	524.56 (21.73)	339.29 (15.68)	**523**	**6.23**
Indri	32.63 (8.60)	107.51 (17.98)	267.46 (17.76)	263.77 (10.92)	287.23 (13.27)	**780**	**8.80**
Karnal	89.69 (23.65)	137.24 (22.95)	358.80 (23.82)	568.17 (23.53)	452.62 (20.91)	**405**	**5.05**
Nilokheri	73.11 (19.27)	87.67 (14.66)	161.00 (10.69)	251.15 (10.40)	288.39 (13.32)	**294**	**3.94**
Nissing	55.03 (14.51)	73.52 (12.29)	263.68 (17.51)	408.08 (16.90)	418.94 (19.36)	**661**	**7.61**
Overall	**379.29 (100.00)**	**598.04 (100.00)**	**1506.18 (100.00)**	**2414.28 (100.00)**	**2164.47 (100.00)**	**470**	**5.70**

Figures in parentheses show per cent to total

The highest growth of employment under MGNREGS was observed in Indri block (750 per cent) followed by Gharounda (443 per cent) and Nissing (430 per cent) during 2013-14 over 2009-10. In district as a whole the increase in employment generation under MGNREGS was observed 313 per cent during the corresponding period. In this way employment in the scheme has grown about 3 to 9 times across different blocks (Table 10).

Table 10 : Block wise growth of employment generated in MGNREGS (in man days)

Block/Year	2009-10	2010-11	2011-12	2012-13	213-14	% Change in 2012-13 over 2009-10	Multiple increase from 2009-10 to 2012-13
Assandh	35730 (20.63)	51484 (19.71)	84350 (14.72)	140851 (17.63)	127928 (17.87)	**258**	**3.58**
Gharounda	22788 (13.16)	31633 (12.11)	93758 (16.36)	172545 (21.59)	123715 (17.28)	**443**	**5.43**
Indri	10482 (6.05)	46166 (17.68)	104927 (18.31)	88426 (11.07)	89058 (12.44)	**750**	**8.50**
Karnal	47665 (27.53)	57804 (22.13)	124413 (21.70)	185274 (23.19)	145366 (20.31)	**205**	**3.05**
Nilokheri	31266 (18.06)	44207 (16.93)	63714 (11.12)	84538 (10.58)	95969 (13.41)	**207**	**3.07**
Nissing	25234 (14.57)	29887 (11.44)	102042 (17.80)	127394 (15.94)	133841 (18.70)	**430**	**5.30**
Total	**173165 (100.00)**	**261181 (100.00)**	**573204 (100.00)**	**799028 (100.00)**	**715877 (100.00)**	**313**	**4.13**

Figures in parentheses show per cent to total

About 52 per cent employment in MGNREGS was obtained by the worker of age group of 18 to 40 years, 28.08 per cent of the age group of 40-50 years, 13.39 per cent of 50-60 years and merely 6.47 per cent was provided to age group of above 60 years (Table 11).

Table 11: Age-wise pattern of employed person in MGNREGS in 2013-14

Age group (years)	No. of person employed	Per cent to total
18-30	6665	21.40
30-40	9548	30.66
40-50	8746	28.08
50-60	4170	13.39
Above 60	2015	6.47
Total	**31144**	**100.00**

In all 210 households completed hundred days employment under MGNREGS in Karnal district in 2009-10 which increased to 10 times in 2012-13 and have shown about 6 times growth in 2013-14 in various blocks during the period under reference (Table 12).

Table 12: Block wise growth of household completed 100 days under MGNREGS

Block/Year	2009-10	2010-11	2011-12	2012-13	2013-14	% Change in 2013-14 over 2009-10	Multiple increase from 2009-10 to 2013-14
Assandh	61	70	82	230	122	**100**	**2**
Gharounda	31	38	151	330	164	**429**	**5.29**
Indri	0	31	119	93	160	**416**	**5.16**
Karnal	48	31	136	362	145	**202**	**3.02**
Nilokheri	48	39	48	127	112	**133**	**2.33**
Nissing	22	30	86	169	125	**468**	**5.68**
Total	210	239	542	1011	828	**294**	**3.94**

Figures in parentheses show per cent to total

The wage rates for different agricultural operations have witnessed tremendous increase ranging from 60 per cent in irrigation and application of manures/fertilizers to 100 per cent in spraying (chemical application) in 2013-14 over 2009-10. The construction wage rate also increased by 100 per cent during the corresponding period. The wage rate under MGNREGS has also shown rise of 42 per cent in 2013-14 over 2009-10. This has shown that implementation of MGNREGS has caused very high rise in wage rates for different agricultural operations (Table13).

Table 13: Comparative wage rates under MGNREGS and agricultural operations (Rs. /man day)

S. No.	Agricultural operations	2009-10	2010-11	2011-12	2012-13	2013-14	% Change in 2013-14 over 2009-10	Multiple increase from 2009-10 to 2013-14
1	Harvesting of Wheat	150	200	250	250	300	100	2.00
2	Transplanting of Rice	150	200	250	250	300	100	2.00
3	Cutting of Mustard	125	175	225	225	250	100	2.00
4	Threshing of Crops	150	200	250	300	300	100	2.00
5	Irrigation	125	150	200	200	200	60	1.60
6	Fertilizer application	125	150	200	200	200	60	1.60
7	Chemical application	125	150	200	200	250	100	2.00
8	Weeding- hoeing	150	180	200	250	300	100	2.00
9	Construction	150	180	250	300	300	100	2.00
10	Water channel cleaning	125	150	200	225	250	100	2.00
	MGNREGS wages	**151**	**167**	**179**	**191**	**214**	**42**	**1.42**

The income earning pattern of MGNREGS worker household indicate that they are earning 10.06 per cent of their total annual earning through MGNREGS work, 50.40 per cent through services, non-farm employment and other social welfare schemes, 23.85 per cent through employment in agricultural operations and 15.69 per cent through live stock rearing. On the other hand, the farm households earned 58.30 per cent from crop enterprise, 29.97 per cent through hiring out machinery, services etc. and 11.73 per cent through livestock enterprise of their total annual earnings (Table14).

Table 14: Farm family income of MGNREGS workers household and farm household 2013-14 (in Rs.)

S.No.	Source of income	MGNREGS workers household	Farm household
1	Agriculture	-	-
i.)	Crop enterprise	-	275028 **(58.30)**
ii.)	Agricultural wages	27390 **(23.85)**	-
2	Livestock Rearing	18022 **(15.69)**	55349 **(11.73)**
3	MGNREGS wages	11556 **(10.06)**	-
4	Other sources (Hiring out machinery, services, Govt. welfare schemes)	57890 **(50.40)**	141370 **(29.97)**
	Total	**114858 (100.00)**	**471747(100.00)**

The MGNREGS employment was less shared by men (37.03 per cent) and highly by women (62.97 per cent) workers. While in agriculture sector, on farm households the men workers got 38.88 per cent and female workers 61.12 per cent of the total employment which is just opposite to result of study conducted in north-eastern zone-Karnal district. Scheduled caste workers dominated both in MGNREGS and agricultural sector employment with more than 50-60 per cent share. BPL households got larger share i.e. 59.26 per cent in total man days employed under MGNREGS while Non-BPL household got 40.74 per cent employment. The agriculture wage earning dominated the scene by providing more than 68 per cent of their total wage earning in all categories of workers (Table 15).

Table 15: Average annual wage income earned by different classes of respondents 2013-14.

Particulars		MGNREGS man days employed	Agricultural man days employed	MGNREGS wages income (Rs.)	Agricultural wages income (Rs.)	Total wage income (Rs.)
Gender	Men	20 (37.03)	42 (38.88)	4280 (27.04)	11550 (72.96)	**15830 (100.00)**
	women	34 (62.97)	66 (61.12)	7276 (31.48)	15840 (68.52)	**23116 (100.00)**
Caste	SC/ST	28 (51.85)	62 (57.41)	5992 (27.64)	15686 (72.36)	**21678 (100.00)**
	Others	26 (48.15)	46 (42.59)	5564 (32.22)	11704 (67.78)	**17268 (100.00)**
Poverty	BPL Household	32 (59.26)	67 (62.04)	6848 (28.41)	17252 (71.59)	**24100 (100.00)**
	Non-BPL Household	22 (40.74)	41 (37.96)	4708 (31.71)	10138 (68.29)	**14846 (100.00)**

	Total	**54(100.00)**	**108(100.00)**	-	-	-

Figures in parentheses show per cent to total

Implementation of MGNERGS has caused lower labour supply in agriculture sector. It has decreased by 32.84 per cent in *kharif* season and 26.50 per cent in*rabi* season. Overall decrease in the supply of agriculture labour for performing different agricultural operations was observed 30.34 per cent owing to the implementation of social employment scheme (Table 16).

Table 16: Labour supply in agriculture in study area (man days)

Labour availability in man days	**Before MGNREGS**	**After MGNREGS**	**Decreased Participation**	**Decreased (per cent)**
Kharif	137.00	92	45	32.84
Rabi	89.8	66	23.8	26.50
Total	**226.8**	**158**	**68.8**	**30.34**

The work scenario undertaken as well as completed under MGNREGS indicated that rural connectivity (earth work) dominate the scene followed by Land development, Micro irrigation and then water conservation as well as water harvesting works (Fig. 4).

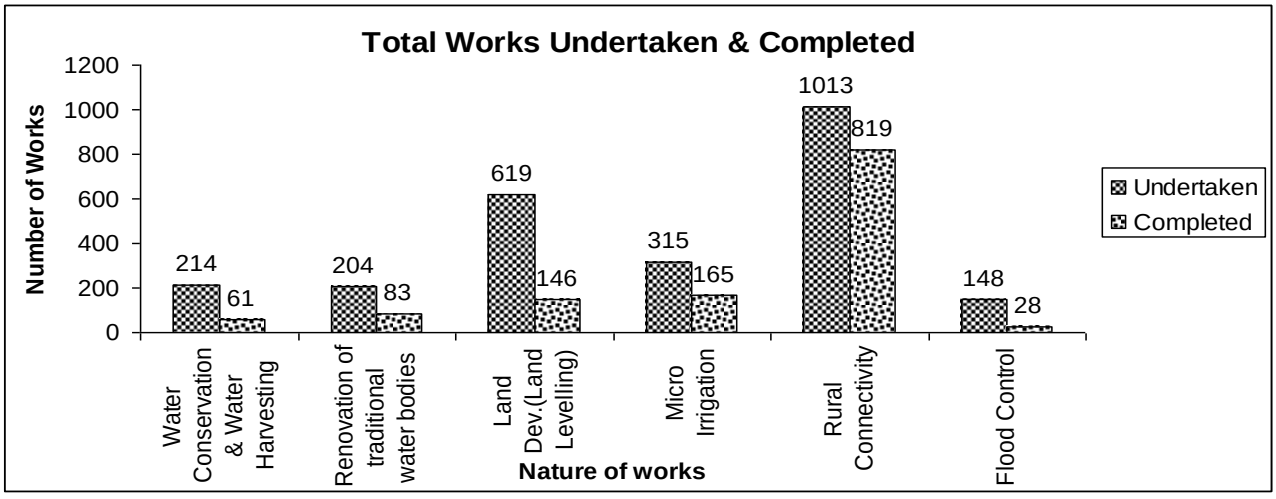

Fig. 3: Types of works undertaken and completed under MGNREGS

The farm household responded regarding the possible impact of MGNREGS in agriculture sector. More than 80 per cent highlighted that MGNREGS has caused higher wage rates, scarcity of hired labour for agricultural operations in peak season. About 52 per cent highlighted that this scheme has reduced profitability of crops due to increase in wage rates thereby inflating the cost of production. However, about 72 per cent of the respondents pointed out that this scheme is beneficial to farming community provided labour is employed in cleaning of irrigation structures including channels (Table 17).

Table 17: Category wise response of respondents w. r. t. impact of MGNREGS (number)

S. No.	Particulars	Small (28)	Medium (17)	Large (15)	Overall Total
1.	Higher wages	20 (71.43)	16 (94.12)	13 (86.67)	49 (81.67)
2.	Reluctance of labour to work in agriculture	25 (89.29)	14 (82.35)	8 (53.33)	47 (78.33)
3.	Scarcity of agricultural labour	17 (60.71)	14 (82.35)	11 (73.33)	42 (70.00)
5.	Impact on profitability	12 (42.86)	10 (58.82)	9 (60.00)	31 (51.67)
6.	Impact on timely completion of agricultural operations	16 (57.14)	7 (41.18)	8 (53.33)	31 (51.67)
7.	Beneficial impact on agriculture (cleaning of irrigation structures etc.)	12 (64.29)	10 (76.47)	5 (80.00)	27 (71.67)

Figures in parentheses show per cent to total

More than 70 per cent sampled farmers responded that there is a need to develop low cost machines for transplanting paddy,custom hiring of all sort of machine at reasonable prices be provided and there is a need of linking of MGNREGS works with agricultural operations, if it is possible the MGNREGS works can be shared on 50: 50 basis by the implementing agency and farmers in peak seasons. More than 82 per cent farmers opined that there is a need to suspend MGNREGS works during the peak agricultural seasons and there is a need to create basic amenities at panchayat level for migrated labourers (Table18).

Table 18: Per cent response of respondents regarding suggestions for suitable strategies to overcome scarcity of labour

Sr. No.	Suggestion	Per cent Response
1.	Development of low cost machines for transplanting paddy and picking of vegetables	74.40
2.	Custom hiring of all sort of machines at reasonable prices (for ploughing, transplanting, leveling combine harvesting, picking, threshing etc.	78.22
3.	Linking of MGNREGS works with agricultural operations shared on 50: 50 basis.	80.00
4.	Suspension of MGNREGS works during the peak agricultural season	82.88
5.	Creation of basic amenities at panchayat level for migratory labour	67.77

- The variable cost in case of paddyhas increased by (71.74 percent) which was highest and followed by sugarcane i.e.55.87 percent. This was due to increase in labour wage rate up to 100

per cent owing to implementation of MGNREGS and also rise in pricesof other farm input. (Table 19&20).The increase in minimum support price is less than as compared to increase in cost of production of sugarcane, paddy dwarf and wheat.

Table 19: Cost and returns per acre of major crops in the study area during 2009-10 and 2013-14 (in Rs./ha

Crop	VC	TC	Yield (q)	GR	ROVC	NR	CP/q	MSP/q
2009-10								
Paddy dwarf	22455	56205	64.87	61626	39171	5421	866	950
Paddy basmati	25598	60420	30.25	84431	58833	24011	1997	2725(Market price)
Wheat	21940	55690	44.8	57815	35875	2125	1243	1080
Sugarcane	67187	135937	812	150220	83033	14283	167	185
2013-14								
Paddy dwarf	38287	84012	69.72	91333	53046	7321	1215	1310
Paddy basmati	43962	94217	34.67	161037	117075	66820	2717	4645(Market price)
Wheat	30812	76487	47.12	79862	49050	3375	1623	1350
Sugarcane	104725	218845	862	243237	138512	24392	254	276

Note: VC-variable cost; TC-total cost; GR-gross returns; ROVC-return over variable cost; NR-net returns; CP-cost of production and MSP-minimum support price

Table 20: Per cent change in cost and returns of major crops after implementation of MGNREGS in 2013-14 over 2009-10

Crop	VC	TC	Yield	GR	ROVC	NR	CP	MSP
Paddy dwarf	70.51	49.47	7.48	48.20	35.42	35.04	40.30	37.89
Paddy basmati	71.74	55.93	14.61	90.73	98.99	178.29	36.05	70.45
Wheat	40.44	37.34	5.18	38.13	36.72	58.82	30.57	25.00
Sugarcane	55.87	60.99	6.16	61.92	66.82	70.78	52.09	49.19

Note: VC-variable cost; TC-total cost; GR-gross returns; ROVC-return over variable cost; NR-net returns; CP-cost of production and MSP-minimum support prices

x. Programme of work for Current Year 2014-15

i Sub-Project I: "Prospects and Problemsin Production and Marketing of Polyhouse cultivation in Haryana"

ii. Objectives:

1. To know the production statusscope of polyhouses in the state
2. To study the marketing channels, costs and margins of poly house produce
3. To examine the marketing constraints faced by farmers in marketing poly house produce

iii. Year of Start **:** 2014-15

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
J.C.Karwasra	Planning, Monitoring and Execution
V.K.Singh	Selection of respondents, data collection, compilation, analysis of data and report writing.
Jitender Bhatia	Preparation of schedule, data collection, compilation, analysis of data and report writing.
Dalip Kumar Bishnoi	Preparation of schedule, data collection, compilation, analysis of data and report writing.

Collaborators: S. K. Goyal, Department of Business Management

v. Method of Study:

The study will be conducted in Karnal district of Haryana being the highest number of poly houses in the state. Gharounda block which has highest number of poly houses (about 50 % of the total poly houses of the district) will be selected. Ten poly houses will be selected for collection of primary data related to various production and marketing aspects. Further, appropriate number of market factionaries involved in the marketing of poly house product will be selected at random. The required secondary data will also be collected from State Horticulture Department and related agencies. Suitable statistical techniques will be applied to analyse the data and to draw the inferences.

Title of Sub-project II: Pattern and extent of crop diversification in Haryana

i. Objectives

1. To study cropping pattern of the state
2. To examine the extent of crop diversification in different zones of Haryana
3. To analyze factors affecting crop diversification

ii. Year of Start **:**2013-14

iii. Period of study: 2013-2015

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
J.C. Karwasra	Planning, data collection, compilation, analysis of data and report writing.
V.K. Singh	Data collection, compilation, analysis of data and report writing.
Jitender Bhatia	Data collection, compilation and analysis of data
Dalip Kumar Bishnoi	Data collection, compilation and analysis of data

v. Work done during 2013-14: As planned, the required time series data were collected and tabulated for further analysis.

vi. Programme of work (2014-15): Study will continue for further analysis, drawing meaningful conclusion and report writing

Sub Project-III: Decision Making Pattern of Farm Women in Socio-Economic Activities in Hisar District of Haryana

i. Objectives:

1. To examine the personal and socio-economic profile of the farm women
2. To study the extent of women's participation in decision making in socio-economic activities
3. To identify the constraints perceived by the farm women in decision making

ii. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Deep Punia	Development of schedule, data collection, compilation, analysis of data and report writing.
R.K.Khatkar	Planning and execution
Baskaur (RA)	Review of literature, development of schedule, collection, compilation and analysis of data.

iii. Method of Study:

The present study was conducted in four villages namely Chirod, Bherian, Thurana & Kanoh from Hisar-I, Hisar-II, Hansi-II & Agroha blocks respectively of Hisar district of Haryana. From

each village 30 farm working women from small, medium & large categories were randomly selected making a total sample of 120. The primary data pertaining to decision making pattern of farm women in performing socio-economic activitiesfor the last year were collected with the help of well structured pre-tested interview-schedules from those 120 households in which both husband & wife were involved in socio-economic activities regarding home affairs, livestock affairs & farm affairs. The extent of rural women participation in decision making in performing various socio-economic activities regarding home affairs, livestock affairs & farm affairs was measured by using a four point continuum namely nil, only consulted, opinion considered and final decision with scores.

iv. Results achieved during 2013-14

Profile: An overwhelming majority of the farm women belonged to general castes (88.33%) and among these, Jats constituted majority (69.17%) followed by Brahmins (16.67%). Less than half of the respondents were from the age group of 18 to 35 years (40.83%) followed by 36 to 45 years (38.33%). About half of the farm women were illiterate (46.67%). Whereas less than one-third of the respondents were up to middle (27.50%) followed by matriculate/higher secondary (19.17%) and graduates/post-graduates (6.66%). Highest level of education in the families of the respondents was matriculation/higher secondary (48.34%) followed by graduation/post-graduation (47.50%). More than half of the total farm women belonged to the joint families (62.50%) followed by nuclear families (37.50%).

Farming was the main occupation of all of the total households. Less than half of the households (46.66%) were having one or the other kind of subsidiary occupations & majority was in service (33.33%). Regarding respondent's employment status, it was found that an overwhelming majority of the respondents were house wives/home makers (90%). Whereas 10 percent of them were working women as teachers, Anganwadi workers, nurse, cook/helpers in schools and earning up to Rs.5000/-per month. Majority of the farm women were watching television (77.50%) and spending one (56.99%) and two hours (43.01%) daily. Less than one-fourth of the respondents (22.50%) were reading the news papers and spending 15 minutes in a day. It was observed that 80 per cent of the farm women personally were not having contacts with extension scientists of University/KVK etc. and they were not the member of any organization i.e. SHGs/NGOs/Mahila Mandals etc. (91.67%).

Regarding the possession of farm assets, more than one-third of the rural households were possessing sprayers (39.17%) followed by tractors (38.33%), disk harrow (35%), seed drill (34.17%), land leveler, tractor trolley & electricity motor (33.33% each), diesel engine (30.83%), cultivator (28.33%), chaff -cutter (28%), thresher (25%) etc. and among these, large farm size families constituted majority (72.50%, 62.50%, 67.50%, 65%, 55%, 57.50%, 60%, 57.50% and 45% each, respectively). Regarding the possession of non-farm assets like shop, plot, shares, house in city, insurance policy etc. it was found that 44.17 per cent of the total respondents were having plots in the village itself/nearby city. Less than one-third of the respondents (30.83%) were keeping more than two insurance policies to secure their future. About one-tenth of the respondents were keeping shops within the village itself (9.17%). Only 4.17 per cent of the households constructed house in the nearby city and among these, all were the large farmers. Nobody had purchased the shares in economic market.

In the study area, an overwhelming majority of the households were keeping different households assets such as mobile phones (100%), cooking gas (95.83%), television (95%), refrigerator (71.67%), motor-cycle (56.67%), cooler (47.50%), washing machine (35.83%), bicycle (24.17%), car & radio transistor (10% each) and among these, large farmers and medium farmers constituted majority.

Decision Making in Household Activities: Extent of participation of the respondents in deciding about household activities reveals that an overwhelming majority of the farm women made the final decisions regarding child rearing practices & cleaning utensils (359 scores each) followed by washing clothes (358 score), cooking & fetching water (357 scores each), gathering fuel wood (347 scores) and grinding & pounding (281 scores). Table shows clearly the high level of participation of farm women in decision making in performing above-mentioned household activities.

Table 21: Extent of women's participation in decision making regarding different activities related to home affairs **N=120**

Household Activities	Extent of participation in Decision Making					
	Nil	Only consulted	Opinion considered	Final decision	Total scores	Rank
Child rearing	-	-	1 (0.82)	119 (99.18)	359	1
Cleaning utensils	-	-	1 (0.82)	119 (99.18)	359	1
Washing clothes	-	-	2	118	358	2

			(1.67)	(98.33)		
Cooking	-	-	3 (2.50)	117 (97.50)	357	3
Fetching water	-	-	3 (2.50)	117 (97.50)	357	3
Gathering fuel wood	-	-	13 (10.83)	107 (89.17)	347	4
Grinding & Pounding	15 (12.50)	-	34 (28.33)	71 (59.17)	281	5
Education of children	-	5 (4.17)	105 (87.50)	10 (8.33)	245	6
Purchasing clothes	15 (12.50)	-	81 (67.50)	24 (20.00)	234	7
Health care of sick person	-	25 (20.84)	88 (73.33)	7 (5.83)	222	8
Household maintenance	-	23 (19.17)	97 (80.83)	-	217	9
Purchasing fruits & vegetables	-	76 (63.33)	20 (16.67)	24 (20.00)	188	10
Purchasing jewellery of gold/silver	25 (20.83)	41 (34.17)	22 (18.33)	32 (26.67)	181	11
Purchasing food items	-	93 (77.50)	-	27 (22.50)	174	12
Arts & Crafts(stitching, knitting, embroidery etc.)	87 (72.50)	-	-	33 (27.50)	99	13
Marriage of children	80 (66.67)	-	40 (33.33)	-	80	14
Saving	100 (83.33)	-	5 (4.17)	15 (12.50)	55	15
Credits/Loans	120 (100.00)	-	-	-	0	16
Sale/purchase of house/plot	120 (100.00)	-	-	-	0	16
Attending training/kisan mela/camp etc.	120 (100.00)	-	-	-	0	16
Purchasing household technologies	120 (100.00)	-	-	-	0	16

Figure in parenthesis indicates percentage to total

In a vast majority of cases, women's opinion was considered in decision making regarding education of children i.e. age of sending children to school, in which school to send, type of school, medium of instruction in school, home work etc. (245 scores) followed by purchasing clothes (234 scores), health care of sick person (222 scores) and household maintenance (217 scores). Decision was made jointly by husband, wife and other family

members. They were only consulted in deciding about purchasing fruits & vegetables (188 scores) followed by purchasing jewellery of gold/silver (181 scores) and purchasing food items of kitchen & others (174 scores). In this way, there was medium level of participation of the respondents in decision making in performing above-mentioned activities.

On the other hand, majority of the respondents was having least participation at all in decision making in arts & crafts i.e. stitching, knitting, embroidery etc.(99 scores) followed by marriage of children i.e. expenditure, giving dowry, selection of life partner etc. (80 scores) and saving (55 scores). None of the farm women was included in decision making in taking credits/loans i.e. whether to borrow or not, from where to borrow and how much amount to borrow etc, sale/purchase of house/plot, purchasing household technologies and attending training/kisan-mela/camp/exhibition etc (nil score each). Data reveal clearly low level of participation of the respondents in decision making in performing above-mentioned activities regarding home-affairs. Pattern of decision making in the family indicates that in majority of the households, husband alone made the decisions in this regard.

Conclusions: More than 88 per cent of farm women pre-dominantly decided the home-affairs activities related to kitchen & child rearing which were confined to home fore-walls and it shows the high level of participation of the farm women in decision making. They were not involved in the important financial decisions like taking credits/loan, sale/purchase of house/plot, purchasing household technologies, attending training/kisan-mela/camp/exhibition (100% each), saving (83.33%), arts & crafts (72.50%) and marriage of children (66.67%) which are a must for the development and progress of farm families. Farm women were being consulted and their opinion was considered in deciding education of children (87.50%), household maintenance (80.83%), purchasing food items (77.50%), health care (73.33%), purchasing clothes (67.50%) & jewellery (34.17%) which indicates their involvement in important decisions.

Decision Making in Livestock Activities: As regards extent of participation of the respondents in deciding about livestock activities, it was found that an overwhelming majority of the farm women were involved in final decision making regarding dung cleaning (358 scores) followed by disposal of dung, preparing of dung cakes & cleaning of shed (355 scores each), washing of animals (346 scores), watering of animals (343 scores), milking (337 scores), churning of milk & feeding of animals (333 scores each), cleaning & grooming (331 scores), grinding of concentrates (322 scores), care of new born animals (310 scores) and chaffing of fodder (300

scores). In this way, farm women made the final decisions in performing above-mentioned livestock activities and data reveal the high level of women' participation in decision making.

Opinion of more than half of the farm women was also considered before deciding about fetching of fodder (292 scores) followed by deworming of animals (281 scores), purchase of concentrates (278 scores), care of pregnant animals (264 scores), care of sick animals (256 scores), purchase of animals (231 scores), sale of animals and breeding (230 scores each). As regards decision making pattern in the family, it was observed that in majority of the households, it was decided jointly by husband, wife & other family members. More than one-third of the respondents were being consulted only in decision making regarding purchase of milk (225 scores), sale of milk (220 scores), sale of ghee (207 scores), construction of shed (206 scores) and purchase of ghee (204 scores). In these activities, husband alone made the decisions and sometimes farm women were being consulted only. Table shows the medium level of women' participation in decision making in performing above mentioned livestock activities.

Analysis of data reveals the low level of women' participation in decision making in performing activities like selection of breed of animals (181 scores), fixing price of animals (169 scores), hospital treatment for sick animals (148 scores), maintaining sale records of milk & milk products (146 scores), insurance of animals (137 scores) and culling & disposal of animals (121 scores). Farm women were having no participation/no say at all in decision making in performing above-mentioned livestock activities. Husband alone made the decisions in this regard.

Table 22: Extent of women's participation in decision making regarding livestock activities

N=120

Livestock Activities	**Extent of participation in Decision Making**					
	Nil	**Only consulted**	**Opinion considered**	**Final decision**	**Total scores**	**Rank**
Dung cleaning	-	-	2 (1.66)	118 (98.34)	358	1
Disposal of dung	-	-	5 (4.17)	115 (95.83)	355	2
Preparing of dung cakes	-	-	5 (4.17)	115 (95.83)	355	2
Cleaning of shed	-	-	5 (4.17)	115 (95.83)	355	2
Washing of animals	-	-	14 (11.67)	106 (88.33)	346	3
Watering of animals	1	-	14	105	343	4

	(0.83)		(11.67)	(87.50)		
Milking	-	-	23 (19.17)	97 (80.83)	337	5
Churning of milk	-	-	27 (22.50)	93 (77.50)	333	6
Feeding of animals	-	-	27 (22.50)	93 (77.50)	333	6
Cleaning & Grooming	2 (1.66)	-	23 (19.17)	95 (79.17)	331	7
Grinding of concentrates	-	-	35 (29.17)	84 (70.00)	322	8
Care of new born animals	2 (1.66)	-	44 (36.67)	74 (61.67)	310	9
Chaffing of fodder	1 (0.83)	-	57 (47.50)	62 (51.67)	300	10
Fetching of fodder	2 (1.66)	-	62 (51.67)	56 (46.67)	292	11
Deworming of animals	-	-	79 (65.83)	41 (34.17)	281	12
Purchase of concentrates	4 (3.34)	-	70 (58.33)	46 (38.33)	278	13
Care of pregnant animals	-	-	96 (80.00)	24 (20.00)	264	14
Care of sick animals	1 (0.83)	-	101 (84.17)	18 (15.00)	256	15
Purchase of animals	-	9 (7.50)	111 (92.50)	-	231	16
Sale of animals	-	10 (8.33)	110 (91.67)	-	230	17
Breeding	5 (4.17)	-	115 (95.83)	-	230	17
Purchase of milk	-	51 (42.50)	33 (27.50)	36 (30.00)	225	18
Sale of milk	-	63 (52.50)	14 (11.67)	43 (35.83)	220	19
Sale of ghee	68 (56.66)	-	17 (14.17)	35 (29.17)	207	20
Construction of shed	-	53 (44.17)	48 (40.00)	19 (15.83)	206	21
Purchase of ghee	68 (56.66)	-	20 (16.67)	32 (26.67)	204	22
Selection of breed of animals	-	59 (49.17)	61 (50.83)	-	181	23
Fixing price of animals	-	71 (59.17)	49 (40.83)	-	169	24
Hospital treatment for sick	46	-	74	-	148	25

animals	(38.33)		(61.67)			
Maintaining sale records of milk & milk products	29 (24.17)	51 (42.50)	25 (20.83)	15 (12.50)	146	26
Insurance of animals	-	103 (85.83)	17 (14.17)	-	137	27
Culling & disposal of animals	-	119 (99.17)	1 (0.83)	-	121	28

Figure in parenthesis indicates percentage to total

Conclusions: An overwhelming majority of farm women decided about the livestock activities being performed by them which were of the manual nature and did not need skill & knowledge. These were culturally traditional activities being performed by rural women folk. Farm women were least involved in financial decisions of insurance of livestock, culling & disposal of animals, selection of breed of animals, sale/purchase of animals, sale/purchase of milk/ghee and other financial matters (fixing prices of animals, shed construction, maintaining sale records of milk/milk products etc.). Even their participation was very low in these activities but they were consulted and/or their opinion was considered. Women' participation was more limited to their opinion consideration, even in some technical activities like breeding (95.83%), care of sick animals (84.17%) and care of pregnant animals (80%).

Decision Making in Agricultural Activities: As regards extent of participation of the respondents in deciding about activities related to farm affairs, it was found that 56.66 per cent of the total respondents were included in the final decisions about cutting fodder (308 scores), whereas 35 per cent of them were final decision makers regarding storage of agricultural produce (282 scores). Their opinion was also considered in deciding these activities (43.34% & 65% respectively).Table clearly shows the high level of women' participation in decision making regarding cutting fodder and storage of agricultural produce. Except these two activities, they were not involved in final decisions in other activities related to farm affairs.

Opinion of more than half of the respondents was also considered before deciding about storage of fodder (199 scores) followed by hoeing (193 scores), picking of cotton (190 scores), harvesting (187 scores) and threshing (162 scores). Decision was made jointly by husband, wife and other family members in such activities (65.83%, 60.83%, 58.33%, 55.83% & 35% respectively). Table clearly showed the medium level of women' participation in decision making in those activities in which their labour force was required. One-third of the farm women were being consulted only in decision making in above mentioned activities (34.17%, 39.17%, 41.67%, 44.17% & 31.67% respectively).

It was observed that majority of the farm women were having low level of participation/no say at all in decision making regarding purchase of land (74 scores), sale of land (72 scores), sale of agricultural produce (70 scores), leased-out of land (69 scores), leased-in of land (64 scores), purchase of farm machineries & transplanting (53 scores each), sale of farm machineries (52 scores), hiring-in/hiring-out practices of farm machineries (50 sores), packaging (43 scores), sowing (40 scores), growing fodder (38 scores), loading/unloading (34 scores), land improvement (16 scores), labour management (12 scores), irrigation (11 scores), selection of variety of crop (4 scores), sale/purchase of fodder (3 scores), grading (2 scores), seed selection (1 score) and transportation, use/purchase of pesticides & fertilizers (nil score each). It shows the least participation of farm women in decision making in above-mentioned activities related to farm affairs. Husband alone made the decisions in this regard.

Table 23: Extent of women's participation in decision making regarding different activities related to farm affairs **N=120**

Agricultural Activities	Extent of participation in Decision Making					
	Nil	Only consulted	Opinion considered	Final decision	Total scores	Rank
Cutting fodder	-	-	52 (43.34)	68 (56.66)	308	1
Storage of agril. produce	-	-	78 (65.00)	42 (35.00)	282	2
Storage of fodder	-	41 (34.17)	79 (65.83)	-	199	3
Hoeing	-	47 (39.17)	73 (60.83)	-	193	4
Picking	-	50 (41.67)	70 (58.33)	-	190	5
Harvesting	-	53 (44.17)	67 (55.83)	-	187	6
Threshing	40 (33.33)	38 (31.67)	42 (35.00)	-	162	7
Purchase of land	83 (69.17)	-	37 (30.83)	-	74	8
Sale of land	85 (70.83)	-	33 (27.50)	2 (1.67)	72	9
Sale of agril. produce	84 (70.00)	2 (1.67)	34 (28.33)	-	70	10
Leased-out of land	87 (72.50)	-	30 (25.00)	3 (2.50)	69	11
Leased-in of land	88	-	32	-	64	12

	(73.33)		(26.67)			
Transplanting	67 (55.83)	53 (44.17)	-	-	53	13
Purchaseof Farm Machineries	67 (55.83)	53 (44.17)	-	-	53	13
Saleof Farm Machineries	68 (56.67)	52 (43.33)	-	-	52	14
Hiring-out & hiring-in practices of Farm Machineries	70 (58.33)	50 (41.67)	-	-	50	15
Packaging	77 (64.17)	43 (35.83)	-	-	43	16
Sowing	80 (66.67)	40 (33.33)	-	-	40	17
Growing fodder	101 (84.17)	-	19 (15.83)	-	38	18
Loading/Unloading	86 (71.67)	34 (28.33)	-	-	34	19
Land-Improvement	112 (93.33)	-	8 (6.67)	-	16	20
Labour-Management	108 (90.00)	12 (10.00)	-	-	12	21
Irrigation	109 (90.83)	11 (9.17)	-	-	11	22
Selection of variety of crop	118 (98.33)	-	2 (1.67)	-	4	23
Sale/purchase of fodder (green/dry)	117 (97.50)	3 (2.50)	-	-	3	24
Grading	118 (98.33)	2 (1.67)	-	-	2	25
Seed selection	119 (99.17)	1 (0.83)	-	-	1	26
Use/purchase of fertilizers	120 (100.00)	-	-	-	0	27
Use/purchase of pesticides	120 (100.00)	-	-	-	0	27
Transportation	120 (100.00)	-	-	-	0	27

Figure in parenthesis indicates percentage to total

Analysis of the data reveals that none of the farm women was included in final decisions and even their opinion was not considered & it was not given weightage before deciding the activities related to farm machineries (i.e. sale, purchase, hiring-in/hiring-out practices etc.) and

marketing of agricultural produce (i.e. transportation, grading, loading/unloading, packaging etc.).

Opinion of less than one-third of the farm women was considered before deciding purchase of land (30.83%) followed by sale of agricultural produce (28.33%), sale of land (27.50%), leased-in of land (26.67%) and leased-out of land (25%). In these cases, decision was made jointly by husband, wife and other family members.

Conclusions: Regarding agricultural activities, farm women were final decision makers in cutting fodder (56.66%) and storage of agricultural produce (35%) only. Their opinion was considered in some of the crop production activities in which their labour force was required i.e. storage of fodder (65.83%), hoeing (60.83%), picking of cotton (58.33%), harvesting (55.83%), threshing (35%) etc. Land is the most important asset and farm women did not participate in making decisions pertaining to land i.e. land improvement (93.33%), leased-in (73.33%), leased-out (72.50%), sale (70.83%) & purchase of land (69.17%) in the farm families. Similarly farm women did not participate in financial and technical decisions i.e. purchase/use of inputs (100% each), selection of seed (99.17%) & crop's variety (98.33%) related to crop production, crop protection, marketing and farm machineries i.e. hiring-out/hiring-in practices (58.33%), sale (56.67%), purchase (55.83%) etc.

Constraints in Decision making: As regards extent of constraints perceived by the farm women in decision making in performing socio-economic activities regarding home affair s, livestock affairs and farm affairs, it was found that an overwhelming majority of the respondents were perceiving constraints very severely i.e. extensive work load with dual responsibilities (356 scores & 97.50%) followed by poor access & knowledge to credit institutions for loans/saving/ insurance etc. (356 scores & 96.67%), poor technical knowledge due to no link from University/KVK etc.(351 scores & 94.17%), fast technological advancement (342 scores & 88.34%), unawareness about new technologies (339 scores & 86.66%), low decision making power in agricultural activities i.e. outside home activities like sale/purchase of land, crops, fodder, farm machineries; use/selection of seed, crops' variety & in-puts, marketing etc. (324 scores & 80.84%), restrictions for attending kisan-mela/training/camp/exhibition etc. (322 scores & 80.83%), traditional beliefs system in society for women i.e. domination of males, gender biasness & sex-discrimination in decision making (281 scores & 41.67%), poor purchasing capabilities of farm women i.e. lack of involvement in financial decisions for purchasing land,

plot, house, animals, crops, farm machineries etc. (245 scores & 46.67%) and under-estimated/under-valued/largely ignored role i.e. considered economically inactive (226 scores & 31.67%).

Table 24: Constraints perceived by the farm women in decision making in performing socio-economic activities. **N=120**

Perceived Constraints	Extent of Constraints				
	Very Severe	Severe	Neutral	Total Scores	Rank
Extensive work load with dual responsibilities	117 (97.50)	2 (1.67)	1 (0.83)	356	1
Poor access & knowledge to credit institutions for loans/saving/insurance etc.	116 (96.67)	4 (3.33)	33-	356	1
Poor technical knowledge due to no link from University/KVK etc.	113 (94.17)	5 (4.17)	2 (1.67)	351	2
Fast Technological Advancement	106 (88.34)	10 (8.33)	4 (3.33)	342	3
Unawareness about new technologies	104 (86.66)	11 (9.17)	5 (4.17)	339	4
Low decision making power in agril. activities	97 (80.84)	10 (8.33)	13 (10.83)	324	5
Restrictions for attending kisan mela/training/camp/exhibition etc.	97 (80.83)	8 (6.67)	15 (12.50)	322	6
Traditional Beliefs system in society for women (domination of males, gender biasness & sex-discrimination in decision making)	50 (41.67)	61 (50.83)	9 (7.50)	281	7
Poor purchasing capabilities of farm women (lack of involvement in financial decisions)	56 (46.67)	13 (10.83)	51 (42.50)	245	8
Under-estimated/under- valued/ largely ignored role (considered economically inactive)	38 (31.67)	30 (25.00)	52 (43.33)	226	9

Figure in parenthesis indicates percentage to total

It was observed that half of the total respondents perceived constraints severely, but not very severely, in deciding farm affairs i.e. traditional beliefs system in society for women (50.83%) followed by under-estimated/under-valued/largely ignored role (25%). On the other hand, remaining respondents were found to be neutral and they were undecided to express their extent of perceived constraints regarding under-estimated/under-valued/largely ignored role (43.33%), poor purchasing capabilities of farm women (42.50%), restrictions for attending kisan mela/training/camp/exhibition etc. (12.50%) and low decision making power in agricultural activities (10.83%).

Conclusions: In a vast majority of cases, farm women were not involved in the important financial decisions regarding different activities related to home affairs, livestock affairs and farm affairs. They pre-dominantly decided the home-affairs activities related to kitchen & child rearing which were confined to home fore-walls. Farm women decided about those culturally traditional livestock activities being performed by the women folk which were of the manual nature. Regarding agricultural activities, farm women were final decision makers in cutting fodder and storage of agricultural produce only. Their opinion was considered in some of the crop production activities in which their labour force was required. In this way, farm women perceived more constraints very severely in decision making in performing agricultural activities as compared to household & livestock activities.

Recommendations/Suggestions: Farm women were not involved and/or least involved in the important financial and technical decisions in performing various socio-economic activities related to home affairs (i.e. taking credits/loan/saving, sale/purchase of house/plot, purchasing household technologies, marriage of children, arts & crafts and attending training/kisan-mela/camp/exhibition etc.); livestock affairs (i.e. insurance of livestock, culling & disposal of animals, selection of breed, sale/purchase of animals, sale/purchase of milk/ghee and other financial matters like fixing prices, shed construction, maintaining sale records of milk/milk products etc.) and farm affairs (i.e. sale/purchase of inputs & farm machineries, hiring-out/hiring-in practices, selection of seed & crop's variety, use of inputs related to crop production, crop protection and marketing) which are a must for the development and progress of farm families. Development Departments should specifically develop the programmes for involving farm women for increasing their exposure and knowledge about the new farm technologies & financial institutions.

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Technical Programme of Work: 2014-15

Title: Participation of Farm Women in Vegetable Cultivation in Hisar District of Haryana

Objectives:

1. To study the extent of women's participation in various activities related to vegetable cultivation

2. To analyse relationship between different socio-economic factors of farm women and their extent of participation in activities of vegetable cultivation
3. To identify the constraints perceived by the farm women invegetable cultivation

Methodology:

The present study will be conducted in Hisar district of Haryana. Two blocks from Hisar district and two villages from each block will be selected randomly. From each village 30 farm working women from small, medium & large categories will be randomly selected making a total sample of 120. The primary data pertaining to farm women's participation in the activities related to cultivation of major vegetable crops for the last year will be collected with the help of well structured pre-tested interview-schedules from those 120 households in which both husband &wife were involved in vegetable cultivation. The extent of rural women's participation in activities of vegetable cultivation will be measured by using a three point continuum namely always, seldom & never. All the activities will be listed under the heads to know(1) in which of these activities the respondents were participating (2) how many days in the last season they devoted to that particular activity and (3) how many hours in a day they devoted to that particular activity in last season. From this information total hours in the seasons for each activity and contribution of females in hours per family in the seasons will be calculated. The Chi-square test will be applied to test the relationship between the variables.

iii. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
Deep Punia	Data collection, compilation, analysis of data and report writing.
J. C. Karwasra	Supervision and Report writing.
Jitender Kumar Bhatia	Collection, compilation and analysis of data.
Dalip Kumar Bishnoi	Collection, compilation and analysis of data.

ii. Name (s) of collaborator(s): N.A.

B. Other Agencies

Scheme I: "Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana" (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Co-operation, Govt. of India)

	No.& Name of the Scheme	C (c) Econ.-I.(CS) Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana

	Year of Start	1970
	Objective	To provide representative and comparative data on Cost of Cultivation of Principal Crops in Haryana
	Period of Study **Location**	2013-14 CCS Haryana Agricultural University, Hisar
	Staff position in the scheme Hon. Director-cum- Professor and Head Senior Research Officer/Sr.Scientist Senior Scientist Senior Scientist Scientist Statistician Computer Assistants Agril. Inspectors	 J.C. Karwasra V.P. Luhach Kuldeep Kumar R.S.Pannu D.P. Malik (on deputation) Mrs. Kiran Kapoor 03 (Three vacant) 28 (Two vacant)

Name of Investigators with Activity Profile:

Scientists	**Activity Profile**
J.C. Karwasra	Planning, execution, overall supervision and verification of data.
V.P. Luhach	Planning, monitoring, supervision, checking and verification of data.
Kuldeep Kumar	Planning, monitoring, supervision, checking and verification of data.
R.S.Pannu	Planning, supervision, checking and verification of data.
D.P. Malik	On deputation in Ministry of Agriculture, GoI for five years.
Mrs. Kiran Kapoor	Compilation, validation and valseas of data

Budget **(in Rupees)**

Particular	**Allotment 2013-14**	**Expenditure 2013-14**	**Budget 2014-15**
Establishment (Salary)	18450000	15283322	18000000
T.A.	820000	434120	800000
Contingency (Recurring and Non-recurring)	1230000	621242	1200000
Total	**20500000**	**16338684**	**2,00,00,000**

Salient Achievements during 2013-14

The scheme is being financed by Ministry of Agriculture, Govt. of India. Under this scheme, the cost of cultivation data of seven important crops of Haryana state namely, Paddy, Cotton, Bajra,

Sugarcane, Wheat, Gram and Rapeseed & Mustard were collected from 30 Centers /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The processed data for the Rabi and Kharif seasons for the year 2012-13 have been submitted in time to the Ministry of Agriculture on C.D. for further analysis, the result of which will be used by the Commission for Agriculture Costs and Prices (CACP) for fixing the minimum support prices of Kharif and Rabi crops at national level.
- Data for Kharif and Rabi seasons of year 2013-14 have been received from the field staff.
- The processing and entry of data for the Kharif season of the year 2013-14 has been completed and validation & valseas for Kharif season data has been done.
- The data for Rabi season for the year 2013-14 is in progress for entry in FARMAP software programme (designed by funding agency) and will be completed well in time for submission to the Ministry of Agriculture and Cooperation, Govt .of India.
- Trainings/meetings of Agril. Inspectors were organized at department of Agricultural Economics during the year 2013-14 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items and keeping daily operation record.
- The scientists working in the scheme also organized meetings of Agril. Inspectors working under their supervision at their respective headquarters for checking of data entries in the records.
- The scientists working in the scheme supervised the work of Agril. inspectors, discussed with selected farmers about crop operations and inputs used at farm level to maintain the accuracy of data.
- The discrepancies in data as reported by funding agency were checked, corrected and re-submitted again.

Plan of Work for the year 2014-15

- Compilation of data for the year 2013-14 is in progress for all the seven crops and will be submitted to the Ministry of Agriculture, Govt. of India in the month of October 2014.
- The data on cost of cultivation of crops Paddy, Cotton, Bajra, Sugarcane, Wheat, Gram and Rapeseed & Mustard for the year 2013-14 will be collected from 30 clusters located in different Agro-Climatic Zones of the state by cost accounting method.
- Strict supervision of data collection work of Agril. Inspectors will be done by respective scientist to maintain accuracy in data.

- Information from funding agency as well as discrepancies in data will be disseminated to the Agril. Inspectors.

Table 25: Cost of production and minimum support prices of major crops in Haryana

Crops	Cost of Production (Rs./q)		Minimum Support Price- (Rs./q)	
	2009-10	**2010-11**	**2009-10**	**2010-11**
Paddy	1150	1305	950	1000
Bajra	921	970	840	880
Cotton	2414	2800	2500* 3000**	2500* 3000**
Wheat	832 (40.91)	773(45.40)	1100	1120+50
Gram	2693(4.22)	2511(5.28)	1760	2100
Rapeseed& Mustard	1556(17.69)	1305(20.43)	1830	1850
Sugarcane	133	135	130 185#	139 210#

Source: Agricultural statistics at a glance, 2012, Directorate of Econ. & Stat. Ministry of Agri. Govt. of India

Cost of production includes all actual expenses in cash and kind incurred in production by owner plus interest on value of owned/fixed capital assets (excluding land) plus rental value of owned land plus imputed value of family labour.

* Medium staple cotton (mm) of 24.5-25.5 and micronaire value of 4.3-5.1

** Long staple cotton (mm) of 29.5-30.5 and micronaire value of 4.5-4.3

^ Fair and Remunerative Price (FRP) in case of Sugarcane

Prices given by Govt. of Haryana

- The cost of production per quintal of paddy, gram and bajra during 2009-10& 2010-11 and that of cotton 2010-11 was found higher than minimum support prices (MSP). Similarly cost of production of sugarcane was also found higher than FRP in the year 2009-10 (Table 27).

Scientists Associated with projects operating in other departments:

Name of Scientist	Name of Project	Name of department operating project
K.K.Kundu	Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets in Sub-Sahara Africa and South Asia	Bajra Section (Department of Genetics & Plant Breeding)
V.P.Luhach	Centre of Excellence on Pearl Millets	Food & Nutrition (College of Home Science)
Dalip Kumar Bishnoi	Zero tillage rice establishment and crop weed dynamics in rice and wheat cropping system in India and Australia (ACIAR project).	Department of Agronomy
	Integrated Farming System Model	Department of Agronomy

REVIEW OF RESEARCH SCHEMES AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2015-16

A. Report by the Head of the Department

I. Name of the Department : Agricultural Economics

II. Salient Research Findings of the Department during the Period under Report (2014-15)

- The per unit sizeof sampled polyhouse was found 2066 Sqm and about 70 per cent of respondentshad farming as the main occupation.
- Major component of the investment was met through subsidy (68.35%) given by the governmentand the rest 31.65 per cent of cost met by farmer from their own sources. The government incentives (subsidy) proved to be the major factors for adoption of protected cultivation scheme.
- Among the various vegetables crops, cucumber was found to be the most predominant crop accounting for about 38 per cent of the cropped area due to higher net profitability.
- In floriculture,Gerbera occupies 64 percent, followed by Rose 15 per cent, Lilium 12 per cent and Chrysanthemum 9 per cent area in polyhouse cultivation on the sample farms.
- Most prevailing channel in marketing of both vegetable and flower is**Producer-Wholesaler-Retailer-Consumer**through which 70 percent of vegetables and 95 per cent of flowers were sold in the study area.
- The study on women participation in vegetable cultivation, women participation was observed higher in the farm activities like weeding, picking/harvesting, hoeing, loading/unloading, cleaning of fields, packaging, transplanting and grading.
- The cost of production per quintal of paddy, gram, bajra and cotton was higher in 2010-11 and 2011-12 than minimum support prices (MSP).

III. Emerging/Thrust Areas

1. Socio-economic analysis of emerging agricultural problems.
2. Demand, supply and price analysis of agricultural input and output.
3. Input use efficiency in existing cropping pattern in different agro-climatic zones.
4. Economic analysis of diversification, marketingand value addition in agriculture.

IV. Action taken Report of the last year's proceedings (2014-15)

S. No.	Observations/Suggestions made	Action Taken
1	In Table 4 at Page 9 and Table 9 at Page 11. The calculations need to be rechecked. **(Action : Concerned Scientist)**	Necessary corrections have been incorporated.
2.	Table 19 at Page 17. In the title instead of per acre, per hectare should be mentioned.	Necessary corrections have been incorporated.
3.	Recommendations/suggestions listed at page 28 of documents should be forwarded to the concerneddepartments of Haryana Govt. for feedback through Directorate of Research, CCSHAU, Hisar. **(Action: HOD, Agril. Economics)**	Submitted to D.R. vide letter no. PAE/14/1533 dated 21.10.2014 for onward transmission to concerned authority.

V. List of research projects (both from state as well as outside agencies) in operation along with sanctioned budget (2015-16)

S. No.	Number and name of the scheme	Sanctioned Budget (Rs. In lakh)	Funding Agency
A.	**State Funded Schemes**		
1.	**C(a)Econ.1 Plan (Agri.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	135.31	State
B.	**Other Agencies**		
2.	**Govt. of India C(c) Econ.1 (CS)** Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana.	250.00	Ministry of Agriculture, GOI

VI. Research projects completed during 2014-15 and the tangible conclusions drawn.

-Nil-

V**II. Research projects sanctioned during 2014-15**

S.No.	Name of the project	Staff position approved	Funding agency
1	**Sardar Partap Singh Kairon Chair**	Prof. Ag. Economics – 1 Assistant Professor – I (Agril. Economics) Assistant Professor –I (Sociology/Ext. Education) Assistant Professor – I (Statistics) Clerk – I Steno-typist – I Jeep/Car Driver – I Messenger - I **(All the post are to be filled up)**	University existing budget of Plan schemes

VIII. Recommendations generated for field application

- There is a need to provide insurance cover to polyhouse structure to cover up risk of damage due to wind storms and other factors.
- The innovative concepts of marketing need to be patronized like opening farmers/Apni Mandi in all towns and cities, direct retailing through retail chains, forming growersassociations for organized marketing.
- Poly house enterprise needs to be considered as an agricultural rather than commercial entity.
- Government should create the required market infrastructure like cold chain, grading standardization facilities.
- There is need to simplify the establishment of a subsidized polyhouse unit. However there isGovt. empanelled agencies but the farmers should be allowed to purchase the required polyhouse material from open market.
- Rural women farmers should be provided trainings for different agricultural enterprises.

IX. Patent filed if any: **Nil**

B. Details of Each Research Scheme(s) for Review:

i) Scheme No. **: C (a) Econ-1 Plan (Agri.)**

Title **: Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming**

ii) Year of Start **:** 2002-2003

iii) Location **:** Haryana

iv) Objective (s) **:**

1. To analyse the resource use efficiency in Haryana farming.
2. To carry out studies into different marketing aspects of major farm inputs and products.
3. To study the possible agricultural diversification in different zones of Haryana.

v) Any need to modify the objectives as per the need of the state

No change is required at present, it covers all the aspects.

vi) Staff provided in the scheme including name of the faculty members

Sr. No.	Sanctioned posts	Status	Designation
1.	Economist(FM) -1	Vacant	-
2.	Assistant Scientist (Agril. Econ) - 6	1. J.C.Karwasra	Principal Scientist & Head
		2. V.K. Singh	Principal Scientist
		3. Jitender Bhatia	Assistant Scientist
		4. Dalip K. Bishnoi	Assistant Scientist
		5. Vacant	Due to Superannuation of R. K. Khatkar
		6. Vacant	VRS of R.S. Khatry
3.	Assistant Scientist (Sociology) - 1	Mrs. Deep Punia	Principal Scientist (Sociology)
4.	Assistant Scientist (Statistics) - 1	Vacant	Due to transfer
5.	Research Associate (Rural Sociology)-1	Vacant	Due to resignation of Mrs. Baskaur

vii) Budget for the year 2014-15 (head-wise sanctioned and expenditure details) (in Rs.)

Sub Head	2014-15		Budget 2015-16
	Allotment	Expenditure	
Pay	5231180	5231154	6238100
ADA	4591400	4591359	5748200
CPF/GPF	500600	500557	491700
Gratuity	813120	813120	993000
OE & Others	20000	19898	22000
TA	300	300	16000
M & S	3500	3468	5000
Other Charges	5500	5484	6000
POL	3300	3260	11000
Total	**1,11,68,900**	**1,11,68,600**	**1,35,31,000**

viii) Achievements in bullet form (telegraphic language)

Marketing of Polyhouse Products in Haryana.

- The most popular design of polyhouse constructed in study area wasquionset type accounting for about 75 per cent of the units. Drip irrigation and fogger have been installed in almostall polyhouse units.
- The polyhouse cultivation has been found to be capital-intensive and on an average total capital investment of sampled farmers was found Rs. 28, 27,100.

- Among the total capital investment, major portion of investment i.e. 79.08 per cent goes to polyhouse structure followed by irrigation structure (18.83 %) and other equipments (2 .09 %) in the study area.

- In poly house vegetables , cucumber covered about 38 per cent followed by Capsicum colored (20.0 %), Capsicum green (15.0 %) and tomato (19.0 %) of the cropped area.

- In poly house flower cultivation 64.00, 15.00, 12.00, and 9.00 per cent of area occupied by Gerbera, Rose, Lilium and Chrysanthemum, respectively.
- Highest marketing efficiency was observed in direct selling of produce to consumer in both vegetables as well as flowers, whereas least marketing efficiency was found in Channel–II (Producer → Wholesaler-cum-Commission Agent (CA) → Retailer → Consumer).
- In case of vegetable cultivation under polyhouse, maximum net profit was obtained from cucumber (Rs. 31.78 lakh/ha), followed by capsicum green (Rs. 18.27 lakh/ha) as well as capsicum colored (Rs. 16.16 lakh/ha) and tomato (Rs. 9.79 lakh/ha).
- Most of respondent farmers expressed lack of polyhouse/ crop insurance schemes to mitigate the risk arising due to damage of crop or structure, followed by attack of insect and pest as well as nematodes, high cost of improved quality seed/seedling material and Inadequate power supply.
- Lack of market information on price and demand in different markets, non-remunerative prices of produce, time consuming marketing process in distant markets, lack of market competition among market functionaries and high cost of marketing due to perishable nature of products were the major marketing problems.

Participation of Farm Women in Vegetable Cultivation in Hisar District of Haryana

- In the study area, majority of total respondents/households were cultivating various kinds of vegetables in the kharif season (72.50%) followed by spring (42.50%) & rabi (38.75%). Average area under vegetable cultivation was 1.74 acres per family.
- Socio-economic factors i.e. working active age, illiteracy, joint family pattern, smaller farm size, lower per capita annual income and extent of women's participation in weeding; picking/harvesting, hoeing, cleaning of fields, loading/unloading, packaging, grading & transplanting were found highly significantly associated.

- An overwhelming majority of the respondents were perceiving various kinds of constraints in vegetable cultivation i.e. Agril. Labour scarcity in villages followed by lack of irrigation water, low output prices, uncertain market situations, lack of awareness about new technologies, non-availability of quality inputs and in timely availability of credit. There is problem of non availability of machinery on custom hiring basis in the study area.

ix) Justification for continuation of the scheme

Objectives of the scheme are of continuous in nature. Hence, its continuation is required to study the emerging socio-economic problems of farmersin Haryana.

x) Constraints, if any nil

C.Technical Programme for the Year – 2014-15

i. Sub-Project -I: "Marketing of poly house products in Haryana"

ii. Objectives:

1. To examine the present status of poly house production in Haryana.
2. To study the marketing channels, costs and margins of poly house produce.
3. To examine the marketing constraints faced by poly house producers.

iii. Year of Start: 2014-15

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
J. C. Karwasra	Planning, Monitoring and Execution
V. K. Singh	Selection of respondents, data collection, analysis of data and report writing.
Jitender Bhatia	Preparation of schedule, data collection, compilation, analysis of data and report writing.
Dalip Kumar Bishnoi	Preparation of schedule, data collection, compilation, analysis of data and report writing.

Collaborator: S. K. Goyal, Deptt. of Business Management (Data analysis & report writing)

v. Method of Study:

The study was conducted in Karnal district of Haryana having the highest number of poly houses in the state. From the district Gharounda block which has highest number of poly houses (about 50 % of the total poly houses of the district) was selected purposively. Fifteen poly houses

farmers were selected and interviewed for collection of primary data related to various production and marketing aspects.Two markets namely Karnal and Panipat within study area and two distant markets i.e.Azadpur (Vegetables) and Ghajipur mandi (Flower) of Delhi were selected and five traders each (Wholesaler-cum-Commission agents and retailers) were selected randomly from each selected marketsto collect primary data on various marketing aspects. The required secondary data werealso collected from State Agriculture Department as well asfrom Horticulture Department and other related agencies. Simple tabular analysis and Shepherd's technique to work out marketing efficiency was applied to analyse the data and to draw the inferences.

vi. Results achieved during 2014-15

Status of poly house production in Haryana

In Haryana state, protected cultivation was started in early 1990s with the establishment of units like Kuber Floritech, Cosco Blossom, German Gardens in Gurgaon; Torbo Floritech, Chandigarh and Mission Flora in Karnal, as entrepreneurial ventures by business houses with the financial support from National Horticulture Board as soft loans. Most of these units could not succeed due to different reasons, primarily the unsuitable design of protected structures, operational expenses on climate control, wrong selection of crops, lack of trained manpower and critical inputs. Protected cultivation in Haryana is still in a state of infancy, as at present, around 194 ha of area is covered under different protected structures in various regions for producing mainly vegetables and a few floricultural crops. The area under protected cultivation in Haryana is likely to increase fast in near future in the wake of several initiatives under schemes from Central and State Governments.

The Department of Horticulture, Govt. of Haryana is providing subsidy of 65, 90 and 50 per cent on cost of polyhouse, irrigation system and planting material, respectively.During the year from 2006-07 to 2013-14, the numbers of beneficiaries covered under protected cultivation increased from 8 to 648 by covering area from 0.40 ha to 193.50 ha.The commercial protected cultivation was adopted by the farmers after launching of National Horticulture Mission and it was further boost up after setting up of the Centre of Excellence for Vegetables at Gharounda in District Karnal under Indo-Israel Project during the year 2012-13. (Table 1)**.**

Table 1:- Year-wise area and assistance provided for protected cultivation in Haryana.

Year	Number of beneficiaries	Area covered* (ha.)	Assistance/subsidy (Rs. in lakh)
2006-07	08	0.40	5.90
2007-08	08	0.46	8.46
2008-09	25	21.65	10.10
2009-10	05	8.60	1.47
2010-11	106	8.98	119.77
2011-12	127	30.33	1222.11
2012-13	548	152.40	6297.74
2013-14	648	193.50	8022.77

Source :- Department of Horticulture, Haryana

**NVPH: Natural ventilated polyhouse, WIT: walk-in-tunnel polyhouse and SNH: Shade net house*

Socio-economic profile of selected polyhouse owners

The average size of polyhouse of the sampled farm was 2066 Sqmcovering 78.75 per cent and 21.25 per cent of area under flower and vegetable crops, respectively. The market value of land as well as land rent of the study area was found higher due to close proximity of the NH-1. Average family size was 6.67 persons comprising of 66 per cent adults and 34per cent children. Majority of the adopters were between the age of 40 to 50 years. About 66 per cent had farming as the main occupation living in joint families. There was high literacy status of polyhouse owners and almost all the selected farmers had acquired education above matriculation. The government incentives/ subsidy (40.00 %), farmers interest (26.67 %), expected high profitability (20.00 %)hasproved to be the major factors for adoption of protected cultivation. (Table 2).

Table 2:- Socio-economic profile of selected polyhouse owners in Karnal district of Haryana

Particulars	Overall average
Average area under Polyhouse (Sqm)	**2066**
Area under Vegetable crops (Sqm)	1627(78.75)
Area under flowers (Sqm)	439(21.25)
Land rent(Rs./ha.)	81,417
Market value of land (Rs./ha.))	83,48,600
Average size of family (no.)	
Adults	4.40
Children	2.27
Total	**6.67**
Age of respondents	

Below 40 year	3 (20.00)
Between 40 to 50 year	7 (46.67)
Above 50 year	5 (33.33)
Occupation	
Farming household	10.00 (66.66)
Other	5.00 (33.33)
Family type	
Joint	9.00 (60.00))
Nuclear	6.00 (40.00)
Literacy status	
Below Matriculation	1.00 (6.67)
Up to Sr. secondary	6.00 (40.00)
Graduate	6.00 (40.00)
Post Graduate	2.00 (13.33)
Motivating factor	
Subsidy	6 (40.00)
Farmer's Interest	4 (26.67)
Profit earning enterprise	3 (20.00)
Following the fellow farmer	2 (13.33)

- Figures in parenthesis represents percentage of total

Capital investment and source of funding

Polyhouse cultivation has been found to be capital-intensive and the capital investment depends upon the size of the polyhouse. The average total capital investment of sampled farmers was found Rs. 28, 27,100. Major component of this investment was in the form of subsidy on polyhouse structure given by the government (68.35 %) andthe farmer share was found to be 31.65 per cent of total investment. Majority of the farmers had invested their share from own funds instead of few who raised loan amount through Kisan Credit Card etc. (Table 3 &Figure 1).

Table 3: Average capital investment under polyhouse units in the study area (Rs. /farm)

Own fund	Subsidy	Total Investment
8,94,817 (31.65)	19,32,283 (68.35)	28,27,100 (100.00)

- Figures in parenthesis represents percentage of total

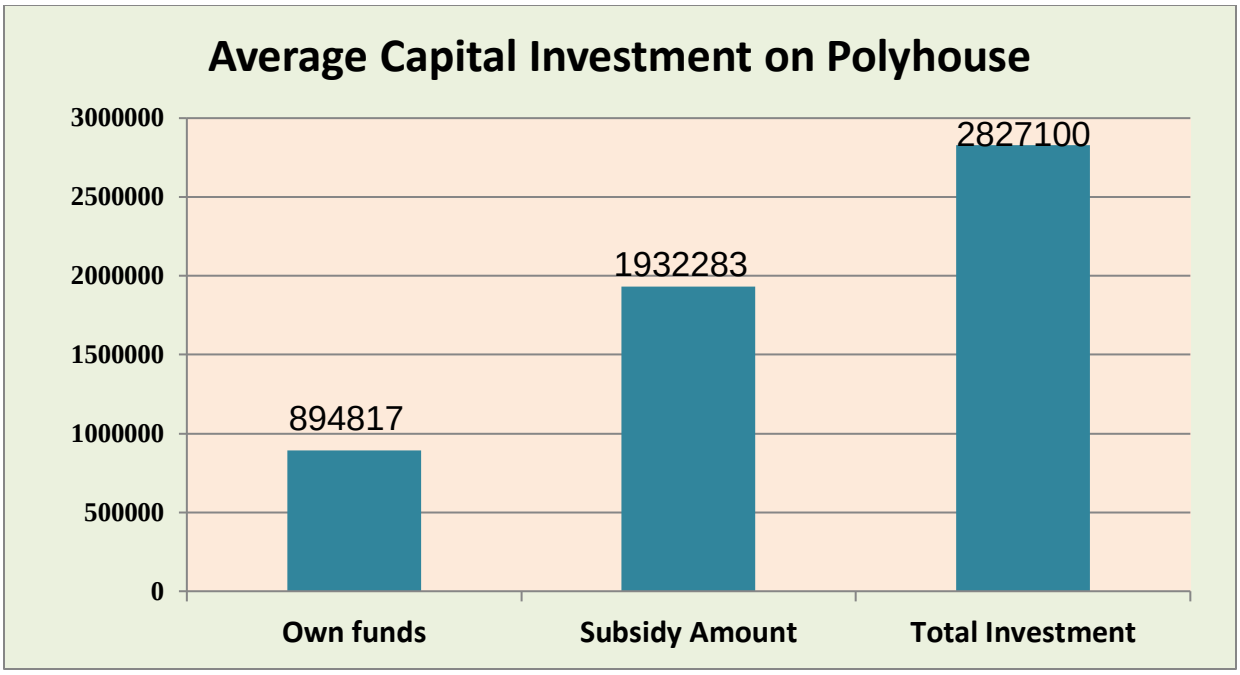


Figure 1: Average capital investment under polyhouse units in the study area (Rs. /farm)

Pattern of capital investment (item wise)

Among the total capital investment, major portion of investment i.e. Rs. 22,35,667 goes to polyhouse structure accounted to be 79.08 per cent followed by irrigation structure Rs. 5,32,333 (18.83%) and other equipments Rs. 59,100 (2 .09 %) in the study area (Table 4).

Table 4:- Pattern of capital investment on different items (Rs. / farm)

Items	Overall average	
	Amount	Per cent
Polyhouse structure	22,35,667	79.08
Irrigation unit	53,2333	18.83
Other equipments	59100	2.09
Total capital Investment	**2827100**	**100.0**

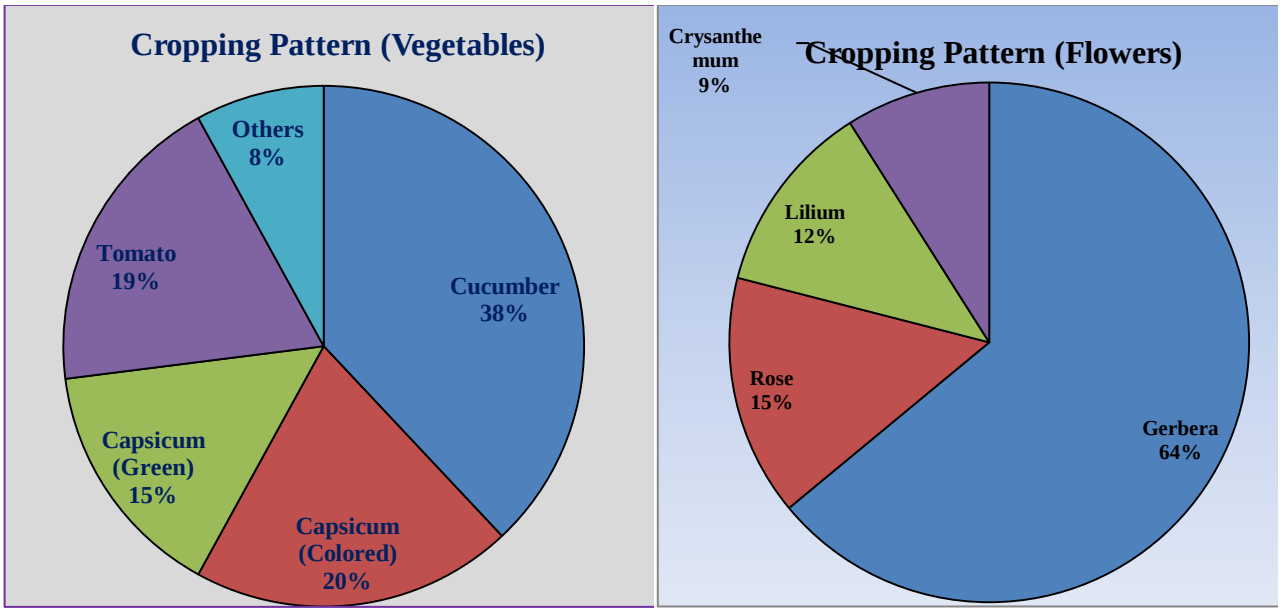
Cropping pattern

Among various vegetables grown under polyhouses in the study area, the Cucumber was found to be the most predominant crop accounting for about 38 per cent of the cropped area, followed by Capsicum colored (20.0 %) and Capsicum green (15.0 %). Next important crop was

Tomato commanding (19.0 %) of the cropped area and rest of area (8.00 %) goes to other crops like peas, brinjal, onion and spinach etc.(Fig. 2)

In case of flower cultivation the area covered on the selected polyhouse farmswere distributedas 64.00, 15.00, 12.00, and 9.00 per cent under Gerbera, Rose, Lilium and Chrysanthemum,respectively. Cropping intensity on the studied polyhouse units was found more than 200 per cent i.e. almost the whole area was cultivated at least twice in a year.(Fig.3)

Figure 2 **Figure 3**



Cropping pattern of vegetables and flowers

Marketing Channels

Five marketing channels have been identified that were prevalent in the study area. These channels were adopted by the farmers to dispose off or to market their polyhouse produce as follows:

Channel-I: Producer → Consumer

Channel-II: Producer → Wholesaler-cum-Commission Agent (CA) → Retailer → Consumer

Channel-III: Producer → Retailer → Consumer

Channel-IV: Producer → Middleman (Broker) → Retailer → Consumer

Channel-V: Producer → Apni Mandi → Consumer

The marketing channels for vegetables as well as flowers are almost same except channel-I (Producer → Consumer) and channel-V(Producer → Apni Mandi → Consumer) which

is not followed in flower marketing due to negligible demand of flowers in local market of the study area. The distribution of growers adopting different marketing channels for sale of their polyhouse produce.(Table5)

Table5: Distribution of producers and proportion of quantity sold through different channels.

Marketing Channel	Overall (per cent)	
	Farmers	Qty sold
Vegetables		
Channel I (Producer → Consumer)	20.00	7.00
Channel II (Producer → Wholesaler-cum-Commission Agent (CA) → Retailer → Consumer)	46.67	70.00
Channel III (Producer → Retailer → Consumer)	13.34	16.54
Channel IV (Producer → Middleman (Broker) → Retailer → Consumer)	13.33	5.00
Channel V (Producer → Apni Mandi → Consumer)	6.66	1.46
Flowers		
Channel – I(Producer → Wholesaler-cum-Commission Agent (CA) → Retailer → Consumer)	86.66	95.00
Channel – II(Producer → Retailer → Consumer)	13.34	5.00

About 46.67 per cent of the growers adopted channel-II i.e. sale through commission agent/wholesaler in the local & distant markets and sold about 70 per cent of the total produce in these markets. About 20 per cent of the producers patronized the direct home sale and sold 7 percent of the total produce (Channel-I). The direct sale to retailers was about 13.34 per cent of the producers who marketed about 16.54 per cent of the produce, while 13.33 per cent producers sold about 5 percent produce through brokersin the distant markets (Channel-III & IV). About 6.66 percentof the producers sold 1.46 percent of the total produce through Apni mandi (Channel-V)especially in Karnal city.This type of direct sale was mostly preferred by small units as their lot size was too small for distant markets or to brokers in distant markets.

Marketing cost and price spread

Marketing cost plays a crucial role in determining marketing efficiency of agricultural commodities. Analysis of price spread is significant from both producers and consumers point of view. An ideal price spread is one where producer gets his due share and at the same time, consumer gets best quality at affordable price. The break-up of price paid by the consumer into different market functionaries and net price received by the producer in sale through different channels has been depicted in Tables 6 to13.

Cucumber

In case of cucumber, the maximum share of producer in consumer's rupee was in Channel-I Rs. 1930/q (93.46%) and Channel-V i.e. Apni Mandi Rs. 2250/q (90.00%). Share of producer in consumer's rupee was lowest Rs. 2026/q i.e. (62.67 %) in the sale of cucumber through Channel-II.Marketing cost born by the producer was highest in channel-V i.e. Rs. 250/qand lowest in Channel-I (Rs. 170/q) whereas the margin of intermediaries was highest in channel-III where the retailer got Rs. 725/q (21.97%) out of price paid by the consumer. In absolute terms, the producer received the highest net sale price in Channel-V (Rs. 2250/q) followed by Channel-III (Rs.2135/q). (Table 6)

Table 6: Price spread of cucumber grown under poly house (Rs. /q)

Particulars	Channel-I	Channel-II	Channel-III	Channel-V
At producer's level				
Net price received by producer	1930 (93.46)	2026 (62.67)	2135 (64.70)	2250 (90.00)
Marketing cost borne by producer	170 (6.54)	214 (6.62)	213 (6.45)	250 (10.00)
Sale price of producer in market	-	2240 (69.29)	2348 (71.15)	
At Commission Agent cum wholesaler's level				
Marketing cost borne by trader	-	43 (1.33)	-	
Margin	-	217 (6.71)	-	
Sale price in the market or purchase price of retailer	-	2500 (77.33)	-	
At retailer's level				
Marketing cost borne by retailers	-	233 (7.21)	227 (6.88)	
Margin	-	500 (15.46)	725 (21.97)	
Sale price of retailer or price paid by consumer	2100 (100.00)	3233 (100.00)	3300 (100.00)	2500 (100.00)

- Figures in parenthesis represents percentage of consumers price

Capsicum (colored)

In case of capsicum (colored), maximum share of producer in consumer's rupee was in direct sale i.e. Channel-I & Channel -V (92.88% & 92.59% respectively) followed by Channel-III i.e. sale to retailer (60.90%). The share of marketing cost borne by producer was fairly high in Channel-IV (16.11%) and low in Channel-III (5.90%). The margin of retailer was highest in

Channel-II (28.87%) followed by Channel-III (27.09%) and Channel-IV (17.55%). In absolute terms, the producer received the highest net price in sale through Channel-V and Channel -I (Rs. 5000/q & Rs. 4365/q respectively) followed by Channel-IV (Rs.3985/q) i.e. Sale in distant market by the producer through broker. (Table 7)

Table 7: Price spread of capsicum (colored) grown under poly house (Rs./q)

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV	Channel-V
At producer's level					
Net price received by producer	4365 (92.88)	3259 (54.31)	3685 (60.90)	3985 (44.28)	5000 (92.59)
Marketing cost borne by the producer	335 (7.12)	361 (6.02)	356 (5.90)	1450 (16.11)	400 (7.41)
Sale price of producer in market	-	3620 (60.33)	4041 (66.80)	5435 (60.39)	-
At Commission Agent cum wholesaler's level					
Marketing cost borne by trader	-	75 (1.25)	-	180 (2.00)	-
Margin	-	189 (3.15)	-	1380 (15.33)	-
Sale price in the market or purchase price of retailer	-	3884 (64.73)	-	6995 (77.72)	-
At retailer's level					
Marketing cost borne by retailers	-	384 (6.40)	370 (6.11)	425 (4.72)	-
Margin	-	1732 (28.87)	1639 (27.09)	1580 (17.55)	-
Sale price of retailer or price paid by consumer	4700 (100.00)	6000 (100.00)	6050 (100.00)	9000 (100.00)	5400 (100.00)

- Figures in parenthesis represents percentage of consumers price

Capsicum (green)

In marketing channel of capsicum (green), the per cent share of producer in consumer's rupee was almost same in both direct channels i.e. Channel-I (92.71%) and Channel-V (92.48%). However, the share of producer in consumer's rupee was lowest (49.77 %) in the sale through Channel-IV (distant markets) involving broker in the supply chain. The share of marketing cost borne by producer was also fairly high in Channel-IV (12.94%) and was found lowest in Channel-III (6.15%). Producer received the highest net price in sale through Channel- V (Rs. 2950/q) followed by Channel IV (Rs.2750/q). The highest price paid by the consumer was in Channel-IV (Rs. 5525/q) followed by Channel-III (Rs. 3800/q). (Table 8)

Table 8: Price spread of capsicum (green) grown under poly house **(Rs./q)**

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV	Channel-V
At producer's level					
Net price received by producer	2656 (92.71)	2322 (53.90)	2300 (61.34)	2750 (49.77)	2950 (92.48)
Marketing cost borne by producer	209 (7.29)	189 (6.42)	175 (6.15)	715 (12.94)	240 (7.52)
Sale price of producer in market	-	2511 (60.32)	2475 (67.49)	3465 (62.71)	
At Commission Agent cum wholesaler's level					
Marketing cost borne by trader	-	62 (1.26)	-	90 (1.63)	
Margin	-	112 (3.15)	-	570 (10.32)	
Sale price in the market or purchase price of retailer	-	2685 (64.73)	-	4125 (74.66)	
At retailer's level					
Marketing cost borne by retailers	-	243 (6.81)	250 (6.51)	400 (7.24)	
Margin	-	850 (28.46)	1075 (26.00)	1000 (18.10)	
Sale price of retailer or price paid by consumer	2865 (100.00)	3778 (100.00)	3800 (100.00)	5525 (100.00)	3190 (100.00)

- Figures in parenthesis represents percentage of consumers price

Tomato

Inmarketing tomato, the per cent share of producer in consumer's rupee was highest in Channel-I (92.50%) and Channel-V (90.41%) when producer himself acted as retailer in the sale of produce directly to consumers. However, the share of producer in consumer's rupee was lowest (53.04 %) in the sale of tomato by farmer itself through Channel-IV (distant markets) involving broker in the supply chain. The share of marketing cost borne by producer was fairly high in Channel-IV (15.61%) and lowest in Channel-III (6.13%). The margin of retailer was highest in Channel-III (27.55%) followed by Channel-II (26.58%). In absolute terms, the producer received the highest net price in sale through Channel-V (Rs. 2667/q) followed by Channel-I (Rs.2380/q). On the contrary, price paid by the consumer was just opposite and direct sale to consumer or sale direct to retailer proved more beneficial to both producers and consumers. (Table 9)

Table 9: Price spread of tomato grown under poly house (Rs./q)

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV	Channel-V
At producer's level					
Net price received by producer	2380 (92.50)	1626 (55.06)	1880 (60.65)	1876 (53.04)	2667 (90.41)
Marketing cost borne by producer	193 (7.50)	194 (6.57)	190 (6.13)	552 (15.61)	283 (9.59)
Sale price of producer in market	-	1820 (61.63)	2070 (66.78)	2428 (68.65)	-
At Commission Agent cum wholesaler's level					
Marketing cost borne by trader	-	38 (1.29)	-	180 (5.09)	-
Margin	-	99 (3.35)	-	295 (8.34)	-
Sale price in the market or purchase price of retailer	-	1957 (66.27)	-	2903 (82.08)	-
At retailer's level					
Marketing cost borne by retailers	-	211 (7.15)	176 (5.67)	230 (6.50)	-
Margin	-	785 (26.58)	854 (27.55)	404 (11.42)	-
Sale price of retailer or price paid by consumer	2573 (100.00)	2953 (100.00)	3100 (100.00)	3537 (100.00)	2950 (100.00)

- Figures in parenthesis represents percentage of consumers price

Gerbera

In marketing of Gerbera flower maximum share of producer in consumer's rupee was in Channel-II (72.40%) sold through retailer, followed by Channel-I i.e. sale through Commission agent cum wholesaler to retailer to consumer (58.91%). The share of marketing cost borne by producer was fairly high in Channel-I (10.60%) as compared to channel-II (8.60%) of the total marketing cost incurred in sale of produce. In absolute terms, the producer received the highest net price when the produce is sold through Channel -I (Rs. 4/stick) followed by Channel-II (Rs.3.62/stick). As far as consumer perspective is concern, the channel-II was found most efficient for them in the study area, where they spent less money (Rs. 5/stick) as compared to channel-I, i.e. (Rs. 6.79/stick). (Table 10)

Table 10: Price spread of Gerbera grown under poly house (Rs. /Stick)

Particulars	Channel - I	Channel -II
At producer's level		
Net price received by producer	4.00 (58.91)	3.62 (72.40)
Marketing cost borne by producer	0.72 (10.60)	0.43 (8.60)

Sale price of producer in market	4.72 (69.51)	4.05 (81.00)
At Commission Agent cum wholesaler's level		
Marketing cost borne by trader	0.25 (3.68)	-
Margin	0.45 (6.63)	-
Sale price in the market or purchase price of retailer	5.42 (79.82)	-
At retailer 's level		
Marketing cost borne by retailers	0.37 (5.45)	0.25 (5.00)
Margin	1.00 (14.72)	0.70 (14.00)
Sale price of retailer or price paid by consumer	6.79 (100.00)	5.00 (100.00)

- Figures in parenthesis represents percentage of consumers price

Rose

In case of rose, the maximum share of producer in consumer's rupee was in Channel-II (60%) where farmer sold his produce through retailer, followed by Channel-I i.e. sale through CA cum wholesaler to retailer to consumer (50%). The share of marketing cost borne by producer was fairly high in Channel-I (16.66%) as compared to channel-II (13.11%) of the total marketing cost incurred in sale of produce. In absolute terms, the producer received the highest net price when the produce is sold through Channel -I (Rs. 3.00/stick) followed by Channel-II (Rs. 2.70/stick). As far as consumer perspective is concern, the channel-II was found most efficient for them in the study area, where they spent less money (Rs.4.50/stick) as compared to channel-I, i.e. Rs. 6.00/stick (Table 11).

Table 11: Price spread of Rose grown under poly house **(Rs. /Stick)**

Particulars	**Channel - I**	**Channel –II**
At producer's level		
Net price received by producer	3.00 (50.00)	2.70 (60.00)
Marketing cost borne by producer	1.00 (16.66)	0.60 (13.33)
Sale price of producer in market	4.00 (66.66)	3.30 (73.33)
At Commission Agent cum wholesaler's level		
Marketing cost borne by trader	0.50 (8.33)	-
Margin	0.40 (6.66)	-
Sale price in the market or purchase price of retailer	4.90 (81.66)	-
At retailer's level		
Marketing cost borne by retailers	0.35 (5.83)	0.40 (8.89)
Margin	0.75 (12.50)	0.80 (17.78)
Sale price of retailer or price paid by consumer	6.00 (100.00)	4.50 (100.00)

- Figures in parenthesis represents percentage of consumers price

Lilium

In case of Lilium, maximum share of producer in consumer's rupee was in Channel-II (76.73%) sold through retailer, followed by Channel-I i.e. sale through CA cum wholesaler to retailer to consumer (66.23%). The share of marketing cost borne by producer was fairly high in Channel-I (9.83%) as compare to channel-II (7.11%) of the total marketing cost incurred in sale of produce. In absolute terms, the producer received the highest net price when the produce is sold through Channel-I (Rs. 21.77/spike) followed by Channel-II (Rs.19.95/spike). As far as consumer perspective is concern, the channel-II was found most efficient for them in the study area, where they spent less money (Rs. 26.00/spike) as compared to channel-I, i.e. (Rs. 32.87/spike) (Table 12).

Table 12: Price spread of Lilium grown under poly house (Rs./Spike)

Particulars	Channel-I	Channel –II
At producer's level		
Net price received by producer	21.77 (66.23)	19.95 (76.73)
Marketing cost borne by producer	3.23 (9.83)	1.85 (7.11)
Sale price of producer in market	25.00 (76.06)	21.80 (83.84)
At Commission Agent cum wholesaler's level		
Marketing cost borne by trader	0.70 (2.13)	-
Margin	1.75 (5.32)	-
Sale price in the market or purchase price of retailer	27.45 (83.51)	-
At retailer's level		
Marketing cost borne by retailers	1.65 (5.02)	1.30 (5.00)
Margin	3.77 (11.47)	2.90 (11.15)
Sale price of retailer or price paid by consumer	32.87 (100.00)	26.00 (100.00)

- Figures in parenthesis represents percentage of consumers price

Chrysanthemum

In case of Chrysanthemum, maximum share of producer in consumer's rupee was in Channel-II (71.43%) sold through retailer, followed by Channel-I (58.22%), sold through CA cum wholesaler to retailer to consumer. The share of marketing cost borne by producer was fairly high in Channel-I (10.82%) as compare to channel-II (8.92%) of the total marketing cost incurred in sale of produce. In absolute terms, the producer received the highest price when the produce is sold through Channel-I (Rs. 4.25/bunch) followed by Channel-II (Rs.4.00/bunch). As far as consumer perspective is concern, the channel-II was found most efficient for them in the

study area, where they spent less money (Rs. 5.60/bunch) as compared to channel-I, i.e. (Rs. 7.30/bunch). (Tabel 13)

Table 13: Price spread of Chrysanthemum grown under poly house (Rs./Bunch)

Particulars	Channel - I	Channel –II
At producer's level		
Net price received by producer	4.25 (58.22)	4.00 (71.43)
Marketing cost borne by producer	0.79 (10.82)	0.50 (8.92)
Sale price of producer in market	5.04 (69.04)	4.50 (80.35)
At Commission Agent cum wholesaler's level		
Marketing cost borne by trader	0.30 (4.11)	-
Margin	0.50 (6.85)	-
Sale price in the market or purchase price of retailer	5.84 (80.00)	-
At retailer's level		
Marketing cost borne by retailers	0.41 (5.62)	030 (5.35)
Margin	1.05 (14.38)	0.80 (14.30)
Sale price of retailer or price paid by consumer	7.30 (100.00)	5.60 (100.00)

- Figures in parenthesis represents percentage of consumers price

Marketing efficiency of vegetable marketing channels

In case of cucumber, marketing efficiency was observed highest 12.35 in Channel-I, followed by Channel-V i.e. 10.00, whereas least marketing efficiency was found 6.60 in Channel-II. In case of capsicum colored, the marketing efficiency was observed higher in the sale through Channel-I(14.03) and Channel-V(13.50) and least marketing efficiency was found in channel –IV(4.38) which may be due higher transportation cost and brokerage. In capsicum green, the polyhouse producers achieved highest efficiency in sale through Channel-I(13.71) and Channel-V(13.29). In case of tomato, marketing efficiency index came out to be as high as 13.33 in Channel-I and 10.42 in Channel-V (*Apni Mandi*). Least marketing efficiency was achieved in Channel-IV i.e. 3.68 (sale in distant market) which may be due to high cost of the transportation. (Table 14)

Table 14:- Marketing efficiency of polyhouse vegetables sold through different channels

Particulars	Channel-I	Channel-II	Channel-III	Channel-IV	Channel-V
Cucumber	12.35	6.60	7.33	-	10.00
Capsicum (colored)	14.03	7.32	8.33	4.38	13.50
Capsicum (green)	13.71	7.65	8.94	4.59	13.29
Tomato	13.33	6.67	8.47	3.68	10.42

Marketing efficiency of flower marketing channels

In case of flowers, the marketing efficiency was observed highest in Channel-IIi.e. 7.35, 4.50, 7.00 and 8.25 for Gerbera, Rose,Lilium and Chrysanthemum, respectively, in which the producers directly sale the produce to retailers by eliminating the middlemen in marketing chain i.e. wholesaler cum CA. however farmers are forcibly adopting channel –I for marketing of huge quantity of the produce which can only be consumed at the national as well as distant markets like Delhi, Chandigarh and Bangalore etc. (Table 15)

Table 15:- Marketing efficiency of polyhouse flowers sold through different channels

Particulars	**Channel-I**	**Channel-II**
Gerbera	**5.07**	**7.35**
Rose	**3.24**	**4.50**
Lilium	**5.89**	**7.00**
Chrysanthemum	**4.86**	**8.25**

Overview of the price spread in different marketing channels

In case of cucumber, the price varied from Rs. 2026/q in Channel-II to Rs. 2135/q in Channel-III (sale through commission agent) and Rs. 1930/q to Rs. 2250/q in direct sale. The producers obtained maximum absolute price worth Rs.5000 by selling the Capsicum colored through Channel-V (Apni Mandi) followed by Rs. 4365/q in Channel-I (direct sale). Same pattern was observed in the sale of capsicum green. Producers obtained maximum absolute price worth Rs. 2667/q by selling tomato through Channel-V (*Apni Mandi*) followed by Rs. 2380/q in Channel-I (direct sale). This was mainly due to low cost of marketing and absence of middlemen in these channels. (Table 16)

Table 16:- Price spread of vegetables in different marketing channels (Rs./q)

Particulars	**Channel-I**	**Channel-II**	**Channel-III**	**Channel-IV**	**Channel-V**
Cucumber					
Producer's share	1930	2026	2135	-	2250
Marketing cost	170	490	450	-	250
Marketing margin	-	717	715	-	-
Consumer's price	2100	3233	3300	-	2500
Capsicum (colored)					
Producer's share	4365	3259	3685	3985	5000
Marketing cost	335	820	726	2055	400
Marketing margin	-	1921	1639	2960	-

Consumer's price	4700	6000	6050	9000	5400
Capsicum (green)					
Producer's share	2656	2322	2300	2750	2950
Marketing cost	209	494	425	1205	240
Marketing margin	-	962	1075	1570	-
Consumer's price	2865	3778	3800	5525	3190
Tomato					
Producer's share	2380	1626	1880	1876	2667
Marketing cost	193	443	366	962	283
Marketing margin	-	884	854	699	-
Consumer's price	2573	2953	3100	3537	2950

In marketing of flowers, producers obtained maximum absolute price worth Rs. 4.00 per unit of flower by selling gerbera through Channel-I(Through CA cum wholesaler), followed by Rs. 3.62 per unit of flower in Channel-II (Through retailer). Same pattern was observed in case of Rose, Lilium and Chrysanthemumi.e.Rs.3.00/unit and 2.70/unit, Rs.21.77/unit and 19.95/unit, Rs. 4.25/unit and 4.00/unit,. in channel –I and channel -II respectively . It was mainly due to higher demand/consumption of flowers in national as well as distant markets (Table 17).

Table 17:- Price spread of flowers in different marketing channels (Rs./unit)

Particulars	**Channel-I**	**Channel-II**
Gerbera		
Producer's share	4.00	3.62
Marketing cost	1.34	0.68
Marketing margin	1.45	0.70
Consumer's price	6.79	5.00
Chrysanthemum		
Producer's share	4.25	4.00
Marketing cost	1.50	0.80
Marketing margin	1.55	0.80
Consumer's price	7.30	5.60
Lilium		
Producer's share	21.77	19.95
Marketing cost	5.58	3.15
Marketing margin	5.52	2.90
Consumer's price	32.87	26.00
Rose		
Producer's share	3.00	2.70
Marketing cost	1.85	1.00
Marketing margin	1.15	0.80
Consumer's price	6.00	4.50

Cost and Returns

In case of vegetable cultivation under polyhouse, maximumnet profit was obtained from cucumber (Rs. 31.78 lakh/ha), followed by capsicum green (Rs. 18.27 lakh/ha) as well as capsicum colored (Rs. 16.16 lakh/ha) and tomato (Rs. 9.79 lakh/ha). As far as benefit - cost ratio is concern, cucumber cultivation in polyhouse was observed more profitable thancapsicum and tomato cultivation. (Table 18).

Table 18: - Economics of vegetables cultivation under polyhouse (Rs. in lakh /ha)

Particulars	Cucumber	Capsicum		Tomato
		Colored	Green	
Variable cost	15.36	16.17	14.91	14.92
Total cost	29.08	27.79	26.39	27.05
Gross returns	60.86	43.95	44.66	36.84
Net Returns over variable cost	45.50	27.78	29.75	21.92
Net Returns over total cost	31.78	16.16	18.27	9.79
B: C Ratio	2.09	1.58	1.69	1.36

In case of flower cultivation under polyhouse, maximum net profit was obtained from Gerbera (Rs. 28.39 lakh/ha), followed by Rose (Rs. 18.89 lakh/ha), Lilium (Rs. 4.92 lakh/ha) and Chrysanthemum (Rs. 1.93 lakh/ha) respectively. From as benefit - cost ratio point of view, Gerbera cultivation was found more profitable thanRose, Lilium and Chrysanthemum cultivation.(Table 19)

Table 19: - Economics of flowers cultivation under polyhouse (Rs. in lakh /ha)

Particulars	Gerbera	Rose	Lilium	Chrysanthemum
Variable cost	23.53	18.29	38.24	17.09
Total cost	35.87	29.28	54.35	27.71
Gross returns	64.27	48.17	59.28	29.64
Net returns over variable cost	40.74	29.87	21.04	12.55
Net returns over total cost	28.39	18.89	4.92	1.93
B: C Ratio	1.79	1.65	1.09	1.07

Problems and Constraints

The sampled poly house growers faced various problems in production as well as marketing of poly house products.Most of respondent farmers expressed lack of polyhouse/ crop insurance schemes to mitigate the risk arising due to damage of crop/structure (84.00 %),followed by attack of insect and pest as well as nematodes (80.00%), supply of inferior

polyhouse materials/lack of advice from service providers(80.00%),high cost of improved quality seed/seedling material(66.66%),Inadequate power supply and higher charges andscarcity of skilled labor (53.33%),lack of proper guidance from extension agencies (50.67%) as the major problems. Beside theseslack of market information on price and demand in different markets (80.67%), non-remunerative prices of produce (76.00%), time consuming marketing process in distant markets (64.00%), lack of market competition among market functionaries (50.67%) high cost of marketing due to perishable nature of products (48.67%). The vegetable growers also reported malpractices adopted by market intermediaries (47.34%) and Lack of properknowledge about standards for grading (42.67%) in the study area.(Table 20)

Table 20: Problems/constraints faced by growers in protected cultivation

(N=15)

Particulars	**Overall (Per cent)**
Production problems	
Lack of polyhouse/crop insurance scheme	84.00
Problems of Nematodes	80.00
Supply of inferior polyhouse materials/Lack of advice from service providers	80.00
High cost of improved quality seed/seedling material	66.66
Scarcity of skilled labour	53.33
Inadequate power supply and higher charges	53.33
Lack of proper guidance from extension agencies	50.67
Lack of adequate and timely supply of inputs	38.00
Non availability required credit for operational expenses	34.00
Marketing problems	
Lack of market information on price and demand in different markets	80.67
Non-remunerative prices of produce	76.00
Time consuming marketing process in distant markets	64.00
Lack of market competition among market functionaries	50.67
High cost of marketing due to perishable nature of products	48.67
Malpractices adopted by market intermediaries	47.34
Delayin payment by traders	46.00
High transportation cost and limited availability of cold chain	44.67

Lack of knowledge about proper packaging and grading techniques	42.67

Conclusions

- It can be concluded that protected cultivation is still in its initials phase and, thus, requires more support to realize full potential by development of efficient market infrastructure, providing liberal financial support at low interest rate.
- Poly house enterprisesshould be treated as agricultural rather than commercial entity.
- There is lot of information gap about standard management practices and cropping system. The extension facilitation and advisory system should be strengthened.
- Strengthening of input supply system for efficient and economical polyhouse cultivation.
- There is a need to provide the appropriate supply chain that ensures remunerative price to the producers.
- Creation of cooperatives by farmers to make best use of poly house jointly not only in production but also in marketing of produce.

Sub-project II: "Pattern and extent of crop diversification in Haryana".

i. Objectives:

1. To study cropping pattern of the state.
2. To examine the extent of crop diversification in different zones of Haryana.
3. To analyze factors affecting crop diversification.

ii. Year of Start **:** 2013-14

iii. Period of study **:** 2013-2016

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
J.C. Karwasra	Planning, data collection, compilation, analysis of data and report writing.
V.K. Singh	Data collection, compilation, analysis of data and report writing.
Jitender Bhatia	Data collection, compilation and analysis of data
Dalip Kumar Bishnoi	Data collection, compilation and analysis of data

v. Work done during 2014-15: District-wise time series data on various aspects were collected and tabulated for analysis.

D. Programme of work for Current Year 2015-16

Sub-Project I:"Economic Analysis of Existing and Alternative Cropping Pattern in different zones in Haryana".

i. Objectives:

1. To examinethe existing cropping patternof selected farmers
2. To analyse the economics of existing cropping patterns.
3. To suggest the alternative cropping patterns.

ii. Year of Start **:** 2015-16

iii. Period of study **:** 2015-18

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
J.C. Karwasra	Planning& Monitoring
V.K. Singh	Selection of sample, compilation and report writing.
JitenderBhatia	Preparation of schedule, data collection, analysis of data
Dalip Kumar Bishnoi	Data collection, compilation, analysis of dataand report writing.

v. Method of Study:

The study will be splitted in different agro-climatic zones during 3 consecutive years i.e. 2015 to 2018. During the year 2015-16, the study will be conducted into semi-arid zone. One district (i.e. Hisar) will be selected to cover all the crops grown in the study area.Further one block fromselected district will be covered randomly and from selected block, two villages with a sample of total sixty farmers of different categories will be interviewed. Data on farm inventory, cropping pattern, input use, labor use, productivity, returns from different crops and problems as well as constraints faced by selected farmers will be collected by survey method. Tabular Analysis and other suitable statistical techniques will be applied to analyse the data.

Sub-project II: "Pattern and extent of crop diversification in Haryana".

i. Objectives:

1. To study cropping pattern of the state.
2. To examine the extent of crop diversification in different zones of Haryana.
3. To analyze factors affecting crop diversification.

ii. Year of Start **:** 2013-14

iii. Period of study **:** 2013-2016

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
J.C. Karwasra	Planning, Execution and report writing.
V.K. Singh	Analysis of data and report writing.
Jitender Kumar Bhatia	Collection and compilation of Data,
Dalip Kumar Bishnoi	Data collection, compilation and analysis of data

v. Programme of work (2015-16): To fulfill the requirement of the study additional data like horticultural and vegetable crops, prices, cost and returns etc. will be collected over time and space for further analysis, drawing meaningful conclusion and report writing

Sub Project-III: "Participation of Farm Women in Vegetable Cultivation in Hisar District of Haryana".

i. Objectives:

1. To study the extent of women's participation in various activities related to vegetable cultivation
2. To analyse relationship between different socio-economic factors of farm women and their extent of participation in activities of vegetable cultivation
3. To identify the constraints perceived by the farm women in vegetable cultivation

ii. Year of Start **:** 2014-15

iii. Period of study **:** 2014-15

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Deep Punia	Preparation of Schedule, analysis of data and report writing
J. C. Karwasra	Monitoring and Execution
Jitender Kumar Bhatia	Collection, compilation and analysis of data
Dalip Kumar Bishnoi	Collection, compilation and analysis of data

v. Methodology:

The present study was conducted in four villages namely Hajampur, Dhana Khurd, Juglan & Dhiktana from Hansi-I & Barwala blocks respectively of Hisar district of Haryana. From each village, 20 farm working women from small, medium & large categories were randomly selected making a total sample of 80. The primary data pertaining to farm women's participation in the activities related to cultivation of major vegetable crops in kharif, rabi and spring seasons for the last year were collected with the help of well structured pre-tested

interview-schedules from selected households in which both husband & wife were involved in vegetable cultivation. The extent of rural women's participation in activities of vegetable cultivation was measured by using a three point continuum namely regular, mostly, occasional. All the activities were listed under the heads to know (1) in which of these activities the respondents were participating in seasons (2) how many days in the last season they devoted to that particular activity and (3) how many hours in a day they devoted to that particular activity in last season. From this information total hours in the seasons for each activity and contribution of females in hours per family in the seasons were calculated. The Chi-square test was applied to test the association between the variables.

Results achieved during 2014-15

Vegetable Cultivation Pattern:

In the study area, majority of the total respondents/households were cultivating various kinds of vegetables in the kharif season (72.50%) and among these, marginal & small farmers constituted majority. Whereas more than one-third of them (38.75%) cultivated vegetables in rabi season. During the spring season, less than half the respondents/households (42.50%) were cultivating vegetables. Average area under vegetable cultivation was 1.74 acres per family.

Women's Participation in Vegetable Cultivation in Kharif:

Extent of women's participation was higher in weeding (153 scores) followed by picking/harvesting (146 scores), hoeing (139 scores), loading/unloading (126 scores), cleaning of fields (120 scores), packaging (119 scores), grading (110 scores) and labour-management (107 scores). Maximum time was devoted by the respondents in weeding (27.60 hours) followed by picking/harvesting (22.86 hours), hoeing (17.72 hours), grading (11.26 hours), labour-management (11.14 hours), packaging (11.02 hours), loading/unloading (8.41 hours) and cleaning of fields (4.52 hours). It shows clearly the high level of participation of farm women in performing above-mentioned activities of manual nature, in which their labour force was more required.

Table 21: Extent of women's participation in various activities related to vegetable cultivation in kharif season

Activities in Kharif	Women's Participation N=58 (72.50%)		Extent of Women's Participation			Scores	Rank	Av. Time Spent(hours/ per head/ season)
	Yes	No	Regular	Mostly	Occasional			
Weeding	**52 (89.66)**	**6 (10.34)**	**50 (96.16)**	**1 (1.92)**	**1 (1.92)**	**153**	**1**	**27.60**

Picking/ Harvesting	**50 (86.21)**	**8 (13.79)**	**46 (92.00)**	**4 (8.00)**	**-**	**146**	**2**	**22.86**
Hoeing	**51 (87.93)**	**7 (12.07)**	**41 (80.39)**	**6 (11.76)**	**4 (7.85)**	**139**	**3**	**17.72**
Loading/ unloading	**47 (81.03)**	**11 (18.97)**	**37 (78.72)**	**5 (10.64)**	**5 (10.64)**	**126**	**4**	**8.41**
Cleaning of fields	**52 (89.66)**	**6 (10.34)**	**28 (53.86)**	**12 (23.07)**	**12 (23.07)**	**120**	**5**	**4.52**
Packaging	**42 (72.41)**	**16 (27.59)**	**38 (90.48)**	**1 (2.38)**	**3 (7.14)**	**119**	**6**	**11.02**
Grading	**40 (68.96)**	**18 (31.04)**	**33 (82.50)**	**4 (10.00)**	**3 (7.50)**	**110**	**7**	**11.26**
Labour-Management	**40 (68.96)**	**18 (31.04)**	**31 (77.50)**	**7 (17.50)**	**-**	**107**	**8**	**11.14**
Cleaning of vegetables	**33 (56.90)**	**25 (43.10)**	**32 (96.97)**	**-**	**1 (3.03)**	**97**	**9**	**5.24**
Transplanting	**35 (60.34)**	**23 (39.66)**	**29 (82.86)**	**4 (11.43)**	**2 (5.71)**	**97**	**9**	**10.34**
Shifting at distance	**38 (65.52)**	**20 (34.48)**	**25 (65.79)**	**8 (21.05)**	**5 (13.16)**	**96**	**10**	**8.43**
On-farm sale of produce	**39 (67.24)**	**19 (32.76)**	**17 (43.59)**	**18 (46.15)**	**4 (10.26)**	**91**	**11**	**7.62**
Sowing of seeds	**52 (89.66)**	**6 (10.34)**	**16 (30.77)**	**1 (1.92)**	**35 (67.31)**	**85**	**12**	**4.77**
Thinning-gap filling	**31 (53.45)**	**27 (46.55)**	**24 (77.42)**	**4 (12.90)**	**3 (9.68)**	**83**	**13**	**3.72**
Staking	**34 (58.62)**	**24 (41.38)**	**20 (58.82)**	**2 (5.88)**	**12 (35.30)**	**76**	**14**	**3.98**
Seed treatment for sowing	**51 (87.93)**	**7 (12.07)**	**11 (21.57)**	**2 (3.92)**	**38 (74.51)**	**75**	**15**	**2.62**
Shading Arrangement	**20 (34.48)**	**38 (65.52)**	**9 (45.00)**	**9 (45.00)**	**2 (10.00)**	**47**	**16**	**5.43**
Raising &mgt. of Nursery	**15 (25.86)**	**43 (74.14)**	**7 (46.67)**	**1 (6.66)**	**7 (46.67)**	**30**	**17**	**2.00**
Plant Protection	**15 (25.86)**	**43 (74.14)**	**2 (13.33)**	**2 (13.33)**	**11 (73.34)**	**21**	**18**	**2.07**
Drying of vegetables	**6 (10.34)**	**52 (89.66)**	**4 (66.67)**	**2 (33.33)**	**-**	**16**	**19**	**1.45**
Storage of vegetables	**6 (10.34)**	**52 (89.66)**	**3 (50.00)**	**1 (16.67)**	**2 (33.33)**	**13**	**20**	**0.41**
Farm -record maintenance	**3 (5.17)**	**55 (94.83)**	**1 (33.33)**	**2 (66.67)**	**-**	**7**	**21**	**1.35**
Transportation	**2 (3.45)**	**56 (96.55)**	**-**	**-**	**2 (100.00)**	**2**	**22**	**1.25**

Note: Figure in parenthesis indicates percentage to total

Whereas extent of women's participation was medium in cleaning of vegetables & transplanting (97 scores each) followed by shifting at distance (96 scores), on-farm sale of produce (91 scores), sowing of seeds (85 scores), thinning & gap filling (83 scores), staking (76

scores) and seed treatment for sowing (75 scores). Maximum time was spent by them in transplanting (10.34 hours) followed by shifting at distance (8.43 hours), on-farm sale of produce (7.62 hours), cleaning of vegetables (5.24 hour), sowing of seeds (4.77 hours), staking (3.98 hours), thinning-gap filling (3.72 hours) and seed treatment for sowing (2.62 hours).

Extent of participation of the respondents was low and they were devoting time in shading arrangement (47 scores and 5.43 hours) followed by raising & management of nursery (30 scores and 2.00 hours), plant protection (21 scores and 2.07 hours), drying of vegetables (16 scores and 1.45 hours), storage of vegetables (13 scores and 0.41 hours), farm record maintenance (7 scores and 1.35 hours) and transportation (2 scores and 1.25 hours). Data given in Table 21reveal clearly low level of participation of the respondents in performing above mentioned activities regarding vegetable cultivation.

Conclusions: It is inferred thatduring the kharif seasontheextent of women's participation was higher in weeding (153 scores) followed by picking/harvesting (146 scores), hoeing (139 scores), loading/unloading (126 scores), cleaning of fields (120 scores), packaging (119 scores), grading (110 scores) and labour-management (107 scores). It shows clearly the high level of participation of farm women in performing above-mentioned activities of manual nature, in which their labour force was more required. Maximum time was devoted by the respondents in labor intensive activities related to vegetable cultivation i.e. weeding (27.60 hours) followed by picking/harvesting (22.86 hours), hoeing (17.72 hours), grading (11.26 hours), labour-management (11.14 hours), packaging (11.02 hours), transplanting (10.34 hours), shifting at distance (8.43 hours), loading/unloading (8.41 hours) and on-farm sale of produce (7.62 hours).

Women's Participation in Vegetable Cultivation in Rabi:

As regards extent of participation of the respondents in various activities of vegetable cultivation, it was found that majority of the farm women were participating in weeding (74 scores) followed by picking/harvesting (72 scores), loading/unloading (69 scores), thinning-gap filling (60 scores), grading & packaging (59 scores each), cleaning of vegetables & shifting at distance (57 scores each) and hoeing (56 scores). They were devoting maximum time in weeding (33.55 hours) followed by hoeing (32.52 hours), picking/harvesting (22.84 hours), packaging (5.23 hours), thinning-gap filling (5.13 hours), cleaning of vegetables(4.97 hours), grading(4.87 hours), loading/unloading (4.61 hours) and shifting at distance (3.58 hours). It was observed

that maximum time was devoted by farm women in weeding (33.55 hours), hoeing (32.52 hours) and picking/harvesting (22.84 hours).Table 22 reveals the high level of participation of farm women in performing above-mentioned activities, in which their labour force was required.

Whereas extent of women's participation was medium in plant protection (48 scores) followed by cleaning of fields (45 scores), transplanting (33 scores), sowing of seeds and on farm sale of produce (30 scores each). Maximum time was spent by the respondents in plant protection (12.22 hours) followed by transplanting (5.87 hours), on-farm sale of produce (4.29 hours), cleaning of fields (3.55 hours) and sowing of seeds (3.45 hours).

Analysis of data given in Table 22 reveals the low level of women's participation in seed treatment for sowing (24 scores and 2.13 hours) followed by raising & management of nursery (18 scores and 0.90 hours), storage of vegetables (16 scores and 1.16 hours), labour-management (15 scores and 2.65 hours), staking (14 scores and 1.93 hours), drying of vegetables (6 scores and 0.90 hours) and shading arrangement (5 scores and 1.45 hours). These respondents were having least participation at all and least time was devoted by them in above mentioned activities of vegetable cultivation.

Table 22: Extent of women's participation in various activities related to vegetable cultivation in Rabi season

Activities in Rabi	Women's Participation N=31 (38.75%)		Extent of Women's Participation			Scores	Rank	Average Time Spent(hours /per head/ season)
	Yes	No	Regular	Mostly	Occasional			
Weeding	27 (87.09)	4 (12.91)	20 (74.07)	7 (25.93)	-	74	1	33.55
Picking/ Harvesting	25 (80.65)	6 (19.35)	22 (88.00)	3 (12.00)	-	72	2	22.84
Loading/ unloading	24 (77.42)	7 (22.58)	21 (87.50)	3 (12.50)	-	69	3	4.61
Thinning-gap filling	22 (70.97)	9 (29.03)	18 (81.82)	2 (9.09)	2 (9.09)	60	4	5.13
Grading	21 (67.74)	10 (32.26)	17 (80.95)	4 (19.05)	-	59	5	4.87
Packaging	20 (64.52)	11 (35.48)	19 (95.00)	1 (5.00)	-	59	5	5.23
Cleaning of vegetables	20 (64.52)	11 (35.48)	17 (85.00)	3 (15.00)	-	57	6	4.97
Shifting at distance	20 (64.52)	11 (35.48)	18 (90.00)	1 (5.00)	1 (5.00)	57	6	3.58
Hoeing	21 (67.74)	10 (32.26)	14 (66.67)	7 (33.33)	-	56	7	32.52

Plant Protection	**20 (64.52)**	**11 (35.48)**	**10 (50.00)**	**8 (40.00)**	**2 (10.00)**	**48**	**8**	**12.22**
Cleaning of fields	**18 (58.06)**	**13 (41.94)**	**12 (66.68)**	**3 (16.66)**	**3 (16.66)**	**45**	**9**	**3.55**
Transplanting	**11 (35.48)**	**20 (64.52)**	**11 (100.00)**	**-**	**-**	**33**	**10**	**5.87**
Sowing of seeds	**20 (64.52)**	**11 (35.48)**	**5 (25.00)**	**-**	**15 (75.00)**	**30**	**11**	**3.45**
On-farm sale of produce	**12 (38.71)**	**19 (61.29)**	**8 (66.67)**	**3 (33.33)**	**-**	**30**	**11**	**4.29**
Seed Treatment for sowing	**14 (45.16)**	**17 (54.84)**	**5 (35.71)**	**-**	**9 (64.29)**	**24**	**12**	**2.13**
Raising & Mgt. of Nursery	**8 (25.80)**	**23 (74.20)**	**5 (62.50)**	**-**	**3 (37.50)**	**18**	**13**	**0.90**
Storage of vegetables	**2 (19.35)**	**25 (80.65)**	**4 (66.67)**	**2 (33.33)**	**-**	**16**	**14**	**1.16**
Labour-Management	**7 (22.58)**	**24 (77.42)**	**4 (57.14)**	**-**	**3 (42.86)**	**15**	**15**	**2.65**
Staking	**6 (19.35)**	**25 (80.65)**	**3 (50.00)**	**2 (33.33)**	**1 (16.67)**	**14**	**16**	**1.93**
Drying of vegetables	**2 (6.45)**	**29 (93.55)**	**2 (100.00)**	**-**	**-**	**6**	**17**	**0.90**
Shading Arrangement	**3 (9.68)**	**28 (90.32)**	**1 (33.33)**	**-**	**2 (66.67)**	**5**	**18**	**1.45**

Note: Figure in parenthesis indicates percentage to total

Conclusions: It may be concluded that an overwhelming majority of the farm women were participating in weeding (74 scores) followed by picking/harvesting (72 scores), loading/unloading (69 scores), thinning-gap filling (60 scores), grading & packaging (59 scores each), cleaning of vegetables & shifting at distance (57 scores each) and hoeing (56 scores). It clearly reveals the high level of participation of farm women in performing above-mentioned activities of manual nature, in which their labour force was more required. Maximum time was devoted by them in weeding (33.55 hours), hoeing (32.52 hours), picking/harvesting (22.84 hours), plant protection (12.22 hours) and transplanting (5.87 hours).

Women's Participation in Vegetable Cultivation in spring:

Extent of women's participation was higher in weeding (70 scores) followed by picking/harvesting (65 scores), packaging & transplanting (60 scores each), hoeing (57 scores), plant protection (56 scores), cleaning of vegetables (55 scores), grading (54 scores), thinning-gap filling (52 scores), cleaning of fields & loading/unloading (50 scores each) and staking (49 scores). Maximum time was devoted by the respondents in picking/harvesting (21.83 hours) followed by transplanting (14

hours), hoeing (13.85 hours), weeding (13.83 hours), plant protection (5.59 hours), staking (5.53 hours), grading (4.59 hours), packaging (3.94 hours), cleaning of vegetables (3.88 hours), thinning-gap filling (3.29 hours), loading/unloading (2.88 hours) and cleaning of fields (2.06 hours). It shows the high level of women's participation in performing above-mentioned activities. It may be concluded that maximum time was spent by them in picking/harvesting (21.83 hours) followed by transplanting (14 hours), hoeing (13.85 hours) and weeding (13.83 hours).

Table 23: Extent of women's participation in various activities related to vegetable cultivation in spring season

Activities in Spring	Women's Participation N=34 (42.50%)		Extent of Women's Participation			Scores	Rank	Average Time Spent(hours/per head/ season)
	Yes	No	Regular	Mostly	Occasional			
Weeding	25 (73.53)	9 (26.47)	21 (84.00)	3 (12.00)	1 (4.00)	70	1	13.83
Picking/ Harvesting	22 (64.70)	12 (35.30)	21 (95.45)	1 (4.55)	-	65	2	21.83
Packaging	21 (61.76)	13 (38.24)	18 (85.71)	3 (14.29)	-	60	3	3.94
Transplanting	21 (61.76)	13 (38.24)	19 (90.48)	1 (4.76)	1 (4.76)	60	3	14.00
Hoeing	21 (61.76)	13 (38.24)	15 (71.43)	6 (28.57)	-	57	4	13.85
Plant protection	21 (61.76)	13 (38.24)	16 (76.19)	3 (8.82)	2 (5.89)	56	5	5.59
Cleaning of vegetables	21 (61.76)	13 (38.24)	17 (80.95)	-	4 (19.05)	55	6	3.88
Grading	21 (61.76)	13 (38.24)	16 (76.19)	1 (4.76)	4 (19.05)	54	7	4.59
Thinning-gap filling	20 (58.82)	14 (41.18)	16 (80.00)	-	4 (20.00)	52	8	3.29
Cleaning of fields	20 (58.82)	14 (41.18)	14 (70.00)	2 (10.00)	4 (20.00)	50	9	2.06
Loading/ unloading	20 (58.82)	14 (41.18)	15 (75.00)	-	5 (25.00)	50	9	2.88
Staking	19 (55.88)	15 (44.12)	14 (73.68)	2 (10.53)	3 (15.79)	49	10	5.53
Shifting at distance	20 (58.82)	14 (41.18)	11 (55.00)	1 (5.00)	8 (40.00)	43	11	2.21
Raising &Mgt. of Nursery	19 (55.88)	15 (44.12)	10 (52.63)	2 (10.53)	7 (36.84)	41	12	2.23
Sowing of seeds	22 (64.71)	12 (35.29)	7 (31.82)	1 (4.55)	14 (63.63)	37	13	2.23
On-farm sale of produce	16 (47.06)	18 (52.94)	8 (50.00)	5 (31.25)	3 (18.75)	37	13	4.56
Seed treatment for sowing	23 (67.65)	11 (32.35)	6 (26.09)	-	17 (73.91)	35	14	2.38

Storage of vegetables	**11 (32.35)**	**23 (67.65)**	**8 (72.73)**	**-**	**3 (27.27)**	**27**	**15**	**1.76**
Labour-Management	**10 (29.41)**	**24 (70.59)**	**3 (30.00)**	**2 (20.00)**	**5 (50.00)**	**18**	**16**	**3.38**
Shading Arrangement	**6 (17.65)**	**28 (82.35)**	**2 (33.33)**	**-**	**4 (66.67)**	**10**	**17**	**2.65**
Drying of vegetables	**3 (8.82)**	**31 (91.18)**	**-**	**1 (33.33)**	**2 (66.67)**	**4**	**18**	**1.24**

Note: Figure in parenthesis indicates percentage to total

It was found that extent of women's participation was medium in shifting at distance (43 scores) followed by raising & management of nursery (41 scores), sowing of seeds & on-farm sale of produce (37 scores each), seed treatment for sowing (35 scores) and storage of vegetables (27 scores). They were spending time in on-farm sale of produce (4.56 hours), seed treatment for sowing (2.38 hours), raising & management of nursery and sowing of seeds (2.23 hours each), shifting at distance (2.21 hours) and storage of vegetables (1.76 hours).

Extent of participation of the respondents was low in labour-management (18 scores and 3.38 hours) followed by shading arrangement (10 scores and 2.65 hours) and drying of vegetables (4 scores and 1.24 hours). Table 23 shows the least participation of farm women in these activities. Least time was also devoted by them in performing such activities.

Conclusions: It is inferred that extent of women's participation was higher in weeding (70 scores) followed by picking/harvesting (65 scores), packaging & transplanting (60 scores), hoeing (57 scores), plant protection (56 scores), cleaning of vegetables (55 scores), grading (54 scores), thinning-gap filling (52 scores), cleaning of fields & loading/unloading (50 scores each) and staking (49 scores). It shows the high level of women's participation in performing above-mentioned activities. It may be concluded that maximum time was spent by them in picking/harvesting (21.83 hours) followed by transplanting (14 hours), hoeing (13.85 hours) and weeding (13.83 hours).

Socio-Economic Factors Influencing Women's Participation:

Age: Active working age of farm women and their extent of participation in loading/unloading, cleaning of fields, packaging, grading and transplanting were found highly significantly associated (χ^2=5.2341*, χ^2=17.85**, χ^2=6.3636*, χ^2=4.4444* and χ^2=4.444* respectively). Working age of farm women and extent of participation in cleaning of fields were highly significantly associated at 1per cent level of probability (χ^2=17.85**). Whereas for loading/unloading, packaging, grading and transplanting significant association was at 5 per cent level of probability(χ^2=5.2341*, χ^2=6.3636*,

χ^2=4.4444* and χ^2=4.444* respectively). It was non-significant in weeding, picking/harvesting and hoeing (χ^2= 0.2343, χ^2= 1.4260 and χ^2=3.6473 respectively).

Table 24:Association between socio-economic factors of farm women and their extent of participation in activities of vegetable cultivation

Activities	Socio- Economic Factors				
	Age (Active working Age)	Education (Illiteracy)	Family Type (Joint Family Pattern)	Farm size /Size of Land Holding (Smaller)	Per capita Annual Income (Lower)
Weeding	χ^2=0.2343NS	χ^2=2.0307 NS	χ^2=1.6307 NS	χ^2=9.0877**	χ^2=9.0877**
Picking/ Harvesting	χ^2= 1.4260NS	χ^2=7.0313**	χ^2=5.7109*	χ^2=7.0313**	χ^2=7.0313**
Hoeing	χ^2=3.6473 NS	χ^2=4.8440*	χ^2=4.8440*	χ^2=7.2890**	χ^2=7.2890**
Loading/Unloading	χ^2=5.2341*	χ^2=3.9998*	χ^2=6.2569*	χ^2=6.2569*	χ^2=6.2569*
Cleaning of fields	χ^2=17.85**	χ^2=0.1788 NS	χ^2=12.99**	χ^2=0.8116NS	χ^2=8.6763**
Packaging	χ^2=6.3636*	χ^2=4.9629*	χ^2=4.9629*	χ^2=5.9063*	χ^2=4.9629*
Grading	χ^2=4.4444*	χ^2= 4.4444*	χ^2=4.4444*	χ^2= 4.4444*	χ^2= 4.4444*
Transplanting	χ^2=4.444*	χ^2= 4.4444*	χ^2=4.4444*	χ^2=5.6*	χ^2=3.15NS

*** Significant at 5 per cent level of probability**
**** Significant at 1 per cent level of probability NS= Non-significance**

Education : Illiteracy of farm women was highly significantly associated with their extent of participation in picking/harvesting, hoeing, loading/unloading, packaging, grading and transplanting (χ^2=7.0313**, χ^2=4.8440*, χ^2=3.9998*, χ^2=4.9629*, χ^2= 4.4444* and χ^2= 4.4444* respectively). It was non-significant in weeding and cleaning of fields **(**χ^2=2.0307 and χ^2=0.1788 respectively). Whereas for picking/harvesting significant association was at 1 per cent level of probability (χ^2=7.0313**).

Family Type: Joint family pattern and women's participation in picking/harvesting, hoeing loading/unloading, , packaging, grading and transplanting were found highly significantly associated at 5 per cent level of probability (χ^2=5.7109*, χ^2=4.8440*, χ^2=6.2569*, χ^2=4.9629*, χ^2=4.4444* and χ^2=4.4444* respectively). Whereas for cleaning of fields significant association was at 1 per cent level of probability (χ^2=12.99**). It was non-significant in case of weeding (χ^2=1.6307).

Farm Size: Smaller farm size and women's participation in weeding, picking/harvesting and hoeing were highly significantly associated at 1 per cent level of probability (χ2=9.0877**, χ2=7.0313** and χ2=7.2890** respectively). Whereas for loading/unloading, packaging, grading and transplanting significant association was at 5 per cent level of probability (χ2=6.2569*, χ2=5.9063*, χ2= 4.4444* and χ2=5.6* respectively). It was non-significant in case of cleaning of fields (χ2=0.8116).

Income: Lower per capita annual income and women's participation in weeding, picking/harvesting, hoeing and cleaning of fields ($\chi 2$=9.0877**, $\chi 2$=7.0313**, $\chi 2$=7.2890** and $\chi 2$=8.6763** respectively) were highly significantly associated at 1per cent level of probability. Whereas for loading/unloading, packaging and grading significant association was at 5 per cent level of probability ($\chi 2$=6.2569*, $\chi 2$=4.9629* and $\chi 2$= 4.4444* respectively). It was non-significant in transplanting ($\chi 2$=3.15).

Constraints perceived by the Farm Women in Vegetable Cultivation:

In the study area, all of the respondents were perceiving various kinds of constraints in vegetable cultivation i.e. agricultural labour scarcity in villages (208 scores) followed by lack of good quality of irrigation water (197 scores), low output prices (192 scores), dependency on canal irrigation water (188 scores), uncertain market situations (182 scores), lack of awareness about new technologies (181 scores), high cost of seeds (165 scores), social restrictions for attending Kisanmela/training/camp/exhibition etc. or cultural & social barriers and costly pesticides (163 scores each), each), capital problems (156 scores), market problems (155 scores), costly electricity & adulterated pesticides (138 scores each), credit availability (136 scores), harsh work conditions/ disease attack (161 scores), insects attack (160 scores), costly fertilizers, extensive work load with dual responsibilities/burden of domestic work & poor economic conditions

Table 25: Constraints perceived by the farm women in vegetable cultivation N=80

Constraints	Extent of perceived Constraints			Scores	Rank
	Very Severe	Severe	Neutral		
Agril. Labour scarcity in villages	48 (60.00)	32 (40.00)	-	208	1
Lack of good quality ofirrigation water	51 (63.75)	15 (18.75)	14 (17.50)	197	2
Low output prices	34 (42.50)	44 (55.00)	2 (2.50)	192	3
Dependency on canal irrigation water	45 (56.25)	18 (22.50)	17 (21.25)	188	4
Uncertain market situations	26 (32.50)	50 (62.50)	4 (5.00)	182	5
Lack of awareness about new technologies	31 (38.75)	39 (48.75)	10 (12.50)	181	6
High cost of seeds	10 (12.50)	65 (81.25)	5 (6.25)	165	7
Social restrictions for attending Kisan mela/training/camp/exhibition etc. (cultural & social barriers)	7 (8.75)	69 (86.25)	4 (5.00)	163	8
Costly pesticide	9 (11.25)	65 (81.25)	6 (7.50)	163	8
Disease attack	7 (8.75)	67 (83.75)	6 (7.50)	161	9
Insects attack	6 (7.50)	68 (85.00)	6 (7.50)	160	10

Costly fertilizers	**5 (6.25)**	**68 (85.00)**	**7 (8.75)**	**158**	**11**
Extensive work load with dual responsibilities/ burden of domestic work	**4 (5.00)**	**70 (87.50)**	**6 (7.50)**	**158**	**11**
Poor economic conditions	**10 (12.50)**	**58 (72.50)**	**12 (15.00)**	**158**	**11**
Capital problems	**3 (3.75)**	**70 (87.50)**	**7 (8.75)**	**156**	**12**
Market problems	**14 (17.50)**	**47 (58.75)**	**19 (23.75)**	**155**	**13**
Costly electricity	**19 (23.75)**	**20 (25.00)**	**41 (51.25)**	**138**	**14**
Adulterated pesticides	**5 (6.25)**	**48 (60.00)**	**27 (33.75)**	**138**	**14**
Credit availability	**4 (5.00)**	**48 (60.00)**	**28 (35.00)**	**136**	**15**
Harsh working conditions/ working under unfavorable conditions	**6 (7.50)**	**43 (53.75)**	**31 (38.75)**	**135**	**16**
Fast technological advancement (seed/fertilizer/pesticides/machinery etc.)	**-**	**53 (66.25)**	**27 (33.75)**	**133**	**17**
Inadequate availability of quality seeds	**5 (6.25)**	**42 (52.50)**	**33 (41.25)**	**132**	**18**
Health problems (due to allergy/blood pressure/headache-migraine etc.)	**3 (3.75)**	**44 (55.00)**	**33 (41.25)**	**130**	**19**
Non-Availability of input supply at proper time (seeds/fertilizers/pesticides etc.)	**2 (2.50)**	**43 (53.75)**	**35 (43.75)**	**127**	**20**
Distance from market	**2 (2.50)**	**19 (3.75)**	**59 (73.75)**	**103**	**21**

Note: Figure in parenthesis indicates percentage to total

(158 scores working under unfavorable conditions (135 scores), fast technological advancementi.e. regarding machinery/seed/fertilizer/pesticide etc. (133 scores), inadequate availability of quality seeds (132 scores), health problems i.e. allergy/blood pressure/headache-migraine etc (130 scores), non-availability of input supply (seeds/fertilizers/pesticides etc.) at proper time (127 scores) and distance from market (103 scores).

As regards extent of constraints perceived by the farm women in vegetable cultivation, it was found that more than half of the respondents were perceiving constraints very severely i.e. lack of good quality of irrigation water (63.75%) followed by agricultural labour scarcity in villages (60%), dependency on canal irrigation water (56.25%), low output prices (42.50%) and lack of awareness about new technologies (38.75%).

It was observed that majority of the respondents perceived constraints severely, but not very severely in vegetable cultivation i.e. capital problems & extensive work load with dual responsibilities/burden of domestic work (87.50% each), social restrictions for attending kisan mela/training/camp/exhibition etc. or cultural & social barriers (86.25%), disease attack (83.75%), costly fertilizers & insects attack (85% each), costly pesticides & high cost of seeds (81.25% each), poor economic conditions (72.50%), fast technological advancementregarding

machinery/seed/fertilizer/pesticide etc. (66.25%), uncertain market situations (62.50%), adulterated pesticides & credit availability (60% each) and market problems (58.75%).

It was observed that as being the farm women specially, majority of the respondents perceived constraints severely i.e. extensive work load with dual responsibilities/burden of domestic work (87.50%), social restrictions for attaining Kisan mela/training/camp/exhibition etc. (86.25%), fast technological advancement regarding machinery/seed/fertilizer/pesticide etc. (66.25 %), health problems i.e. allergy/blood pressure/headache-migraine etc (55 %), harsh work conditions/working under unfavorable conditions (53.75%) and lack of awareness about new technologies was perceived very severely by more than one-third of the farm women (38.75%).

On the other hand, remaining respondents were found to be neutral and they were undecided to express their extent of perceived constraints regarding distance from market (73.75%) followed by costly electricity (51.25%), non-availability of input supply (seeds/fertilizers/pesticides etc.) at proper time (43.75%), inadequate availability of quality seeds & health problems (41.25% each) and harsh work conditions/working under unfavorable conditions (38.75%). And among these, those respondents constituted majority, who were having low level of perceived constraints.

Recommendations/Suggestions:

As the participation of women in activities of vegetable cultivation is indispensable and on the increase in rural areas, some important steps need to be taken to control/supervise the high cost/prices, quality & non-availability at proper time of seeds, fertilizers, pesticides, irrigation water, electricity etc. Purchase centre of vegetables at village level (either private or govt.) should be there to avoid wastage of time, money and resources to be used effectively. Priority must be given to women in accessing credit on soft terms from banks and other financial institutions for setting up their business related to vegetables. Government Departments and other welfare agencies & organizations should specifically conduct more number of need based workshops/seminars/trainings/awareness programmes where the rural farm women are aquatinted with the new modern cost effective agricultural techniques/technologies to enhance their knowledge & skill and to encourage them to diversify the agricultural activities. Recognition of labour work of working women in the rural economy may be accounted in monetary terms. Labour scarcity is bound to increase; therefore mechanization of labour

intensive operations is the need of hour. Full awareness about intake of healthy diet among the rural farm women should be undertaken on priority basis.

Technical Programme of Work: 2015-16

SubProject-III: Decision Making Pattern of Farm Women in Performing Vegetable Cultivation Activities in Hisar Districtof Haryana

i). Objectives:

1. To examine the personal and socio-economic profile of the farm women.
2. To study the extent of women's participation in decision making in vegetable cultivationactivities.
3. To identify the constraints perceived by the farm women in decision making.

ii. Year of Start **:** 2015-16

iii. Period of study **:** 2015-16

iv). Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Deep Punia	Preparation of Schedule, analysis of data and report writing
J. C. Karwasra	Monitoring and Execution
Jitender Kumar Bhatia	Collection, compilation and analysis of data
Dalip Kumar Bishnoi	Collection, compilation of data

v) Methodology:

The present study will beconducted in four villages namely Hajampur, Dhana Khurd, Juglan & Dhiktana from Hansi-I & Barwala blocks respectively of Hisar district of Haryana. From each village 20 farm working women from small, medium & large categories will be randomly selected making a total sample of 80. The primary data pertaining to decision making pattern of farm women in performing activitiesrelated to cultivation of major vegetable crops for the last year will be collected with the help of well structured pre-tested interview-schedules from those 80 households in which both husband & wife were involved in vegetable cultivation. The extent of rural women's participation in decision making in performing various activities regarding vegetable cultivation will be measured by using a four point continuum namely nil, only consulted, opinion considered and final decision with scores & ranking.

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B. Other Agencies

Scheme: "Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana" (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Co-operation, Govt. of India)

Name of the Scheme	C (c) Econ.-I.(CS)-Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana
Year of Start	1970
Objective	To provide representative and comparative data on Cost of Cultivation of Principal Crops in Haryana
Period of Study /Location	2014-15(CCS Haryana Agricultural University, Hisar)
Staff position in the scheme	
Hon. Director-cum- Prof. & Head	J.C. Karwasra (from 01.03.2014)
Principal Research Officer	Vacant
Principal Scientist	V.P. Luhach
Principal Scientist	Kuldeep Kumar
Principal Scientist	R.S.Pannu
Senior Scientist	D.P. Malik (on deputation)
Statistician	Mrs. Kiran Kapoor
Computer Assistants	03 (Three vacant)
Agril. Inspectors	28 (Two vacant)

Name of Investigators with Activity Profile:

Scientists	**Activity Profile**
J.C. Karwasra	Planning, execution, overall supervision and verification of data.
V.P. Luhach	Planning, monitoring, supervision, checking and verification of data.
Kuldeep Kumar	Planning, monitoring, supervision, checking and verification of data.
R.S.Pannu	Planning, monitoring, supervision, checking and verification of data.
D.P. Malik	On deputation in Ministry of Agriculture, GoI for five years.
Mrs. Kiran Kapoor	Compilation, validation and valseas of data

Budget: **(Rs. In lakh)**

Particular	**Allotment 2014-15**	**Expenditure 2014-15**	**Budget 2015-16**
Establishment (Salary)	180.00	179.37	225.00
T.A.	8.00	3.88	10.00
Contingency (Recurring and Non-recurring)	12.00	9.02	15.00
Total	**200.00**	**192.27**	**250.00**

Salient Achievements during 2014-15

The scheme is being financed by Ministry of Agriculture, Govt. of India. Under this scheme, the cost of cultivation data of seven important crops of Haryana state namely, Paddy, Cotton, Bajra, Sugarcane, Wheat, Gram and Rapeseed & Mustard were collected from 30 Centers /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The processed data for the Rabi and Kharif seasons for the year 2013-14 have been submitted in time to the Ministry of Agriculture on C.D. for further analysis, the result of which will be used by the Commission for Agriculture Costs and Prices (CACP) for fixing the minimum support prices of Kharif and Rabi crops at national level.
- Data for Kharif and Rabi seasons of year 2014-15 have been received from the field staff.
- The processing and entry of data for the Kharif season of the year 2014-15 has been completed and validation & valseas for Kharif season data has been done.
- The data for Rabi season for the year 2014-15 is in progress for entry in FARMAP/FARMAP.DAC.GOV.IN software programme (designed by funding agency) and will be completed well in time for online submission to the Ministry of Agriculture and Cooperation, Government of India.
- Trainings/meetings of Agricultural Inspectors were organized at Department of Agricultural Economics during the year 2014-15 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items and keeping daily operation record.
- The scientists working in the scheme also organized meetings of Agricultural Inspectors working under their supervision at their respective headquarters for checking of data entries in the records.
- The scientists working in the scheme supervised the work of Agricultural Inspectors, discussed with selected farmers about crop operations and inputs used at farm level to maintain the accuracy of data.
- The discrepancies in data as reported by funding agency were checked, corrected and re-submitted again.

Plan of Work for the year 2015-16

- Compilation of data for the year 2014-15 is in progress for all the seven crops and will be submitted to the Ministry of Agriculture, Govt. of India in the month of October 2015.
- The data on cost of cultivation of crops Paddy, Cotton, Bajra, Sugarcane, Wheat, Gram and Rapeseed & Mustard for the year 2015-16 will be collected from 30 clusters located in different Agro-Climatic Zones of the state by cost accounting method.
- The data will be collected for the year 2015-16 by using both old RT's and new RT's developed by Ministry of Agriculture because if any information lacking in new RT's that

can be taken from old one. After completion of Kharif season (2015-16), the entry of the data offline as well as online by AI's at cluster headquarter. This will be forwarded to field supervisor after proper checking of the data and if the data found correct it will be forwarded to the field officer (SRO).Otherwise it can be returned back to the field men for the proper checking and correction. The correct data received by Field Officer/SRO will be thoroughly cross checked, validation and valseas of data and it will be sent online to the Ministry of Agriculture for future processing the data which is required for fixing the MSP of various crops.

- The data entry module of FARMAP 2.0 software has been uploaded in the public domain at URL and hand-on-training to use this software has been taken by the Scientist in the month of January 2015. Now, after allotting the user id and password to Honorary Director/Field Officer of this centre by NIC. The field officer (SRO) has created the user ID and password to field Supervisor/Scientist and Field man/AI. Although there is no Field Officer/SRO at the centre. Now, from this year 2015-16 onward they are supposed to enter the data online.
- The data entry of both Rabi and Kharif season in the FARMAP 2.0 of all the clusters/centres for all the principle crops of the state for the year 2012-13 is in progress and by the end of July 2015, the online entry of data in FARMAP 2.0 for whole state will be provided to the Agriculture Ministry Govt. of India by the stipulated period i.e. 31st July 2015 to test the results of the FARMAP 2.0 software.
- Strict supervision of data collection work of Agricultural Inspectors will be done by respective scientist to maintain accuracy in data.
- Information from funding agency as well as discrepancies in data will be disseminated to the Agricultural Inspectors.

Table 26: Cost of production and minimum support prices of major crops in Haryana

Crops	**Cost of Production (Rs./q)**		**Minimum Support Price- (Rs./q)**	
	2010-11	**2011-12**	**2010-11**	**2011-12**
Paddy	1305	1250.61	1000	1080
Bajra	970	1122	880	980
Cotton	2800	3229	2500* 3000**	2800* 3300*
Wheat	773(45.40)	851(50.78)	1120+50	1285
Gram	2511(5.28)	3472(5.65)	2100	2800
Rapeseed& Mustard	1305(20.43)	2046(18.93)	1850	2500
Sugarcane	135	163	139 210#	145 L266-M271-E276#

Source: Agricultural statistics at a glance, 2012, Directorate of Econ. & Stat. Ministry of Agri. Govt. of India

Cost of production includes all actual expenses in cash and kind incurred in production by owner plus interest on value of owned/fixed capital assets (excluding land) plus rental value of owned land plus imputed value of family labour. * Medium staple cotton (mm) of 24.5-25.5 and micronaire value of 4.3-5.1

** Long staple cotton (mm) of 29.5-30.5 and micronaire value of 4.5-4.3

^ Fair and Remunerative Price (FRP) in case of Sugarcane # Prices given by Govt. of Haryana

L-Late variety, M-mid sown, E-early sown.

The cost of production per quintal of paddy, gram, bajra and cotton was higher in 2010-11 and 2011-12 than minimum support prices (MSP). Similarly cost of production of sugarcane was also found higher than FRP in the year 2010-11 and 2011-12 (Table 26).

Scientists Associated with projects operating in other departments:

Name of Scientist	Name of Project	Name of department operating project
V.P.Luhach	Centre of Excellence on Pearl Millets	Food & Nutrition (College of H. Sc.)
K.K.Kundu	Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets in Sub-Sahara Africa and South Asia	Bajra Section (Department of Genetics & Plant Breeding)
Dalip Kumar Bishnoi	Zero tillage rice establishment and crop weed dynamics in rice and wheat cropping system in India and Australia (ACIAR project).	Department of Agronomy
	Integrated Farming System Model	Department of Agronomy

List of PG students with their thesis title and name of Major Advisors

S.No.	Name of student	Admn. No.	Research topic	Major advisor
M. Sc. Students				
1	Pankaj Kumar	2012A3M	Economic analysis of production and marketing of poplar (Populus deltoides) in Yamunanagar district of Haryana	Dr. Neeraj Pawar
2	Jai Parkash Bisen	2013A2M	Supply chain management in fruit and vegetable markets in Haryana State: A comparative analysis	Dr. R.K.Patel
3	Parveen Kumar	2013A3M	Economic Analysis of vegetable cultivation under poly house in Haryana	Dr.R. S. Chauhan
4	Kavita	2013A4M	Impact of government intervention on sugar prices in India: An economic analysis	Dr.R. K. Grover
5	Raj Kumar	2013A5M	An Economic Analysis of production and marketing of onion in Haryana	Dr.A. K. Rathee
6	Meenu Punia	2013A6M	Production and Export Potential of Tomato and its processed products in India	Dr. V.P.Mehta
7	Moro Seidu	2013A115M	Role of FDI in the Development of Indian Agriculture	Dr. K.K.Kundu
8	Mrityunjay Pandey	2014A1M	Estimation of demand for NPK use in Haryana	Dr. U.K.Sharma
9	Suraj Choudhary	2014A2M	An economic analysis of fish farming and marketing in Haryana introduction	Dr. Neeraj Pawar
10	Heena	2014A4M	An economic analysis of fertilizer use in Haryana	Dr. V.P.Luhach

11	Sunita	2014A6M	Diversification of cropping pattern and production in Haryana	Dr. V.P.Mehta
12	Sanjay	2014A7M	A study on regulated markets of Haryana	Dr. Sanjay Kumar
Ph.D. students				
1	Ajay Kumar	2012A2D	Economic analysis of production and marketing of major vegetable crops in Haryana	Dr. R.S.Pannu
2	Vinay Mehla	2012A3D	An Economic Analysis of Resource Conservation Technologies in Haryana	Dr. U. K. Sharma
3	Veer Sain	2013A1D	Market Information System and its application for agricultural commodities in Haryana	Dr. K.K.Kundu
4	Jitender Kumar	2013A2D	Role of Sarva Haryana Gramin bank in financing farmer of Hisar district	Dr. V.P.Mehta
5	Sumit	2014A1D		Dr. R.S.Chauhan

REVIEW OF RESEARCH SCHEMES AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2016-17

A. Report by the Head of the Department

i) Name of the Department: Agricultural Economics

ii) Salient Research Findings of the Department (2015-16):

- The average size of landholding on sampled farms was 1.54, 3.20 and 7.50 haon small, medium and large categories respectively.A positive relationship was observed in farm size and average size of family in farm households.
- Tractor and tractor drawn implements accounted for about one-fourth (24.22 per cent) of the total investment followed by milch animals (22.96 per cent), farm buildingandcattle shed (14.52 per cent) andtube well (13.45 per cent).
- Cotton (55.58 per cent) followed by cluster bean (21.26 per cent), pearl millet(14.63 per cent) was observed as the important crops in terms of net area sown (NAS) allocated in kharif season by the sampled households while area allocated under moong beanwas (4.63 per cent) and fodder crop jowar (3.89 per cent).
- In Rabi season, highest area allocated was under wheat (58.61 per cent) followed by rapeseed and mustard (27.71per cent), gram (4.69 per cent) and berseem (4.57 per cent).
- Area under paddy, wheat, rapeseed & mustard and cotton has increased by 398, 147, 419 and 203 percent respectively from year 1970-71 to 2013-14. Whereas area under gram, maize, jowar, barley and pearl millet has drastically declined by 92, 90, 70, 66 and 48 percent respectively from the year 1970-71 to 2013-14 in the state.
- Production of paddy, wheat, rapeseed & mustard and cotton has increased by 963, 508, 1208 and 544 percent respectively from year 1970-71 to 2013-14.On other hand production of gram, maize and jowar has declined by 90, 76, and 24 percent respectively during the study period.
- Maximum increment in productivity has witnessed in pearl millet which was 242 per cent followed by barley (208 per cent), maize (164 per cent), rapeseed & mustard (159 per cent), wheat (148 per cent), jowar (145 per cent) cotton (118 per cent), paddy (116 per cent) and sugarcane (65 per cent) during the study period.
- In vegetable cultivation, one-third of the farm women were final decision makers in cleaning of vegetables followed by nursery-management/raising nursery for seedling, packaging, loading/unloading, picking, staking, grading and shifting at distance only.Opinion of majority of the respondents was also considered before deciding about

transplanting followed by weeding, picking, harvesting, staking, hoeing, packaging,thinning-gap filling,grading etc. Data clearly showed the high level of women' participation in decision making in those activities in which their labour force was more required.

- The area of harvest of the major field crops except pearl millet and sugarcane for both Haryana continuous increased trends and growth for the past five decades. The growth rates in area were higher wheat, paddy, cotton, and rapeseed and mustard on acreages. Continuous rising trend and growth in production and production were observed in all the major field crops in the two study areas. Nonetheless, growth rates of wheat, paddy, pearl millet and oilseeds were more prominent .However, in the case of the production of cotton and sugarcane; India production levels were higher than that of Haryana. But also for the productivity of sugarcane, the growth rate was higher in Haryana than in national level.

- The cost of production per quintal of paddy, gram, pearl millet and cotton was higher in 2011-12 and 2012-13 than minimum support prices (MSP).

iii)Emerging/Thrust Areas

1. Socio-economic analysis of emerging agricultural problems.
2. Demand, supply and price analysis of agricultural input and output.
3. Input use efficiency in existing cropping pattern in different agro-climatic zones.
4. Economic analysis of diversification, marketing and value addition in agriculture.

iv)Action taken Report of the last year's proceedings:

S.No.	Suggestions	Action Taken
1	In the Ist point under the head Salient Research Findings, the unit i.e. square meter for the area of polyhouse be rechecked and corrected.**(Action:HOD, Agricultural Economics)**	Unit is used by State horticulture department, verified.
2.	Sub-Project, Page 6: the cropping intensitymentioned at Page 11 be rechecked and verified. **(Action: Concerned Scientist)**	Necessary corrections have been incorporated.
3.	Table 7 and 8, Page 14-15: The calculations be rechecked and verified.**(Action: Concerned Scientist)**	Necessary corrections have been incorporated.
4.	The research findings should be forwarded to the concerned departments for further necessary action **(Action: HOD, Ag.Econ.and Concerned Scientist)**	Necessary Action has been taken.
5.	The objective of sub-project 1 and 2 on Page 25 be checked and verified. Programme of work of project 2 to be specified. **(Action: Concerned Scientist)**	Necessary Action has been taken.

6.	Sub-Project 3, Page 26; Equal number of respondents be taken different landholding categories and the constraints mentioned should be specific to farm women. **(Action: Concerned Scientist)**	Checked and Necessary corrections have been incorporated.
7.	Activity Profile of the scientist working in an experiment should not be similar and be properly distributed as per the programme of work. **(Action: Concerned Scientist)**	It will be taken carefully in next TP-2016-17.
8.	List of PG students along with their advisors and research problem be furnished at the end of technical programme **(Action: Concerned Scientist)**	Information has been incorporated.

v) List of research projects (both from state as well as outside agencies) in operation along with sanctioned budget (2015-16)

S. No.	Number and name of the scheme	Sanctioned Budget (In lakh)	Funding Agency
A.	**State Funded Schemes**		
1.	**C(a)Econ.1 Plan (Agri.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	175.80	State
B.	**Other Agencies**		
2.	**Govt. of India C(c) Econ.1 (CS)** Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana.	250.00	Ministry of Agriculture, GOI

vi) Research Project completed during 2015-16.

S. No.	No. of Scheme	Title of Sub-Project	Status
1.	**C(a)Econ.1 Plan (Agri.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	Pattern and Extent of Crop Diversification in Haryana	Report is to be submitted.
2.	**-do-**	Decision Making Pattern of Farm Women in performing Vegetable Cultivation Activities	Report is to be submitted.

vii) Research projects sanctioned during 2015-16

-Nil-

viii) Recommendations generated for field application

- Keeping in view the low profitability of cotton – wheat cropping system, some of the area under cotton may be shifted to alternate crop like pigeon pea, moong bean and cluster bean.In cotton – wheat cropping system some of area may be allocated to vegetables like ridge gourd, bottle gourd, bhindi, cauliflowerand kharif onion etc. and fruit crops like kinnow, guava and ber.
- Proper procurement of pulses should be ensured, which leads not only the viable options of cotton - wheat cropping system but also helps in enhancing the productivity of soil.
- Timely availability of farm inputs and accessibility of appropriate market information system should also be ensured by the concerned departments.
- Minimum support price (MSP) of major vegetable crops should be announced to stabilize the variability in the prices of vegetable crops so that it may emerge as the best viable options instead of cotton – wheat cropping system especially for marginal and small holders.
- All the identified constraints/problems faced by the farmers should be addressed on priority basis.
- Labour scarcity is bound to increase; therefore, mechanization of labour intensive operations is the need of hour.
- There is greater need to promote pulses production by proper institutional support for sustainable crop diversification.
- Need to have an integrated approach to encourage more diversification by the concerned departments/institutions, especially for agricultural developed districts, like Karnal, Kurukshetra, Sonepat and Panipat which registered low level of diversification or getting more specialization crops like paddy and wheat.
- Government Departments and other welfare agencies & organizations should specifically conduct/developmore number of need based workshops/trainings/awareness programmes for involving farm women in decision making which will increase their exposure and knowledge about the new farm technologies & financial institutions.
- Yield stabilization policies should be strengthen to reduce production variability in the major crops through: extension, efficient management of irrigation, and adoption of less risky technology, assured timely supply of inputs, use of plant protection measures.

ix) Patent filed if any: **Nil**

B. Details of Each Research Scheme(s) for Review:

i) Scheme No. : C (a) Econ-1 Plan (Agri.)

Title : Economic Studies into Emerging Marketing andProduction Problems Related to Haryana Farming

ii) Year of Start : 2002-2003

iii) Location : Haryana

iv) Objectives:

1. To analyse the resource use efficiency in Haryana farming.
2. To carry out studies into different marketing aspects of major farm inputs and products.
3. To study the possible agricultural diversification in different zones of Haryana.

v) Any need to modify the objectives as per the need of the state

No change is required at present, it covers all the aspects.

vi) Staff provided in the scheme including name of the faculty members

Sr. No.	Sanctioned posts	Status
1.	Economist (FM) -1	Vacant
2.	Assistant Scientist (Ag. Econ.) - 6	Vacant- 4
		1. Jitender Bhatia
		2. Dalip K. Bishnoi
3.	Assistant Scientist (Sociology)/ - 1	Mrs. Deep Punia, Principal Scientist
4.	Assistant Scientist (Statistics) - 1	Vacant
5.	Research Associate (Rural Sociology)-1	Vacant

vii) Budget for the year 2015-16 (head-wise sanction and expenditure details) (inRs.)

Sub Head	2015-16		Budget 2016-17
	Allotment	Expenditure	Allotment
Pay	4557780	4476346	6490400
ADA	4786210	4762975	7928600
CPF/GPF	476630	461785	592000
Gratuity	945000	944939	2000000
OE & Others	22000	21191	25000
TA	16000	10166	18000
M & S	5000	2511	6000
Other Charges	6000	5356	7000
POL	11000	450	13000
Medical	72000	16596	100000
LTC	117800	117186	400000
Total	**1,10,15,420**	**1,08,19,501**	**17,58,00,000**

viii) ACHIEVEMENTS:

Economic Analysis of Existing and Alternative Cropping Pattern in different zones in Haryana

- The level of education of heads varied across farm sizes. In particular, share of illiterate heads was observed higher in small category (18.92 per cent) in comparison to other categories and vice versa.
- The average size of family was around 7 persons in selected farm households. The category of large farm households indicated higher size (around 9 persons) in comparison to other categories. It could be due to prevalence of joint family system on large category of farms.
- Among livestock, 45 per cent were milch animals comprising 37.93 per cent of buffaloes and 7.24 per cent of cow with a 36 per cent of young stock while 19 per cent of total were used as draught animals.
- Although, the practice of leasing in land was prevalent but leasing out of land was found negligible. This imply that majority of sampled farmers were owner cultivators. A fraction of cultivated land was found leased in. It appeared that the system of leasing out was not popular among the selected farmers.
- Large category farmers operated 7.50 hectares per household while small and medium farmers operated around 1.54 and 3.20 hectares of land respectively. Thus, disparities in operational holdings across farm categories were found significant.
- More than 70 per cent of land operated by farmers at the aggregate level was found irrigated. Comparatively land operated by large farm households was more irrigated (77.33 per cent). The land rent ranged between Rs. 45-49 thousand/ ha in the study area.
- Results about the ownership of per household assets for the entire sample covering all categories were on expected lines since large category indicated the highest value of farm assets during the study period.
- Each category of farm households possessed various inventories like tractor, trolley, harrow, cultivator, electric motor, diesel engine, submersible pump, spray pump, generator, cart, drip system, storage shed and small tools. The sampled farm households on an average possessed assets worth Rs. 4, 55,838 at the overall level.
- Tractor and tractor drawn implements accounted for about one-fourth (24.22 per cent) of the total investment followed by milch animals (22.96 per cent), farm building and cattle

shed (14.52 per cent), tube well (13.45 per cent), chaff cutter (4.85 per cent), draught animals (4.84 per cent) and cart (1.76 per cent). Investment in remaining farm assets including transport means was very low (13.41 per cent).

- Highest returns over total cost was from kinnow orchard (Rs. 112315) followed by guava and ber i.e. Rs. 60420 and 28342 per hectare respectively which reveals that kinnow was found most profitable fruit crop with highest benefit cost ratio (1.64) than guava and ber .
- Bottle gourd - wheat (Rs.30288/ha), bhindi - wheat (Rs.26882/ha), ridge gourd - wheat (Rs.22000/ha) kharif onion - wheat (Rs.17652/ha) and cauliflower - wheat (Rs.12095/ha) may be feasible options for the marginal and small categories of farmers to switch over some area from cotton towards these vegetable crops.
- Pigeon pea – wheat, cluster bean – wheat, moong bean – wheat, pearl millet – wheat were profitable cropping system over cotton– wheat cropping system with net returns of Rs. 20850,14908, 14408 and 6258 per hectare respectively, as compared to net returns from cotton – wheat cropping system i.e. Rs. - 6113 per hectare i.e. found to be negative during study period.
- Lack of irrigation facilities as well as poor quality underground water (83.33per cent), followed by Shortage of labor (71.66per cent), small and fragmented land holdings (28.33per cent), lack of credit(38.33per cent) and non-availability of quality chemicals/pesticides (66.66per cent) were observed as major constraints in the study area.While fluctuations in market prices of commodities (93.33 per cent), difficulty in accessing information regarding demand, supply and prevailing prices of agricultural commodities (61.66 per cent) and lack of scientific storage facilities (21.66 per cent) were observed as marketing related problems in the study area.

Pattern and Extent of Crop Diversification in Haryana

- Area under paddy cultivation has increased at the compound growth rate of 3.74 per cent per annum during the study period that is the maximum growth experienced by any of the kharif season crop in Haryana. Further, production of paddy has also exhibited an increase of 4.97per cent per annum. This is contributed by expansion in acreage and growth in yield.
- Area, production and yield of cotton recorded an increase of 2.37, 4.01 and 1.63 per cent per annum during the study period. Clearly, area expansion has played more important role in comparison to yield. The growth of cotton production was found highest (6.38 per cent) between 2000-01 and 2011-12 due to remarkable increase in productivity that

was recorded 6.71per cent per annum.

- The scenario of increase in acreage of coarse cereals i.e. pearl millet and maize is discouraging despite their nutritional value. However, production of pearl millet increased at the rate of 2.09 per cent per annum due to commendable growth of 3.62 per cent per annum in yield during this period.
- Among the major Rabi season crops, area under wheat cultivation has increased at the rate of 1.91 per cent per annum during the study period in Haryana. Further, production as well as productivity of wheat has also exhibited an increase of 4.38 and 2.42 per cent per annum.

Decision Making Pattern of Farm Women in performing Vegetable Cultivation Activities

- One-third of the farm women were final decision makers in cleaning of vegetables followed by nursery-management/raising nursery for seedling, packaging, loading/unloading, picking, staking, grading and shifting at distance only. Opinion of majority of the respondents was also considered before deciding about transplanting followed by weeding, picking, harvesting, staking, hoeing, packaging, thinning-gap filling, grading etc. Data clearly showed the high level of women' participation in decision making in those activities in which their labour force was more required.
- Farm women were not involved and/or least involved in the important financial and technical decisions in performing various activities related to vegetable cultivation.
- Women generally did not participate in financial decisions i.e. marketing, fixing prices of vegetables, purchase of inputs, arrangement of inputs, availing farm credits/loans from bank, investment on farm, sale/purchase of land, leased-in/leased-out of land, sale/purchase of farm machineries, custom hiring-in/hiring-out of farm machineries, arrangement of transportation etc. and technical decisions i.e. farm-record maintenance/maintaining sale records of vegetables, adoption of HYVs, attending Kisan mela/training/camp/exhibition etc., seed storage/seed preservation, plant protection/use of pesticide, seeds & fertilizers/use of inputs related to vegetable production & vegetable protection, seedling preparation & seed treatment for sowing, selection of seeds, selection of vegetable variety etc. which are a must for the development and progress of farm families.
- More than half of the respondents were perceiving constraints very severely i.e. extensive work load due to agril. labour scarcity in villages followed by lack of awareness about

new technologies due to fast technological advancement, traditional beliefs system in society for women i.e. domination of males, gender biasness & sex discrimination, low decision making power/secondary status in decision making, poor purchasing capabilities/power of farm women-due to lack of involvement in financial decisions, underestimated/under-valued/largely ignored role, considered economically inactive, work discrimination, unfavourable social conditions for getting information from extension workers and poor technical knowledge due to no link from University/KVK etc.

- Majority of the respondents perceived constraints severely in deciding vegetable cultivation affairs i.e.poor access & knowledge to credit institutions for loans/saving/insurance/investment etc., extensive work load with dual responsibilities due to domestic work, social restrictions for attending Kisan mela/training/camp/exhibition.

Growth and Instability in Area, Production and Productivity of Major crops in Haryana

- The area of harvest of the major field crops except pearl millet and sugarcane for both Haryana continuous increased trends and growth for the past five decades. The growth rates in area were higher wheat, paddy, cotton, and rapeseed and mustard on acreages. Continuous rising trend and growth in production and production were observed in all the major field crops in the two study areas.
- There was a highly significant positive relationship between the area of harvest and production levels of all the major crops except pearl millet which was otherwise in Haryana.

ix) Justification for continuation of the scheme

Objectives of the scheme are of continuous in nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers in Haryana.

x) Constraints, if any: Shortage of Faculty in the scheme.

C.TECHNICAL PROGRAMME FOR THE YEAR: 2015-16

Sub-Project I: "Economic Analysis of Existing and Alternative Cropping Pattern in different zones in Haryana"

i) Objectives:

1. To examine the existing cropping pattern of selected farmers
2. To analyse the economics of existing cropping patterns.
3. To suggest the alternative cropping patterns.

ii) Year of Start **:** 2015-16

iii) Period of study **:** 2015-18

iv) Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
J. C. Karwasra	Planning, Monitoring and Execution
V. K. Singh	Selection of respondents, data collectionand analysis of data.
Jitender Bhatia	Data collection, compilation, analysis of data and Report writing.
Dalip Kumar Bishnoi	Data collection, compilation, analysis of data and Report writing.

v) Method of Study: The study was conducted in Hisar District which represents the semi-arid zone of State. Hisar, the west central most district of Haryana State with a total geographical area of 3983.00 sq. km is lies between the North latitudes 28o56'00": 29o38'30" and East longitudes 75o 21'12": 76o18'12". The district is under control of Hisar division and administratively divided into nine community development blocks namely Agroha, Adampur, Barwala, Hansi-I, Hansi-II, Hisar-I, Hisar-II, Narnaund, and Uklana Mandi.

Table 1: Zone wise distribution of districts in Haryana

Name of Zone	**Name of Districts**
Zone –I (Arid)	Bhiwani, Mahendergarh and Rewari
Zone –II (Semi-Arid)	Hisar, Sirsa, Fatehabad, Rohtak ,Jhajjar, Gurgaon, Mewat and Jind
Zone –III (Humid)	Sonepat, Faridabad, Panipat, Karnal, Kurukshetra, Yamunanagar, Panchkula, Kaithal ,Ambala and Palwal

The district area falls in Yamuna sub-basin of Ganga basin. The area is irrigated by shallow tube wells and network of Bhakra Canal Systems and Western Yamuna Canal Systems. The main canals are the Fatehabad branch of Bhakra Canal, Barwala Branch, Balsamand and Pabra

Sub-branch of Barwala Link and Sirsa branch from Bhakra Main Line, Hisar major distributary and Deosar feeder of Western Yamuna canal System through Hansi branch. Canals are irrigating about 76.83 per cent (209000 ha) of the area, 23.17 per cent (63000 ha) is irrigated by ground water. There are sand dunes in canal command area, over which rain fed crops are grown. A total of 269 villages of the district come under Canal Irrigation System.

Table 2: Category-wise distribution of sampled farmers according to farm size groups in Hisar district

Selected Village	Small	Medium	Large	Total
Village I **(Choudhariwas)**	20	7	4	31
Village II **(Kalwas)**	17	8	4	29
Total	**37**	**15**	**8**	**60**

From Hisar district, Hisar-II block was selected randomly and from selected block, two villages i.e. Choudhariwas and Kalwas, with a sample of total sixty farmers of different categories were interviewed through a pre-structured schedule. Data on farm inventory (resource structure), cropping pattern, input use, labor use, productivity, returns from different crops and problems as well as constraints faced by selected farmers were collected by survey method. Tabular analysis and other suitable statistical techniques were applied to draw the inference of the study.

vi) Results achieved during 2015-16

Demographic Characteristics: Age and education of the head of selected farm households plays an important role in adoption of technology and diversification of farming. The general characteristics of sample households were presented in Table 3. The study reveals that only 10.70 per cent of heads were found below 30 in age group. However, none of the large farmers belonged to this age group. Around half of the heads were found in the age group of 30-50

Table 3: General characteristics of sampled households

Particulars	Small (37)	Medium (15)	Large (8)	Overall (60)
Age of Head (Years)				
Up to 30	10.81	13.33	0.00	10.70
30 - 50	54.06	40.00	37.50	51.50
Above 50	35.13	46.67	62.50	37.80
All	100.0	100.0	100.0	100.0
Educational status of head of the family				
Illiterate	18.92	13.33	0	17.43

Primary	27.03	13.33	25	25.09
Secondary	32.43	53.33	37.5	35.47
Sr. Secondary	10.81	13.33	25	11.70
Graduate and above	10.81	6.67	12.5	10.31
Average Family Size (No.)				
Males	3.08	4.00	5.00	3.60
Females	2.67	3.06	3.63	2.86
Total	5.75	7.06	8.63	6.46
Occupation of Head of family				
Agriculture as Main Occupation	92.00	93.33	100.00	92.40
Agriculture as Subsidiary Occupation	8.00	6.67	0.00	7.60

years while about 37 per cent were observed above 50 years at the overall level. The range of age group of head of selected farm households showed significant variations across farm sizes. Particularly, large farm households showed higher share of heads above 50 years of age in the study area.

Education is a catalytic factor in attaining efficiency in management of skills and capacity to improve and innovate. Among the selected households, more than 70 per cent of them attained education up to senior secondary level. Around 25 and 35 per cent heads studied up to primary and secondary level. It is depressing to note that 17.43 per cent heads at the overall level were illiterate in the study area. The level of education of heads varied across farm sizes. In particular, share of illiterate heads was observed higher in small category (18.92 per cent) in comparison to other categories and vice versa. In large farm size category share of graduate and above (12.50 per cent) superseded other categories of sampled farms.

The main occupation of head of selected farm households was agriculture in case of 92.40 per cent and only 7.60 per cent were engaged in subsidiary occupation at the overall level. Only 8 per cent of the heads in small farm category took up agriculture as subsidiary occupation while around 6 per cent of medium and none in large category farmers adopted supportive activities to augment their family income. In demographic details, average size of family was also analyzed. This indicates availability of manpower to initiate additional activities related to agriculture. The average size of family was around 7 persons in selected farm households. The category of large farm households indicated higher size (around 9 persons) in comparison to other categories. It could be due to prevalence of joint family system on large category of

farms. The average size of family was 5.75 persons in small category while it was 7.06 persons in case of medium category. A positive relationship was observed in farm size and average size of family in the farm households. The number of males and females was also observed higher in large size category. Surprisingly, the number of males was higher in each size category and at the aggregate level also. This implies a low sex ratio which is indicative of imbalance in the male and female population.

Table 4: Average size of land holding and sources-wise average area irrigated on sampled farms in Hisar district (ha/ farm)

Farm Size Category	Owned	Leased in	Irrigated Canal/T W	Unirrigated	Total Operational Holding	Land Rent Rs. / ha
Small	1.24 (80.52)	0.30 (19.48)	0.94 (61.04)	0.60 (38.96)	1.54 (100.00)	45268
Medium	2.75 (85.93)	0.45 (14.07)	2.37 (74.06)	0.83 (25.94)	3.20 (100.00)	49338
Large	6.20 (82.66)	1.30 (17.33)	5.80 (77.33)	1.70 (22.67)	7.50 (100.00)	46058
Overall	2.28 (82.91)	0.47 (17.09)	1.95 (70.91)	0.80 (29.09)	2.75 (100.00)	46531

Figures in parentheses show per cent to the total operational holding

Land Resources:

After analyzing demographic features of sample farm households, we examined status of land resources during the study period. Land details assume aspecial significance in the area because they indicate the economic and socialstatus of the farmer. The status of land holdings of sampled households indicatesthat the selected farm households owned 2.28 hectares per household at theaggregate level. As expected, land owned by large farm households was higher thansmall and medium farmers. Thus, a positive relationship emerged between farm sizeand land owned by the farm households. An examination of land resources ofsampled farmers revealed that all categories of farmers leased in land and it wasobserved higher in the case of large farmers in comparison to other categories offarmers. Although, the practice of leasing in land was prevalent but leasing out ofland was found negligible. This implythat majority of sampled farmers were owner cultivators. A fraction of cultivated landwas found leased in. It appeared that the system of leasing out was not popularamong the selected farmers (Table 4).

In view of Haryana being an agriculturallyadvanced state, hardly any land was observed as current fallow. This finding wasalmost uniform for each farm size category.Farm size plays an

important role in decision making about the crop pattern,input use and adoption of technology. An examination of average size of netoperated land on sampled farms in Table 6 indicates that it was 2.75 hectares perhousehold at the overall level. Large category farmers operated 7.50 hectares perhousehold while small and medium farmers operated around 1.54 and 3.20 hectares ofland respectively. Thus, disparities in operational holdings across farm categories were foundsignificant. The status of irrigation was an important factor in realizing productivityper unit of land. More than 70 per cent of land operated by farmers at the aggregatelevel was found irrigated. Comparatively land operated by large farm households wasmore irrigated (77.33 per cent). We had also sought information about source of irrigation during oursurvey. It was observed that tube wells and canal are major sources of irrigation in the area. Some farmerscombined tube wells and canal for watering their fields. The land rent ranged between Rs. 45-49 thousand/ ha in the study area.

Resource structure of sample farmers:

Land and other resources influence the level and pattern of farmmanagement in rural households. The efficient and optimal use of agricultural land depends on the availability of appropriate farm assets. We havecollected data related to the value of major farm assets excluding land, per farm as well as per acre owned by thesurveyed households. In our sampled households, each category of farmhouseholds possessed various inventories. Now, we will take up theownership of farm inventory by the selected farm households during thereference year. These include tractor, trolley, harrow, cultivator, electricmotor, diesel engine, submersible pump, spray pump, generator, cart, storage shed and small tools.The sampled farm households on an average possessed assets worth Rs. 4, 55,838 at the overall level. The farm size disparities were very wide. The smallcategory of farm households owned farm assets worth Rs. 2, 73,886 against Rs.10, 18,750 by the large farm category. It may be highlighted thatpresent value of farm assets increased with increasing size of holding and indicated a positive relationship. As expected, households in small category indicated lowest value of farm assets. While the large category of farm households owned the highest. It is apparent from the Table 5 that investment per unit of area per acre declined with an increase in farm size. The point to be noticed is that the sample farms of all categories, on an average owned almost all the needed assets. However the Tractor and tractor drawn implements accounted for about one-fourth (24.22 per cent) of the total investment followed by milch animals (22.96 per cent), farm building and cattle shed (14.52 per cent), tube well (13.45 per cent), chaff cutter (4.85 per cent), draught animals (4.84 per cent) and cart (1.76 per cent). Investment in remaining farm assets including transport means was very low (13.41 per cent). Results about the ownership of per

household assets for the entire sample covering all categories were on expected lines since large category indicated the highest value of farm assets during the study period.

Table 5: Category wise resource structure of sampled farms in Hisar district (semi-arid zone) **(in Rs.)**

Sr. no.	Particulars	Size							
		Small		Medium		Large		Overall	
		Per Farm	Per Acre	Per Farm	Per Acre	Per Farm	Per Acre	Per Farm	Per Acre
1.	Farm Building & Cattle shed	45135	14522 (16.48)	65000	9466 (10.75)	120625	7782 (11.84)	60167	12359(14.52)
2.	Tube well &Pumping Set	38108	12261 (13.91)	82333	11990 (13.62)	103250	6661 (10.13)	57850	11447(13.45)
3.	Draught Animals	14162	4557 (5.17)	32400	4718 (5.36)	15250	984 (1.50)	18867	4121(4.84)
4.	Tractors	41486	13348 (15.15)	136333	19854 (22.56)	235000	15161 (23.07)	91000	15216(17.88)
5.	Cultivators	3432	1104 (1.25)	10133	1476 (1.68)	16500	1065 (1.62)	6850	1192(1.40)
6.	Harrow	2649	852 (0.97)	11200	1631 (1.85)	11875	766 (1.17)	6017	1035(1.22)
7.	Leveler	1027	330 (0.37)	4467	650 (0.74)	14000	903 (1.37)	3617	487(0.57)
8.	Thresher	1622	522 (0.59)	8333	1214 (1.38)	23063	1488 (2.36)	6158	824(0.97)
9.	Seed Drill	1243	400 (0.45)	7333	1068 (1.21)	11500	742 (1.13)	4133	613(0.72)
10.	Trolley	2973	957 (1.09)	9667	1408 (1.60)	34500	2226 (3.39)	8850	1239(1.46)
11.	Bullock Cart	5892	1896 (2.15)	8267	1204 (1.37)	3162.5	204 (0.31)	6122	1497(1.76)
12.	Chaff-Cutter	16000	5148 (5.84)	19867	2893 (3.29)	26750	1726 (2.63)	18400	4128(4.85)
13.	Plough	1697	546 (0.62)	10800	1573 (1.79)	7325	473 (0.72)	4723	793 (0.93)
14.	Buffalo	63703	20496 (23.26)	106400	15495 (17.60)	158000	10194 (15.51)	86950	17872(21.00)
15.	Cow	6649	2139 (2.43)	6267	913 (1.04)	13575	876 (1.33)	7477	1664(1.96)
16.	Others	28108	9043 (10.26)	85633	12471 (14.17)	224375	14476 (22.02)	68658	10625(12.48)
Total		**273886**	**88120 (100.00)**	**604433**	**88024 (100.00)**	**1018750**	**65726 (100.00)**	**455838**	**85110 (100.00)**

Figures in parentheses show per cent to the total investment on different categories.

Agriculture- Livestock Integration.

In principle, undistorted process of crop livestock integration mitigates the negative effects of expansion of cultivation by reducing pressure on the remaining rangelands. Furthermore, mixed farming systems represent, at least partially, a closed system, which allows the waste products from one enterprise (crop residues), which would otherwise be loaded on to the natural resource base, are used by other enterprise which returns its own waste products (manure) back to the first enterprise Livestock is a source of sustenance and good health to man, in providing not only food security but also nutritional security.

Table 6: Average number of livestock maintained on sampled farms in Hisar district

Category of Animals	Small	Medium	Large	Overall
Milch cow	0.32 (7.89)	0.27 (4.60)	0.63 (9.80)	0.35 (7.24)
Milch buffalo	1.46 (35.53)	2.27 (39.08)	2.75 (43.14)	1.83 (37.93)
Cow heifer	0.24 (5.92)	0.40 (6.90)	0.25 (3.92)	0.28 (5.86)
Buffalo heifer	1.32 (32.24)	1.53 (26.44)	2.00 (31.37)	1.47 (30.34)
Bullock	0.62 (15.13)	1.20 (20.69)	0.75 (11.76)	0.78 (16.21)
Camel	0.05 (1.32)	0.07 (1.15)	0.00 (0.00)	0.05 (1.03)
He- buffalo	0.08 (1.97)	0.07 (1.15)	0.00 (0.00)	0.07 (1.38)
Total	4.11 (100.00)	5.80 (100.00)	6.38 (100.00)	4.83 (100.00)

Figures in parentheses show per cent to the total livestock

To achieve a true foodsecurity, food should not only be available to individuals of a household, thefood should be adequate and biologically balanced such that the nutrientstherein, when absorbed upon digestion, would meet the maintenance andphysiological requirements of the individuals.During the study, it was observed that being near to district headquarter, dairying is a popular subsidiary occupation of selected farm households in study area. Among livestock, 45 per cent were milch animals comprising 37.93 per cent of buffaloes and 7.24 per cent of cow with a 36 per cent of young stock while 19 per cent of total livestock were used as draught animals on the sampled farms (Table 6).

Cropping Pattern:

Crop pattern signifies the proportion of cultivated area under different crops ata point of time. Crop pattern of an area depends on agro-climatic conditions like soil, water and temperature.Crops are grown mainly in twoseasons- kharif and Rabi. Farmer's decision to grow a particular crop during a season is mostly based onprofitability, resource availability, requirement for domestic consumption, payment inkind and feed for the livestock.Since, one of our main objectives is to assess the cost of cultivation and thereturns generated from crops grown by the sampled farmers in study area, it ispertinent to examine crop pattern adopted by the sampled farm households. Theinformation about the cropping pattern of sampled farmers was collected during thestudy, and these results are presented in Table 7.

Table 7: Average cropped area &cropping pattern on sampled farms in Hisar district (ha/ farm)

Crop		**Small**	**Medium**	**Large**	**Overall**
Cotton	Desi	0.1 (6.76)	0.16 (5.28)	0.4 (5.69)	0.16(5.94)
	American	0.83 (56.08)	1.37 (45.21)	3.3 (46.94)	1.29(49.64)
Pearl millet		0.17(11.49)	0.52 (17.16)	1.1 (15.65)	0.38(14.63)
Cluster bean		0.26(17.57)	0.68 (22.44)	1.68 (23.90)	0.55(21.26)
Moong bean		0.05(3.38)	0.2 (6.60)	0.3 (4.27)	0.12(4.63)
Jowar		0.07(4.73)	0.1 (3.30)	0.25 (3.56)	0.10(3.89)
Kharif		**1.48 (100.00)**	**3.0 (100.00)**	**7.03 (100.00)**	**2.61 (100.00)**
Wheat		0.86(56.58)	1.6 (52.22)	3.84 (52.75)	1.45(53.92)
Gram		0.07(4.61)	0.12 (3.80)	0.4 (5.49)	0.13(4.69)
Mustard		0.42(27.63)	0.92 (29.11)	1.94 (26.65)	0.75(27.71)
Barley		0.1(6.58)	0.32 (10.13)	0.78 (10.71)	0.25(9.11)
Berseem		0.07(4.61)	0.15 (4.75)	0.32 (4.40)	0.12(4.57)
Rabi		**1.52 (100.00)**	**3.16 (100.00)**	**7.28 (100.00)**	**2.70 (100.00)**
Total cropped area		3.00	6.19	14.31	5.31
Total cultivable area		1.54	3.20	7.50	2.75
Cropping intensity		**194.81**	**193.44**	**190.80**	**192.93**

Figures in parentheses show per cent to the total cropped area in respective season

According to the survey, cotton in Kharif and wheat in Rabi dominated the crop pattern of sample farm households at the aggregate level. This result was found uniform for all categories although share of net area sown (NAS) devoted to these crops varied in each farm size. Cotton (55.58 per cent) followed by cluster bean (21.26 per cent), pearl millet(14.63 per cent) was observed as the important crops in terms of net area sown devoted in kharif season by the sampled households while area allocated under moong beanwas (4.63 per cent) and fodder crop jowar (3.89 per cent). In Rabi season, area allocated was under wheat (58.61 per cent) followed by rapeseed and mustard (27.71per cent), gram (4.69 per cent) and berseem (4.57 per cent).

It is clear from the table thatcropping pattern of the study area was dominated by wheat, gram, pearl millet, cotton and mustard crops howeverless than 5 per cent of gross cropped area (GCA) was devoted to kharif pulses(moong bean) and Rabi pulses (gram) despite their highly nutritive value, nitrogen fixingcapacity and low requirement of irrigation. Farmers also grew fodder in kharif andrabi seasons in order to feed their dairy animals. Itmay be noted that proportion of gross cropped area (GCA) allocated to various crops grown by farmersvaried significantly across farm sizes. Overall average cropping intensity of the study area was 192.93 percent ranged between 190.80 to 194.81 per cent on different category of farms.

Cropping System

Table 8: Area, production and productivity of the cotton-wheat cropping system in Haryana.

Year	Cotton			Wheat		
	Area 000 ha	Production 000 bales	Productivity Kg/ ha	Area 000 ha	Production 000 tonnes	Productivity Kg/ ha
2004-05	621.2	2075	568	2316.7	9043	3901
2005-06	583.8	1502	437	2302.7	8853	3844
2006-07	527.7	1805	581	2377.1	10059	4232
2007-08	482.5	1882	664	2460.7	10232	4158
2008-09	456.1	1862	694	2461.4	11360	4614
2009-10	505.1	1918	646	2487.7	10488	4215
2010-11	493.3	1747	510	2504	11578	4624
2011-12	602	2616	739	2531.3	13119	5183
2012-13	593	2378	681	2496.9	11117	4452
2013-14	567	2027	608	2499.1	11800	4722
2014-15	648	1943	510	2601	10354	3981
2015-16	615	993	274	2511	11011	4385

Source: Statistical Abstract of Haryana & CAB, Crop Cutting 2016

It is evident from Table 8 that production and productivity of cotton in the state of Haryana showed a declining trend from 2011-12. Although cotton is treated as cash crop however farmers are fed up with the dismal performance of cotton crop. Keeping in view the decline in productivity due to severe infestation of white fly in cotton, farmers are in search of some feasible as well as economically viable alternate crop enterprise for cotton-wheat cropping system.

Economics of the existing cropping pattern of the sampled farms in Hisardistrictof Haryana

Economics or profitability of various crops is the most important determinant of production of agricultural commodities governing the behaviour of producers. In reality, perceptions of profitability derive crop options. Farmers grow crops, which offer thehighest returns per unit of their precious resources such as land, water and other expensive inputs. Profitability being a catalytic factor in increased production of agricultural commodities, it is analyzed related issues such as input use pattern, cost of cultivationand economics of production of existing vis-à-vis alternative crops grown in kharifand rabiseason on the sampled farms in Hisar district (Zone – II) of Haryana during 2015-16. The analysis of gross and net returns from cultivation of selected

Table 9: Cost and returns of existing kharif crops in Hisar district of Haryana (Rs. /ha)

Particulars	Cotton(Bt)	Cluster bean	Pearl millet	Moong bean
Variable cost	45198	24185	18373	26038
Total cost	83963	50572	39415	56873
Gross returns	67943	55075	35768	61875
Returns over variable cost	22750	30890	17395	35835
Returns over total cost (Net Returns)	-16018	4503	-3648	5003
B: C Ratio	0.8	1.09	0.92	1.09
Average Yield (Kg./ha)	1592	1100	2250	1125

Crops are based on data collected during the field survey from selected respondents. The discussion is confined to cotton, pearl millet, cluster bean, pigeon pea and moong beaninkharif season and wheat, barley, mustard and gram in Rabiseason. Further, net returns from these selected crops are computed. The variable costs constituted human labour (hired and family), livestock labor, machine labour, seed, fertilizer, plant

protection, manure, irrigation, interest on working capital, risk and management factor which is 10 per cent each of variable cost. The net returns for each crop were worked out by subtracting total costs (variable+fixed) from gross returns. Gross returns for these crops were calculated on the basis of the value of the main product and by product.

The details of cost incurred by the selected respondents on various inputs in crop grown in kharifseason are presented in Table9.The per hectare total cost of cultivation of cotton, cluster bean, pearl millet and moong beanwere observed Rs. 83963, 50572, 39415 and 56873 respectively, whereas variable cost wereRs. 45198, 24185, 18373 and 26038 per hectare respectively on sampled farms. Highest returns over total cost were observed from moong bean(Rs. 5003) followed by cluster bean (Rs. 4503)per hectare whereas in case of cotton and pearl millet, it was found negative i.e.Rs, -16018 and -3648 per hectare respectively. As far as per hectare returns over variable cost was concerned, highest returns observed in case of moong bean followed by cluster bean, cotton and pearl millet i.e. Rs. 35835, 30890, 22750 and 17395 per hectare respectively.

Table10: Cost and returns of existing rabi crops in Hisar district of Haryana(Rs. /ha)

Particulars	**Wheat**	**Barley**	**Mustard**	**Gram**
Variable cost	34928	25658	24575	22770
Total cost	71700	60415	52665	49750
Gross returns	81605	62623	55430	50943
Returns over variable cost	46678	36965	30855	28173
Returns over total cost	9905	2208	2765	1193
B: C Ratio	1.14	1.04	1.07	1.02
Average Yield (Kg./ha)	4538	4375	1550	1412

The details of cost incurred by the selected respondents on various inputs and returns from crop grown in Rabi season are presented in Table10.The per hectare total cost to cultivate wheat, barley, mustard and gram werefound Rs. 71700, 60415, 52665 and 49750 whereas variable cost were observed Rs. 34928, 25658, 24575 and 22770 per hectare respectively on sampled farms. Highest returns over total cost were observed from wheat followed by mustard and barley i.e. Rs. 9905, 2765, 2208 per hectare respectively whereas, least returns over total costs were found in case of gram i.e. Rs.

1193 per hectare.As far as per hectare returns over variable cost was concerned, highest returns was also observed in case of wheat followed by barley, mustard and gram i.e. Rs. 46678, 36965, 30855 and 28173 respectively.

Table 11: Cost and returns of different fruit crops in Hisar district of the Haryana (Rs. /ha)

Particulars	Fruits		
	Guava	Ber	Kinnow
Ist Year Establishment cost	117975	91612	127650
Variable cost	73150	47007	78072
Total cost	164580	101032	175185
Gross returns	225000	129375	287500
Returns over variable cost	151850	82370	209430
Returns over total cost	60420	28342	112315
B: C Ratio	1.37	1.28	1.64
Average Yield (Kg./ha)	18750	11250	25000

The details of cost incurred by the selected respondents on various inputs and returns fromfruit crops are presented in Table-11.Per hectare highest establishment cost as well as operational cost were observed in case of kinnow orchard (Rs. 127650 and 78072)followed by guava and ber i.e. Rs.117975, 73150 and 91612, 47007 respectively. As far as profitability was concerned, highest returns over total cost was foundfromkinnowwhich is Rs. 112315 followed by guava and ber i.e. Rs. 60420 and 28342 per hectare respectively. The table result revealed that kinnow was found most profitable fruits with highest benefit cost ratio (1.64) than guava and ber orchard.

Most of the farmers grow the fodder crop in order to meet out the feedingrequirements of their livestock reared only for fulfillment of their domestic requirements rather than commercials purpose. The cost of cultivation as well as returns from fodder crops are presented in Table 12 .The total cost to cultivate the berseem as well as jowar fodder crop was observed Rs. 68508 and 47868 per hectare respectively, whereas variable cost of cultivation was found Rs. 30185 and 19993 per hectare respectively. Returns over total were observed Rs. 15745 and 10018 per hectare. It was evident from the table among the fodder crops, berseem was found profitable over jowar with highest benefit cost ratio 1:24.

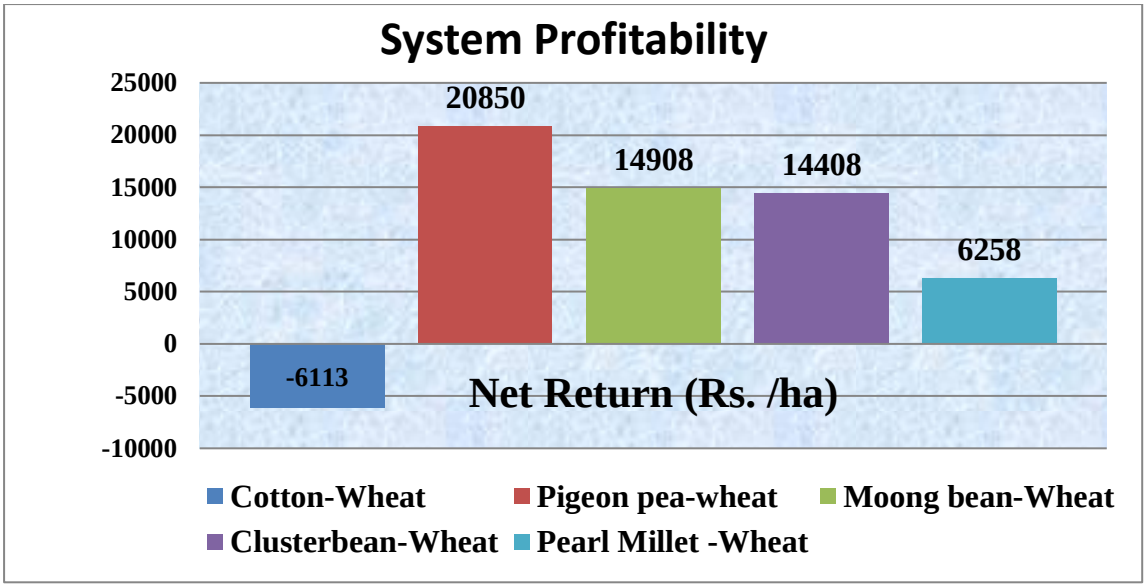
Table 12: Cost and returns of existing fodder crops in Hisar district of the Haryana (Rs. /ha)

Particulars	Berseem /Oat	Jowar
Variable cost	30185	19993
Total cost	68508	47868
Gross returns	84253	57883
Net Returns over variable cost	54068	37890
Net Returns over total cost	15745	10018
B: C Ratio	1.24	1.24
Average Yield (Kg./ha)	57500	50000

Alternative Cropping Patterns

Cotton - wheat is the predominately cropping system especially in semi-arid zone of the state. After the introduction of Bt. cotton, productivity and profitability has drastically increased and due to that cotton-wheat growers enjoyed maximum profitability per unit area. But from the last some years, due to high incidence of white fly in Bt. cotton crop, cotton – wheat cropping system became least profitable in semi-arid zone of the state. The cultivation of alternative crops in kharif including vegetables and fruits has ample scope when profitability/returns from alternative crops are ensured to farmers through effective price policy and availability and affordability of technology for better yield levels. In this backdrop, we have examined the comparative returns from cotton – wheat cropping system and alternative cropping systems i.e. Cluster bean – Wheat, Moong bean – Wheat, Pearl millet – Wheat and some vegetable and fruits crops on sampled farmsduring study period 2015-16.

Fig. 1: Comparative analysis of profitability of different cropping systems



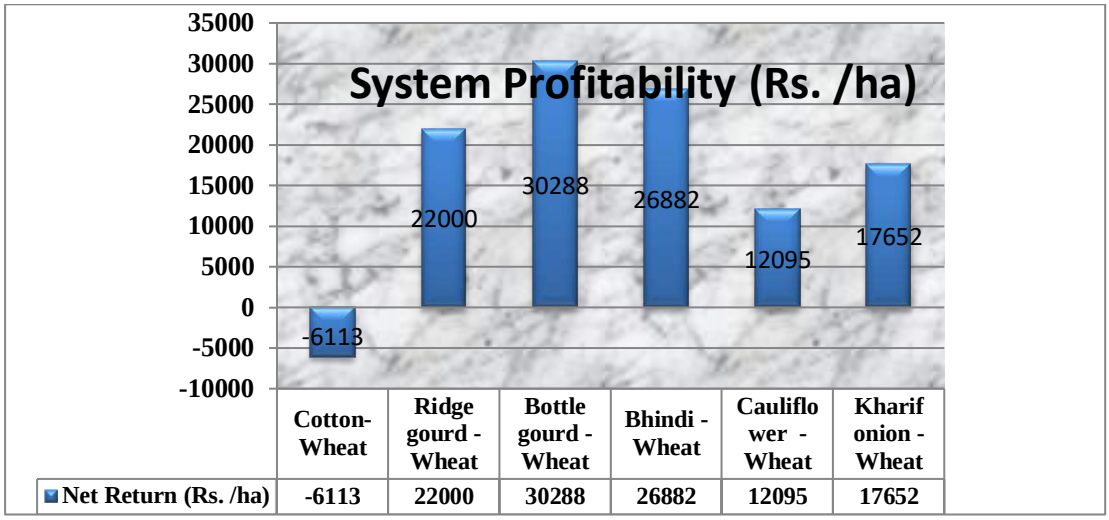
Comparative profitability as well as cost and returns analysis of cotton – wheat cropping system vis – a - vis possible alternative cropping system are presented in Table 13.It was clearly indicated from the results that pigeon pea – wheat, moong bean– wheat, cluster bean – wheat, pearl millet – wheat were found profitable cropping system over cotton– wheat cropping system with net returns of Rs. 20850,14908, 14408 and6258 per hectare respectively, as compare to negative net returns from cotton – wheat cropping system i.e. Rs. -6113 per hectare. As far as per unit total cost of cultivation was concerned, cotton – wheat cropping system (Rs. 155663/ha)was found costlier as compare to pigeon pea – wheat, moong bean - wheat, cluster bean – wheat, , pearl millet – wheat cropping system i.e. Rs. 135750, 128573, 122272and 111115 respectively.

Table 13: System profitability of cotton-wheat vis-à-vis alternative cropping patterns in Hisar district of Haryana (Rs. /ha)

Particulars	Cotton - Wheat	Pearl millet - Wheat	Cluster bean - Wheat	Moong bean - Wheat	Pigeon pea - Wheat
Variable cost	80125	53300	59113	60965	66844
Total cost	155663	111115	122272	128573	135750
Gross returns	149548	117373	136680	143480	156600
Returns over variable cost	69428	64073	77568	82513	89756
Returns over total cost	-6113	6258	14408	14908	20850
B: C Ratio	0.96	1.06	1.12	1.12	1.15

Comparative economic analyses of cotton - wheat cropping system vis-a-vis different vegetable crops are presented in table 14. The result revealed that bottle gourd – wheat (Rs. 30288/ha), bhindi – wheat (Rs. 26882/ha), ridge gourd – wheat (Rs. 22000/ha), onion – wheat(Rs. 17652/ha)

Fig. 2: Comparative analysis of profitability of different cropping systems (Vegetables)



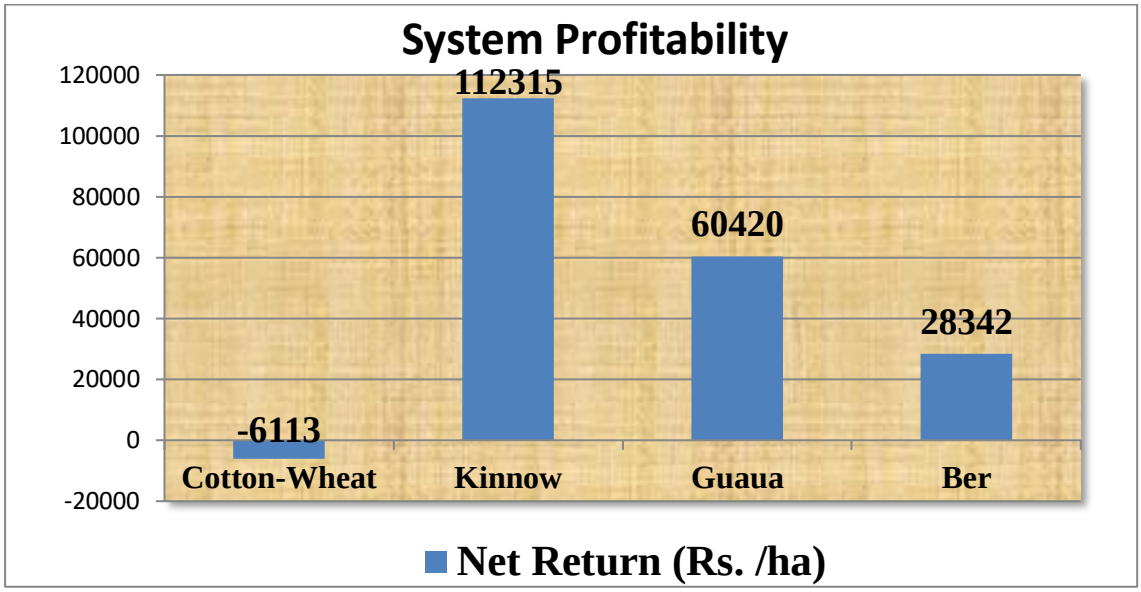
and cauliflower – wheat (Rs. 12095/ha) were observed profitable cropping system over cotton – wheat (Rs. -6113/ha) copping system. Whereas per hectare highest cost of cultivation were observed in case of bhindi – wheat (Rs. 229723/ha) followed by kharif onion – wheat (Rs. 221453/ha), bottle gourd – wheat (Rs. 211317/ha), ridge gourd – wheat (Rs. 209605/ha) and cauliflower – wheat (Rs. 175760/ha) respectively. It concluded from the results that vegetables crops may also viable options especially for marginal and small holders to replace some of the cotton area by the suitable vegetables as per available resources (Fig. 2).

Table 14: System profitability of cotton-wheat vis-à-vis alternative vegetable crops in Hisar district of Haryana (Rs. /ha)

Particulars	Cotton-Wheat	Ridge gourd - Wheat	Bottle gourd - Wheat	Bhindi - Wheat	Cauliflower - Wheat	Kharif onion - Wheat
Variable cost	80125	124640	126065	139011	95603	133681
Total cost	155663	209605	211317	229723	175760	221453
Gross returns	149548	231605	241605	256605	187855	239105
Returns over variable cost	69428	106965	115540	117594	92252	105424
Returns over total cost	- 6113	22000	30288	26882	12095	17652
B: C Ratio	0.96	1.10	1.14	1.12	1.07	1.08

Comparative economic analysis of cotton - wheat cropping system vis-à-vis fruit crops are presented in table 15and figure 3. It was clearly indicated from the table that kinnow was found most profitable with per hectare highest net returns Rs. 112315 followed by guava (Rs.60420/ha) and ber (Rs. 28342/ha) over cotton - wheat cropping systemi.e.

Fig. 3: Comparative analysis of profitability of different cropping systems (Fruits)



Rs.-6113 per hectare. As far as per rupee investment was concern, again, all the fruit crops like kinnow, guava and ber was found viable option with benefit cost ratio 1.64, 1.37 and 1.28 as compare all the existing as well as possible cropping system like cotton - wheat, pigeon pea-wheat, moong bean-wheat, cluster bean-wheat and pearl millet - wheat with benefit cost ratio 0.96, 1.15, 1.12 and 1.06, respectively. It was concluded from the results that fruits crops may also viable as well as economically feasible options especially for large farmers to acquire more profitability from per unit area (Fig. 3).

Table 15: System profitability of cotton-wheatvis-à-vis alternative fruit crops in Hisar district of Haryana (Rs. /ha)

Particulars	Cotton - Wheat	Fruits		
		Guava	Ber	Kinnow
Establishment cost		117975	91612	127650
Variable cost	80125	73150	47007	78072
Total cost	155663	164580	101032	175185
Gross returns	149548	225000	129375	287500
Returns over variable cost	69428	151850	82370	209430
Returns over total cost	-6113	60420	28342	112315
B: C Ratio	0.96	1.37	1.28	1.64

Finally, it was concluded through the study that pigeon pea –wheat , moong bean – wheat , cluster bean – wheat, pearl millet – wheat may be viable alternative option for the predominating cotton –wheat cropping system with per hectare net returns of Rs.

20850, 14908, 14408and 6258 respectively, as compare to negative net returns from cotton – wheat cropping system i.e. Rs.-6113. These viable alternative cropping system not only save the per unit cost of cultivation but also helps in improve the soil fertility status due to introduction of pulses crop in between the cropping system. Secondly fruits orchards like kinnow, guava,berand vegetables like ridge–gourd, bitter-gourd, bhindi, cauliflower and kharif onion would also be viable options with highest net profitability as well as per rupee investment over cotton - wheat cropping system.

Problems and constraints faced by the farmers

It is well known fact that biotic as well as abiotic factors affect crop production and sustainability of agricultural production.Inthese conditions, diversification within the existing cropping system as well among the other viable cropping system can reduce the risk in agriculture rather than monoculture in agricultural activities. Various problems as well as constraints faced by the farmers of the study area are presented in Table16.

Table 16: Problems/constraints faced by the farmers in existing cropping system in Hisar district of Haryana (N = 60)

Disease		
S. No.	**Particulars**	**Overall (Per cent response)**
1	Stem rot in mustard	65.00
2	Bacterial leaf blight in cluster bean	53.33
3	Leaf curl virus and Wilt in cotton	36.60
4	Yellow rust and nematodes in wheat	15.00
5	Grain smut, powdery mildew and ergot in pearl millet	10.00
Insects/pests		
1	white fly and aphid in Cotton	95.00
2	Jassid in cluster bean	85.00
3	Mustard aphid	68.33
4	Root bug in pearl millet	35.00
5	Aphid in wheat	31.66
Weeds		
1	Phalaris minor in wheat	70.00
2	Orobanche in mustard	58.33
3	Chenopodium album in gram	55.00
Environmental problems		
1	Drought at sowing and fruiting stage	18.33
2	Less, untimely and uneven distribution of rains	35.00
3	Higher temperature at sowing, fruiting and maturity stage	25.00
4	Lower temperature at growth and maturity stage	15.00

Non-availability of inputs		
1	Lack of Irrigation facility and poor quality underground water	83.33
2	Shortage of farm labour	71.66
3	Small and fragmented land holding	28.33
4	Lack of credit facilities	38.33
5	Non-availability of quality seeds, chemicals/Pesticides & fertilizers	66.66
Marketing problems		
1	Variability in the prices of agricultural produce	93.33
2	Difficult to access information regarding demand, supply and price of agricultural commodities	61.66
3	Lack of storage facilities	21.66

The result indicated that the 65 percent of the farmers rated stem rot as major disease in mustard, followed by bacterial leaf blight in cluster bean (53per cent), leaf curl virus and wilt in cotton (37per cent), yellow rust and nematode problem in wheat (15 per cent)and grain smut, powdery mildew and ergot in pearl millet (10 per cent). 95 percent of farmers stated thatwhite fly and aphid as major insect pest problem in cotton crop followed by Jassid in cluster bean (85 per cent), mustard aphid (68 per cent), root bug in pearl millet (35 per cent) and aphid in wheat crop, which causes damage to the quantity and quality of agriculture produce. Weeds infestation is also a major problem for the different cropping system, as they compete with the crops for water, soil, nutrients and sun light. Therefore, timely and appropriate weed control greatly increases the crop yield. The 70 percent of the cultivators opined that phalaris minor in wheat, followed by orobanche (58 per cent), chenopodium album in gram (55per cent) identified as major weeds problem which hamper the productivity of these crops at large extent. Environmental factor is also one of the major factors which effects the allocation of area under particular crops as well as productivity of the crops. It reveals from the survey results that 15 to 35 percent of the farmers opined that environmental factors like drought at sowing and fruiting stage, less, untimely and uneven distribution of rains, higher temperature at sowing, fruiting and maturity stage andlower temperature at growth and maturity stage were the major variables which effects the area and productivity of the crops at considerable level.

Lack of irrigation facilities as well as poor quality underground water (83per cent), followed by Shortage of labor (72 per cent), small and fragmented of land holding (28

per cent), lack of credit facilities (38 per cent) and non-availability of quality chemicals/pesticides (67 per cent) were observed as major constraints in the study area. While fluctuations in market prices of commodities (93 per cent), difficulty in accessing information regarding demand, supply and prevailing prices of agricultural commodities (62 per cent) and lack of scientific storage facilities (22 per cent) were observed as problems related to marketing in study area.

Major findings of the study

1. Pigeon pea-wheat, moong bean-wheat andcluster bean-wheat cropping system were observed profitable over cotton- wheat cropping system followed by the farmers in the study area.
2. Kinnow, guava and ber fruits orchard emerged as viable option for diversification over cotton- wheat cropping system especially for the large farmers in the study area.
3. Vegetable crops like bottle gourd, bhindi, ridge gourd, onion and cauliflower may be feasible options for the marginal and small categories of farmers to switch over some area from cotton towards these vegetable crops.
4. Bacterial leaf blight in cluster bean, Leaf curl virus in cotton were identified the major diseases which effects the agriculture production.
5. Cotton white fly, aphid and Jassid were considered major insect pest that hamper the productivity of respective crops at large extent.
6. *Phalaris minor* in wheat and *orobanche* and *chenopodium album* in mustard were identified major weeds in the study area.
7. Drought, low, untimely and uneven distribution of rains and higher as well as lower temperature were found major environmental factors which responsible for area, production and productivity of crops grown in the study area.
8. Lack of irrigation facility and poor quality underground water, shortage of labor, small and fragmented land holding, lack of credit and non-availability of quality seeds, chemicals/pesticides& fertilizers were observed farm input related major constraints.
9. Variability in prices of agricultural produce, lack of market information system leads to difficulty in accessing demand, supply and price of agricultural commodities.Lack of storage facilities at village level was observed as one of marketing problems in the area.

Sub-Project II: Pattern and extent of crop diversification in Haryana

i. Objectives:

1. To study cropping pattern of the state.
2. To examine the extent of crop diversification in different zones of Haryana.
3. To analyze factors affecting crop diversification.

ii. Year of Start **:** 2013-14

iii. Period of study **:**2013-16

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
J. C. Karwasra	Planning, Monitoring and Execution
V. K. Singh	Selection of respondents, data collection, analysis of data.
Jitender Bhatia	Data collection, compilation and analysis of data.
Dalip Kumar Bishnoi	Data collection, compilation and analysis of data.

v.Work done during 2015-16:

Method of Study:

The study was conducted in the state of Haryana. It was based on secondary data collected from published and unpublished sources. The relevant information about the state as well as districts were obtained from various issues of the Statistical Abstract of Haryana, Government of Haryana; Agricultural at a Glance, Ministry of Agriculture, Govt. of India. Further, the time series data on area, production and yield of paddy and alternative/competing crops for selected districts and state were also culled out from this source. The data were analysed as per requirement and presented under various sub-headings.

Cropping pattern of the state

The district wise cropping systemsprevailing in the state are presented in Table 17. The table revealed that paddy – wheat cropping system dominated in most of the districts like Ambala, Karnal, Kaithal, Kurukshetra, Panipat, Sonepat and Rohtak in the state. Whilecotton – wheat cropping system was dominated in Hisar, Sirsa and Jind. Maize and sunflower showed presence in Ambala and Yamunanagar district of the state. The oilseed and pulses are dominated in Rewari, Mahendergarh and Bhiwani district in the state.

Table17: Cropping pattern of different districts of Haryana

District	Cropping pattern
Ambala	Paddy – Wheat, Maize / Sunflower – Paddy - Vegetables, Sugarcane – Wheat –Paddy
Yamunanagar	Sugarcane based intercropping, Maize / Sunflower – Paddy - Vegetables, Paddy – Wheat
Kurukshetra	Paddy – Wheat, Sugarcane – Wheat
Kaithal	Paddy – Wheat, Cotton – Wheat
Karnal	Paddy – Wheat, Sugarcane based cropping system– Wheat
Panipat	Paddy – Wheat and Sugarcane
Sonepat	Paddy – Wheat Sugarcane – Paddy and Mustard
Rohtak	Paddy – Wheat, Cotton – Wheat/Barley/Mustard and Sugarcane
Faridabad	Pearl millet/Cluster bean/Cotton – Barley/Wheat/Sugarcane/Mustard
Gurgaon	Pearl millet/Cluster bean – Wheat/Barley/Mustard
Rewari	Pearl millet/Cluster bean – Wheat/Mustard/Barley/Gram
Mahendergarh	Pearl millet/Cluster bean – Wheat/Mustard/Barley/Gram
Bhiwani	Pearl millet/Cluster bean/Cotton – Wheat/Mustard/Barley/Gram
Jind	Cotton/ Pearl millet - Wheat, Paddy – Wheat/ Barley/Gram
Hisar	Cotton/ Pearl millet - Wheat, Paddy – Wheat/ Barley/Gram
Sirsa	Cotton - Wheat, Paddy – Wheat/ Barley/Gram

Percentage of gross cropped area under important crops

Decadal percentage of gross cropped area under major crops in the state was presented in the Table 18.The major crops of Haryana were wheat, rice, sugarcane, cotton, oilseeds, gram, barley andpearl- millet. The major kharif crops of Haryana are rice, cotton,pearl millet, maize, sugarcane, sesame and groundnut. The major Rabi crops are wheat, gram, rapeseed and mustard. However agriculture sector shows a satisfactory performance in all the crops production and area except coarse cereal and pluses but in case of maize and gram shows worse trends over the periods.It was evident from the results that over the decades the area of major cereal crops increased

from 1967 thousand hectare to 3763 thousand hectare whereas area under major pulses crop has drastically decreased (from 14.55 thousand hectare to 1.89 thousand hectare). This was mainly due to assured higher net returns from cereals crops. Gram is the major pulse crop grown in the state but due to expansion of irrigation facilities, it showed a steep decline in area sown under the crop (12.19 thousand hectare to 1.22 thousand hectare).

Table 18: Decadal percentage of gross cropped area under important crops in Haryana

Year	GCA* ('000 ha)	Rice	Wheat	Pearl millet	Maize	Gram	Total Pulses	Other Food Grains	Total Food	Mustard	Cotton	Other Crops
1980-81	5462	8.86	27.07	15.92	1.3	12.19	14.55	4.84	72.54	5.49	5.79	16.18
1990-91	5919	11.17	31.25	10.28	0.58	10.96	12.53	3.1	68.91	8	8.29	14.8
2000-01	6115	17.24	38.5	9.94	0.25	2.03	2.56	2.54	71.03	9.08	9.08	13.2
2011-12	6489	19.02	39.01	8.87	0.17	1.22	1.89	1.64	70.6	8.25	9.27	11.88

*Gross Cropped Area
Source: Director of Land Records, Haryana

Trend in area of major crops

The trends in area under important crops grown in kharif as well as rabi season in Haryana during the triennium ending (TE) 1970-71 to (TE) 2013-14 are presented in Table 19. The table reveled the acreage under total food grain has increased from 3617 thousand hectare to 4505 thousand hectare which was 25 percent increment during the study period. Maximum expansion in acreage was observed under paddy which was 398 per cent followed by wheat 147 per cent in food grain crops. Whereas acreage under gram (-92 per cent), Maize (-90per cent), jowar (-70per cent), barley (-66per cent) and pearl millet (-48 per cent) has declined during the study period. In oilseed crops, acreage under rapeseed mustard increased 418 percent which was highest as compare to total acreage increased under total oilseed crops (368 per cent). In commercial crops, acreage under cotton crop increased more than two hundred percent whereas in case of sugarcane it has declined 39 percent during the study period. In a nutshell, pattern of area allocation in food grain crops during the TE 1970-71to 2013-

14 in Haryana was found highest increment in paddy, wheat whereas skewed under gram, maize jowar, barley and pearl millet which require minimum irrigation. Shifts in area and crop pattern changes can lead either to crop specialization or to crop diversification andthis trend could be due to partly to their yield advantages as well as assured higher maximum returns per unit of area from paddy - wheat created by irrigation expansion and Green Revolution technologies and partly to government policies pursued to encourage food production and eliminate food imports. As a result, there was a tendency towards cereal centered specialization. Whereas the specialization tendency also witnessedin oilseed as well as cotton crops due to the increasing demand and severe supply shortage of oilseeds for cooking oil and feed & fiber in national and international market and changes in consumption pattern of population.

Table 19: Trends in area of major crops in Haryana (TE 1970-71, to TE 2013-14) (Area 000 ha)

Crop	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2010-11	2013-14	per cent change
Rice	246	290	386	559	635	794	1055	1029	1189	1226	398
Jowar	215	170	167	139	129	109	108	96	83	64	-70
Pearl millet	895	961	905	745	674	551	593	615	603	464	-48
Maize	104	127	102	55	40	28	18	16	13	10	-90
Wheat	1015	1174	1396	1730	1845	1984	2324	2312	2473	2506	147
Barley	140	185	97	78	55	43	36	26	48	47	-66
Gram	908	935	1081	677	606	394	123	120	113	76	-92
Total food grains	3617	3922	4205	4058	4069	3974	4295	4275	4577	4505	25
Rapeseed & Mustard	105	168	133	283	429	578	463	677	511	545	419
Total oilseed	120	184	146	297	442	611	478	698	561	562	368
Cotton	200	251	264	347	465	590	576	577	485	606	203
Sugar cane	162	156	185	117	139	125	147	141	83	99	-39

Trend in production of major crops

The trends in productionof important crops grown in kharifas well as rabiseason in Haryana during the triennium ending (TE) 1970-71 to (TE) 2013-14 are presented in Table 20.The results revealed that incase of food grain crops , the maximum increment

in production was witnessed by paddy i.e. from 368 thousand tonnes to 3910 thousand tonnes which was 963 percent followed by wheat (508 per cent), pearl millet (78 per cent) and barley (3 per cent) during the triennium ending(TE) 1970-71 to (TE) 2013-14. Whereas Gram (-90 per cent), maize (-76) and Jowar (-24 per cent) showed declining trend in production during the study period. In case of oilseed production, the production of rapeseed & mustard has increased from 66 thousand tonnes to 863 thousand tonneswhich was more than twelve hundred times. Whereas, in case of commercial crops, the highest increment in production was observed in case of cotton i.e. 544 per cent. This increment in production could be due to area expansion under particular crops and development of new high yielding, diseases resistant-stress tolerant varieties and awareness regarding scientific packages and practices of crops among the farmers.

Table 20: Trends in production of major crops in Haryana (TE 1970-71 to TE 2013-14) (000 Tones)

Crop	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2010-11	2013-14	er cent change
Rice	368	519	1003	1443	1676	2046	2668	2998	3554	3910	963
Jowar	45	43	28	31	44	28	22	26	42	34	-24
Pearl millet	524	505	405	448	640	486	690	819	1039	932	78
Maize	111	138	95	69	50	43	43	39	30	27	-76
Wheat	2006	2064	2993	4713	6189	7268	9585	9003	11107	12189	508
Barley	167	199	132	119	111	114	102	70	166	172	3
Gram	794	566	944	420	480	408	87	88	111	81	-90
Rapeseed & Mustard	66	85	77	242	513	778	648	861	895	863	1208
Cotton	363	461	514	640	1064	1260	1136	1661	1844	2337	544
S. cane	723	624	755	524	725	717	836	861	553	730	1

Trend in productivity of major crops

The trends in productivityof important crops grown in kharifas well as rabiseason in Haryana during the triennium ending (TE) 1970-71 to (TE) 2013-14 are presented in Table 21.The results revealed that during the triennium ending(TE) 1970-71 to (TE) 2013-14 in case of food grain crops, the maximum productivity has increased in pearl millet from 586 Kg/ha to2007 Kg/ha was 242 percent followed by barley (208 per cent), maize (164 per cent), wheat (148 per cent), jowar (145 per cent) and paddy (116 per cent). Fewer increments were observed in case of gram (25 per cent) among all the food

grain crops while in case of oilseed crops, the productivity of rapeseed & mustard has increased from 611 kg/ha to1585 kg./hai.e. 159 percent. Whereas in case of commercial crops, maximum increment in yield was witnessed in cotton i.e. 118 per cent followed by sugarcane which was 65 percent. The increment in productivity could be due to development of new high yielding, stress tolerant varieties and adoption of new technologies and mechanization in agriculture.

Table 21: Trends in yield of major crops in Haryana (TE 1970-71, to TE 2013-14) (Kg/ha)

Crop	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2010-11	2013-14	Per cent change
Rice	1476	1779	2586	2576	2634	2586	2531	2913	2994	3191	116
Jowar	211	249	168	224	333	255	205	267	500	517	145
Pearl millet	586	520	444	594	926	875	1164	1347	1722	2007	242
Maize	1044	1086	924	1242	1288	1546	2417	2377	2340	2761	164
Wheat	1963	1756	2138	2729	3356	3664	4125	3894	4492	4862	148
Barley	1193	1071	1371	1511	2010	2681	2825	2720	3418	3671	208
Gram	851	586	874	607	786	1035	690	737	958	1066	25
Rapeseed &Mustard	611	494	597	853	1193	1346	1394	1284	1754	1585	159
Cotton	310	312	330	320	388	364	342	486	647	676	118
Sugar cane	4459	3992	4164	4497	5223	5744	5683	6143	6680	7350	65

Compound growth rates of area, production and yield of important crops in Haryana

After presenting details of percentage of area, production and yield of important crops grown in Haryana over the periods, it would be worthwhile to understand the annual growth of these indicators in the selected sub- periods from 1970-71 to 1984-85, 1985-86 to 1999-2000, and 2000-01 to 2013-14 and entire study from 1970-71 to 2013-14 period at the state level. Table 22 indicates that area under paddy cultivation has increased at the rate of 3.74 per cent perannum during the study period that is the maximum growth experienced by any of the kharif season crop in Haryana. Further, production of paddy has also exhibited an increase of 4.97per cent per annum. Among the three sub-periods, first period was observed far more important in terms of area expansion and increase in yield in comparison to the remaining sub-periods.

Unfortunately, growth in productivity of paddy became negative during the second sub- period (1985-86 to 1999-2000).

Table 22: Compound annual growth rates of area, production and yield of major crops in Haryana (1970-71 to 2013-14) (Percent/Annum)

Year/Crop		1970-71 to 1984-85	1985-86 to 1999-2000	2000-01 to 2013-14	1970-71 to 2013-14
Rice	**A**	6.12	4.98	1.94	3.74
	P	9.82	4.78	3.62	4.97
	Y	3.51	-0.19	1.65	1.19
Jowar	**A**	-3.18	-0.64	-4.20	-2.08
	P	-4.12	-1.16	4.71	-0.64
	Y	-1.16	-0.48	9.34	1.48
Pearl millet	**A**	-1.17	-4.24	-1.85	-1.61
	P	-1.79	5.71	3.16	2.09
	Y	-0.63	6.83	5.05	3.62
Maize	**A**	-6.08	-6.40	-4.43	-6.18
	P	-6.38	-1.49	-2.95	-3.56
	Y	-0.34	5.19	1.58	2.81
Wheat	**A**	3.39	1.83	0.81	1.91
	P	6.22	4.19	2.51	4.38
	Y	2.74	2.32	1.69	2.42
Barley	**A**	-4.08	-5.57	4.36	-3.45
	P	-1.94	-1.23	7.43	-0.40
	Y	2.20	4.61	2.93	3.15
Gram	**A**	-3.97	-6.49	-2.71	-6.71
	P	-5.73	-4.68	0.64	-5.69
	Y	-1.83	1.91	3.44	1.10
Total food grains	**A**	0.26	0.80	0.70	0.34
	P	4.10	3.86	2.82	3.61
	Y	3.83	3.03	2.10	3.26
Rapeseed & Mustard	**A**	2.87	4.00	-0.23	3.90
	P	6.36	6.22	1.94	7.03
	Y	3.39	2.13	2.19	3.01

Total oilseed	**A**	2.64	4.35	0.05	3.82
	P	5.83	6.81	2.42	6.85
	Y	3.09	2.40	2.36	2.91
Cotton	**A**	3.85	3.94	-0.10	2.37
	P	4.02	3.19	6.38	4.01
	Y	0.17	-0.72	6.71	1.63
Sugar cane	**A**	-0.64	0.81	-5.16	-0.72
	P	-1.41	2.15	-3.04	0.77
	Y	-0.73	1.30	2.24	1.49

Likewise, area, production and yield of cotton recorded an increase of 2.37, 4.01 and 1.63 per cent per annum during the study period. Clearly, area expansion has played more important role in comparison to yield. The growth of cotton production was found highest (6.38per cent) between 2000-01 and 2013-14 due to remarkable increase in productivity that was recorded 6.71per cent per annum. These results are encouraging. It seems that adoption of Bt. technology by farmers for cultivation of cotton during this period has played an important role and contributed to the growth. The scenario of increase in acreage of coarse cereals i.e., jowar, pearl millet and maize is discouraging despite their nutritional value. However, production of pearl millet increased at the rate of 2.09 per cent per annum due to commendable growth of 3.62 per cent per annum in yield from the year 1970-71 to 2013-14.

As far as major rabi season crops was concerned, area under wheat cultivation has increased at the rate of 1.91 per cent per annum during the study period in Haryana. Further, production as well as productivity of wheat has also exhibited an increase of 4.38 and 2.42 per cent per annum. Among the three sub-periods, first period was observed far more important in terms of area, production and productivity increased in comparison to the remaining sub-periods. Unfortunately, growth in productivity as well as production of barley became negative during the first (1970-71 to 1983-84) and second sub- period (1985-86 to 1999-2000). Where as in third sub –period (2001-02 to 2013-14) area, production and productivity of barley has increased by rate of 4.36 and 7.43 and 2.93 respectively. As far as gram is concerned, area, production and productivity has witnessed negative trend in first period where as only productivity showed increased trend in second, third and also on overall basis. Area, production

and productivity of rapeseed and mustard have increased with the rate of 3.90, 7.03 and 3.01 per annum in the study area.

Regional crop specialization

Regional crop specialization of major crops over the different state was determined by using the Location Quotient technique. It is a simple and most wieldy used measure of regional crop specialization. For this analysis only those district were included for which complete series of required information were available.

Location Quotient

It is defined as the ratio of the share of acreage under a particular crop in the district to the share of that crop in the state total cropped acreage. This metric considers the relative position of a crop in a district with that of at the state level. The result reveals the degree of regional specialization in each crop. It is calculated as:

$$LQij = \frac{Aij/Aj}{Ai/A}$$

Where,

LQij = Location quotient of ith crop in jth district

Aij = Acreage of ith crop in jth district

Aj = Gross cropped acreage in jth district

Ai = Acreage of ith crop in jth state

A = Gross cropped acreage in the state

A value of location quotient equal to unity ($LQ_{ij} = 1$) indicates that the state and district proportions of a crop are equal, whereas a value below unity ($LQ_{ij} < 1$) means that the district is less specialized than the state. A value of quotient in excess of unity ($LQ_{ij} > 1$) indicates that the crop studied is more important or specialized in the district in relation of its importance at the state level. Larger the value of quotient indicates, higher the specialization of the district in the concerned crop. Also, observing location quotients over time show if a crop is becoming more or less specialized in the district. It is possible to increase the quotient even when the acreage under the crop in the district has shrink and vice-versa.

Table 23: Location quotient of maize, wheat, rice, mustard and cotton in different Districts

Districts	Maize			Wheat			Rice			Rapeseed &Mustard			Cotton		
	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III
Ambala	18.5	20.7	19.58	1.47	1.08	1.28	2.01	1.73	1.87	0.23	0.13	0.18	0.01	0	0.01
Yamuna Nagar	3	3.79	3.40	1.25	0.94	1.10	1.82	1.74	1.78	0.09	0.1	0.10	0	0	0.00
Kurukshetra	0.73	0.12	0.43	1.54	1.16	1.35	3.07	2.61	2.84	0.16	0.02	0.09	0.12	0	0.06
Kaithal	0.74	0.05	0.40	1.38	1.23	1.31	2.74	2.56	2.65	0.06	0.03	0.05	0.07	0.07	0.07
Karnal	0.72	0.19	0.46	1.02	1.19	1.11	3.07	2.63	2.85	0.03	0.02	0.03	0.01	0	0.01
Panipat	0.3	0.04	0.17	1.73	1.23	1.48	2.6	2.37	2.49	0.24	0.05	0.15	0.04	0	0.02
Sonepat	0.09	0.74	0.42	1.49	1.3	1.40	1.4	1.51	1.46	1.48	0.18	0.83	0.2	0.06	0.13
Rohtak	0.3	0.13	0.22	0.99	1.11	1.05	0.31	0.47	0.39	0.85	1.42	1.14	0.18	0.35	0.27
Faridabad	0.62	0.37	0.50	1.61	1.52	1.57	0.6	0.8	0.70	1.69	0.24	0.97	0.01	0.01	0.01
Gurgaon	0	0	0.00	0.79	1.04	0.92	0.12	0.15	0.14	1.83	1.76	1.80	0	0.01	0.01
Rewari	0	0	0.00	0.68	0.67	0.68	0.01	0.02	0.02	4.25	3.73	3.99	0.11	0.21	0.16
Mahendergarh	0.02	0	0.01	0.62	0.42	0.52	0	0	0.00	3.87	3.49	3.68	0.7	0.22	0.46
Bhiwani	1.15	0.01	0.58	0.18	0.49	0.34	0.02	0.1	0.06	0.69	2.26	1.48	0.39	0.87	0.63

Jind	0.18	0.15	0.17	1.52	1.23	1.38	1.18	1.24	1.21	1.19	0.21	0.70	3.16	1.14	2.15
Hisar	0.73	0.01	0.37	2.25	1.01	1.63	0.52	0.59	0.56	2.31	0.76	1.54	4.04	2.72	3.38
Sirsa	0	0	0.00	0.34	0.98	0.66	0.27	0.4	0.34	0.28	0.99	0.64	1.28	3.11	2.20

P-I (1991-92to 1999-00)

P-II (2000-01 to2011-12)

P-III (1991-92 to 2011-12)

The district wise location quotient of maize, wheat, rice, mustard and cotton are presented in Table 23. The entire period of the study divided into Period-I (1991-92 to 1999-2000), Period-II (2000-01 to 2011- 12) and Period-III (1991-92 to 2011-12). The study revealed that maize crop does its best in Ambala and Yamunanagar districts throughout the entire study period. The highest specialization of the crop is observed in the district Ambala with the quotient value 20.7 during Period-II implying that the share of maize crop in gross cropped area of the district is more than twenty times than the share of the crop in gross cropped area of the state.

If we look at the specialization of wheat, Ambala, Kurukshetra, Kaithal, Karnal, Panipat, Sonepat, Faridabad, Jind and Hisar districts remain specialized throughout the whole period. The Yamunanagar district enjoys specialization in wheat crop during Period-I and III while Rohtak district has acquired specialization during Period- II and III. The specialization of Gurgaon district in wheat is observed during Period-II only. The highest specialization is observed in Hisar district during Period-I (2.25) and period III (1.63) whereas during Period-II District Faridabad having highest specialization (1.52) in wheat. .

Rice crop remains specialized throughout the entire period in Ambala, Yamunanagar, Kurukshetra, Kaithal, Karnal, Panipat, Sonepat and Jind districts. The districts of Kurukshetra and Karnal, both having 100 per cent irrigated cropped areas, equally enjoy the status of highest specialization during Period- I (3.07) while Karnal continues at the top during Period- II (2.63) and Period-III (2.85) as well. The highest rice mills of the state are located in Karnal. As rice planting continued and diversified during the 1990s and 2000s, the value of location quotient for majority of districts has fallen steadily during the later period. Nonetheless, even though the value of location quotient

has declined since 1991-92, northern region retains a significant concentration of rice. The districts of Rewari, Mahendergarh and Gurgaon remain specialized in mustard throughout the entire period. Besides these, Sonepat and Jind districts during Period-I, Bhiwani and Rohtak during Period-ll and Period-III, Hisar during period – I and Period-III, remain specialized in mustard crop. The best position in the crop is attained only by Rewari and Mahendergarh throughout the entire period with the highest value of quotient ranging from 4.25 to 3.49. The districts of Rewari, Mahendergarh and Bhiwani represent extreme arid to semi-arid climate, slight sloping to undulating plains and substantial rain fed cropland. These conditions necessitate for devoting higher acreages to low water consuming crops like mustard, pearl millet, barley and gram. The value of location quotient of mustard for Bhiwani district increased from 0.69 during Period-I to 2.26 during Period-II mainly due to introduction of sprinkler irrigation system.The cotton crop remains specialized in districts of Hisar, Jind and Sirsathroughout the period under reference. The highest specialization of the crop is occurred in Hisar district during Period-I (4.04) and Period-III (3.38) while the Sirsa (3.08) district showed highest specialization during Period- II.

Table 24: Location quotient of sugarcane, barley, pearl millet and gram in different Districts

Districts	Sugarcane			Barley			Pearl millet			Gram		
	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III	P-I	P-II	P-III
Ambala	5.51	2.76	4.14	0.2	0.11	0.16	0.09	0.04	0.07	0.18	0.15	0.17
Y.nagar	6.35	8.83	7.59	0.11	0	0.06	0.05	0.05	0.05	0.04	0.04	0.04
Kurukshetra	1.77	2.51	2.14	0.1	0	0.06	0.16	0	0.08	0.04	0.03	0.04
Kaithal	0.74	0.38	0.56	0.06	0.01	0.04	0.12	0.32	0.22	0.03	0.03	0.03
Karnal	0.92	1.36	1.14	0.06	0.07	0.07	0.03	0.04	0.04	0.02	0.03	0.03
Panipat	2.07	1.63	1.85	0.35	0.08	0.23	0.2	0.03	0.12	0.05	0.03	0.04
Sonepat	2.21	2.02	2.12	1.2	0.27	0.78	0.8	0.28	0.54	0.46	0.02	0.24
Rohtak	1.43	1.62	1.53	1.4	1.31	1.4	0.86	1.06	0.96	0.31	0.4	0.36
Faridabad	1.07	1.23	1.15	3.44	1.35	2.5	1.69	0.49	1.09	0.35	0.2	0.28
Gurgaon	0.1	0.05	0.08	1.81	1.62	1.73	1.76	1.77	1.77	0.37	0.19	0.28
Rewari	0	0	0.00	1.76	1.29	1.68	4.02	3.12	3.57	1.17	0.15	0.66
Mahendergarl	0.07	0	0.04	1.39	0.54	1.03	4.91	3.7	4.31	4.78	2.16	3.47

Bhiwani	0.53	0.11	0.32	1.33	1.7	1.44	1.02	2.69	1.86	1.26	5.14	3.20
Jind	0.65	0.62	0.64	1.5	0.4	1.02	1.4	1.09	1.25	2.23	0.07	1.15
Hisar	1.41	0.23	0.82	3.1	1.6	2.43	1.89	0.78	1.34	2.96	0.94	1.95
Sirsa	0.01	0.07	0.04	0.57	1.85	1.14	0.02	0.08	0.05	0.3	0.88	0.59

P-I (1991-92to 1999-00)

P-II (2000-01 to2011-12)

P-III (1991-92 to 2011-12)

The location quotients of sugarcane, barley, jowar, pearl millet and gram are presented in Table 24. The results reveal that sugarcane not only specialized in Yamunanagar, but also remains at the top with quotient values of 6.35, 8.83 and 7.59 during Period-I, II and III respectively. This may partially be because of increase in irrigation facilities availability of large operational holdings, plain land and existence of numerous sugar mills at Yamunanagar. Other districts having specialization in sugarcane crops include Ambala, Kurukshetra, Panipat, Sonepat, Rohtak and Faridabad. Hisar remains specialization in sugarcane during Period-I (1.41) only.

Faridabad, Hisar, Gurgaon, Rewari, Rohtak and Bhiwani remain specialized in barley crop throughout the entire period. Among districts, Faridabad remains at the top during Period-I (3.44) and Period-III (2.50) while Sirsa remains at the top during Period-II in specialization of barley. District Mahendergarh comes first with 4.91, 3.70 and 4.31 during whole study period whereas Rewari and Bhiwani occupied 2nd and 3rd position during entire periodof the study in case of pearl millet specialization in the state. The districts of Faridabad (1.69) remains specialized in pearl millet during Period-I. During Period- II, its cropping pattern has shifted towards sugarcane and rice.

The districts of Bhiwani (5.14) and Mahendergarh (2.16) are the core of the gram cultivation region of the state during Period-II. Mahendergarh (4.78), Hisar (2.96), Jind (2.23) and Rewari (1.17) remain specialized in gram during Period-I. But during Period-II, the cropping pattern of Hisar and Jind districts has shifted towards rice. Gram crop is completely marginalized in the irrigated areas of the state. The district enjoying higher irrigation facilities tends to present low location quotient for gram. For example, for both Kurukshetra and Panipat districts, having high irrigation intensity, the value of location quotient is reported at 0.03 during Period-II.

Table25: Specialization of Districts in different crops

District	Crops in descending order of magnitude of location quotient (LQ > 1)
Ambala	Maize, sugarcane, rice, wheat
Yamunanagar	Sugarcane, maize, rice, wheat
Kurukshetra	Rice, sugarcane, wheat
Kaithal	Rice, wheat
Karnal	Rice, wheat, sugarcane
Panipat	Rice, sugarcane, wheat
Sonepat	sugarcane, rice, wheat, mustard
Rohtak	Barley, sugarcane, mustard, wheat
Faridabad	Barley, wheat, sugarcane, mustard
Gurgaon	Mustard, barley, pearl millet
Rewari	Mustard, pearl millet, barley, gram
Mahendergarh	Pearl millet, gram, mustard, barley
Bhiwani	Gram, mustard, pearl millet, barley, maize
Jind	Cotton, wheat, rice, barley, pearl millet, gram
Hisar	Cotton, barley, gram, wheat, pearl millet
Sirsa	Cotton, wheat, barley

All the foregoing analysis classified the districts on the basis of specialization in different crops and reported in Table 25. It is clear from the table that out of the total 16 districts in the state, only one acquires specialization in maize and sugarcane, four each in rice and barley, three in cotton and one each in gram mustard and pearl millet.

Factors affecting the crop diversification in the state

With the start of modern agricultural technology, especially during the period of the Green Revolution in the late sixties and early seventies, there is a continuous surge for diversified agriculture in terms of crops, primarily on economic considerations. The crop pattern changes, however, are the outcome of the interactive effect of many factors which can be broadly categorized into the following groups:

- Resource related factors covering irrigation, rainfall and soil fertility.

- Technology related factors covering not only seed, fertilizer, and water technologies but also those related to marketing, storage and processing.
- Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity.
- Price related factors covering output and input prices as well as trade policies and other economic policies that affect these prices either directly or indirectly.
- Institutional and infrastructure related factors covering farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

Obviously, these factors are not watertight but inter-related. For instance, the adoption of crop technologies is influenced not only by resource related factors but also by institutional and infrastructure factors. Similarly, government policies - both supportive and regulatory in nature - affect both the input and output prices. Likewise, special government programmes also affect area allocation and crop composition. More importantly, both the economic liberalization policies as well as the globalization process are also exerting strong pressures on the area allocation decision of farmers, essentially through their impact on the relative prices of inputs and outputs. Although the factors that influence the area allocation decision of farmers are all important, they obviously differ in terms of the relative importance both across farm groups and resource regions. While factors such as food and fodder self-sufficiency, farm size, and investment constraints are important in influencing the area allocation pattern among smaller farms, larger farmers with an ability to circumvent resources constraints usually go more by economic considerations based on relative crop prices than by other non-economic considerations. Similarly, economic factors play a relatively stronger role in influencing the crop pattern in areas with a better irrigation and infrastructure potential. In such areas, commercialization and market networks co-evolve to make the farmers more dynamic and highly responsive to economic impulses.

What is most notable is the change in the relative importance of these factors over time. From a much generalized perspective, Indian agriculture is increasingly getting influenced more and more by economic factors. This need not be surprising because irrigation expansion, infrastructure development, penetration of rural markets, development and spread of short duration and drought resistant crop technologies have all contributed to minimizing the role of non-economic factors in crop choice of even

small farmers. What is more, the reform initiatives undertaken in the context of the ongoing agricultural liberalization and globalization policies are also going to further strengthen the role of price related economic incentives in determining crop composition both at the micro and macro levels. Obviously, such a changing economic environment will also ensure that government price and trade policies will become still more powerful instruments for directing area allocation decisions of farmers, aligning thereby the crop pattern changes in line with the changing demand-supply conditions. In a condition where agricultural growth results more from productivity improvement than from area expansion, the increasing role that price related economic incentives play in crop choice can also pave the way for the next stage of agricultural evolution where growth originates more and more from value-added production.

Conclusions

1. Area under paddy cultivation has increased at the compound growth rate of 3.74 per cent per annum during the study period that is the maximum growth experienced by any of the kharif season crop in Haryana. Further, production of paddy has also exhibited an increase of 4.97per cent per annum. This is contributed by expansion in acreage and growth in yield.
2. Area, production and yield of cotton recorded an increase of 2.37, 4.01 and 1.63 per cent per annum during the study period. Clearly, area expansion has played more important role in comparison to yield. The growth of cotton production was found highest (6.38 per cent) between 2000-01 and 2011-12 due to remarkable increase in productivity that was recorded 6.71per cent per annum.
3. The scenario of increase in acreage of coarse cereals i.e. pearl millet and maize is discouraging despite their nutritional value. However, production of pearl millet increased at the rate of 2.09 per cent per annum due to commendable growth of 3.62 per cent per annum in yield during this period.
4. Among the major rabi season crops, area under wheat cultivation has increased at the rate of 1.91 per cent per annum during the study period in Haryana. Further, production as well as productivity of wheat has also exhibited an increase of 4.38 and 2.42 per cent per annum respectively.
5. Area, production and productivity of gram has witnessed negative trend in first period where as only productivity showed increased trend in second, third as well as overall basis. Area, production and productivity of rapeseed and mustard have increased with the rate of 3.90, 7.03 and 3.01 per annum respectively in the study area.

6. The study revealed that maize crop does its best in Ambala and Yamunanagar districts throughout the entire study period.
7. As far as wheat specialization was concerned, Ambala, Kurukshetra, Kaithal, Karnal, Panipat, Sonepat, Faridabad, Jind and Hisar districts remain specialized throughout the whole period.
8. Rice crop remains specialized throughout the entire study period in Ambala, Yamunanagar, Kurukshetra, Kaithal, Karnal, Panipat, Sonepat and Jind districts.
9. The districts of Rewari, Mahendergarh and Gurgaon remain specialized in rape seed and mustard throughout the entire period.
10. The cotton crop remains specialized in districts Hisar, Jind and Sirsa throughout the period under reference.
11. Sugarcane not only specialized in Yamunanagar, but also remains at the top with quotient values of 6.35, 8.83 and 7.59 during Period-I, II and III respectively. This may partially be because of increase in irrigation facilities availability of large operational holdings, plain land and existence of numerous sugar mills at Yamunanagar.

D. Programme of work for Current Year 2016-17

Sub-Project I: Economic Analysis of Existing and Alternative Cropping Pattern in different zones in Haryana

i. Objectives:

1. To examinethe existing cropping pattern of selected farmers
2. To analyse the economics of existing cropping patterns.
3. To suggest the alternative cropping patterns.

ii. Year of Start **:** 2015-16

iii. Period of study **:** 2015-18

iv. Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
R. K. Patel	Planning& Monitoring
JitenderBhatia	Preparation of schedule, data collection.
Dalip Kumar Bishnoi	Compilation, analysis of dataand report writing.

v. Method of Study:

The study was to be splitted in different agro-climatic zones during 3 consecutive years i.e. 2015 to 2018. During the year 2015-16, the study wasundertaken into semi-arid zone.During the year 2016-17, the study will be conducted into humid zone. Two districts (i.e. Karnal and Yamuna Nagar) will be selected to cover all the crops grown in the study area. Further one block from each selected district will be covered randomly and from each selected block, two villages will be selected randomly with a sample of total eighty(80) farmers of different categories will be interviewed through pre-structured schedule.

Sub Project III:Decision Making Pattern of Farm Women in performing Vegetable Cultivation Activities in Hisar District of Haryana

Objectives:

1. To examine the personal and socio-economic profile of the farm women.
2. To study the extent of women's participation in decision making in vegetable cultivation activities.
3. To identify the constraints perceived by the farm women in decision making.

Year of Start: 2015-16

Period of Study: 2014-16

Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity Profile**
Deep Punia	Preparation of Schedule,compilation& analysis of data and report writing
J.C. Karwasra	Monitoring and Execution
Jitender Kumar Bhatia	Collection of data
Dalip Kumar Bishnoi	Collection of data

Methodology:

The present study was conducted in four villages namely Hajampur, DhanaKhurd from Hansi-I block and Juglan, Dhiktana from Barwala block of Hisar district of Haryana. From each village 20 farm working women were randomly selected making a total sample of 80.The primary data pertaining to decision making pattern of farm women in performing activities related to cultivation of major vegetable crops in

kharif, rabi and spring seasons for the last year were collected with the help of well structured pre-tested interview-schedule from those 80 households in which both husband and wife were involved in vegetable cultivation. The extent of rural women's participation in decision making in performing various activities regarding vegetable cultivation was measured by using a four point continuum namely nil, only consulted, opinion considered and final decision with scores and ranking.

Results achieved during 2015-16:

Profile of Farm Women:

In the present study, one-third of the farm women were Jat (33.75per cent) followed by Ahir/Yadav (28.75per cent), Dhanak (12.50per cent), Brahmins (10per cent), Saini/Mali (8.75per cent) etc. Less than half of the respondents were from the age group 18 to 35 years (41.25per cent) followed by 36 to 45 years (33.75per cent). One-third of the farm women were illiterate (32.50per cent).Whereas one-third of the respondents were matriculate/higher secondary (32.50per cent) followed by up to middle (30per cent) and graduates (5per cent). Highest level of education in the families of the respondents was matriculation/higher secondary (51.25per cent) followed by graduation/post-graduation (45per cent). Half of the total farm women belonged to the nuclear families (51.25per cent) followed by joint families (48.75per cent) as shown in Table 26.

Farming was the main occupation of all of the total households. More than one-third of the total households (36.25per cent) were having one or the other kind of subsidiary occupations & majority was in service (51.73per cent). Regarding respondent's employment status, it was found that an overwhelming majority of the respondents were house wives/home makers (93.75per cent). Whereas only 6.25 per cent of them were working women and they were teachers, *anganwadi* workers & cook/helpers in schools.

It was found that 52.50 per cent of the total respondents were having 2.5 to 5.0 acres of land followed by up to 2.5 acres (17.50per cent), 5 to 10 acres and above 10 acres of land (15per cent each). Table 26 shows that majority of the respondents were the small farmers (70per cent) followed by medium and large farmers (15per cent each). Majority of the rural households (72.50per cent) were having up to Rs.49, 666 per capita annual incomes per family and among these, small and medium farmers constituted majority (92per cent and 88per cent respectively).

An overwhelming majority of the farm women were watching television (95per cent) and spending up to two hours (61.84per cent) daily. One-third of the respondents (32.50per cent) were reading the news papers and spending 20 minutes in a day. It was observed that 76 per cent of the farm women personally were not having contacts with extension scientists of University/KVK etc. and they were not the member of any organization (77.50per cent).

Table 26: Personal and socio-economic profile of the respondents

Variables	**FrequencyN=80**	**Percentage**
Caste:		
Brahmin	8	10.00
Jat	27	33.75
Ahir/Yadav	23	28.75
Saini/Mali	7	8.75
Kumhar	2	2.50
Gujjar	3	3.75
Dhanak	10	12.50
Age:		
Below 18 yrs	-	-
18 to 35	33	41.25
36 to 45	27	33.75
46 to 60	18	22.50
Above 60 yrs	2	2.50
Education:		
Illiterate	26	32.50
Primary	14	17.50
Middle	10	12.50
Matriculation	19	23.75

Higher Secondary	7	8.75
Graduation	4	5.00
Post-Graduation	-	-
Highest Education in Family:		
Primary	-	-
Middle	3	3.75
Matriculation	7	8.75
Higher Secondary	34	42.50
Graduation	30	37.50
Post-Graduation	6	7.50
Family Type:		
Nuclear	41	51.25
Joint	39	48.75
Family Size:		
Up to 4 members	24	30.00
5 to 8	43	53.75
9 to 12	13	16.25
More than 12 members	-	-
Main Occupation of Family:		
Agriculture	80	100.00
Subsidiary Occupation of Family:		
Service	15	51.73
Shop	4	13.79
Business	5	17.24
Livestock	5	17.24

Not applicable	51	63.75
Respondent's Employment Status:		
Working	5	6.25
Housewives/Homemakers	75	93.75
Farmers' categories & Land Holding (acres):		
Small:		
Up to 2.5 acres	14	17.50
2.5 to 5	42	52.50
Medium:		
5 to 10	12	15.00
Large:		
10 to 15	8	10.00
15 to 20	-	-
Above 20 acres	4	5.00
Per Capita Annual Income of Family:		
Up to Rs. 49,666	58	72.50
Rs.49,667 to Rs. 87,332	20	25.00
More than Rs. 87,332	2	2.50

Regarding the possession of farm assets, more than one-third of the rural households were possessing tractors (40per cent) followed by electric motor (32.50per cent), seed drill (28.75per cent), cultivator (27.50per cent), sprayers & chaff cutter (25per cent each), tractor trolley (23.75per cent), diesel engine (17.50per cent), disk harrow (15per cent), pump set (13.75per cent), ridge-maker (10per cent), thresher (8.75per cent), farm machinery attachment & drip irrigation set (7.50per cent each), planker & sprinkler set (6.25per cent each), *desi* plough (5per cent) and land lazer leveler, duster, winnower, rotavator & reaper (1.25per cent each) and among these, large and medium farmers constituted majority.

Regarding the possession of non-farm assets like shop, plot, shares, house in city, insurance policy etc. it was found that 12.50 per cent of the total respondents were having plots in the village itself/nearby city. Less than one-fourth of the respondents

(18.75per cent) were keeping more than two life insurance policies to secure their future. Less than one-tenth of the respondents were keeping shops within the village itself (7.50per cent). Only 6.25 per cent of the households constructed house in the nearby city and among these, all were the large farmers. Nobody had purchased the shares in economic market.

In the study area, an overwhelming majority of the households were keeping different households assets such as television (91.25per cent), cooking gas (86.25per cent), mobile phones (82.50per cent), cooler (72.50per cent), refrigerator & motor-cycle (71.25per cent each), washing machine (45per cent), bicycle (30per cent), radio (20per cent), VCD & DVD player (17.50per cent), car (12.50per cent), music system (8.75per cent), scooter (6.25per cent), transistor (5per cent), landline phone (3.75per cent), A.C., laptop & jeep (2.50per cent each) etc. and among these, large and medium farmers constituted majority.

Vegetable Cultivation Pattern:

In the study area, majority of the total respondents/households (72.50per cent) were cultivating various kinds of vegetables in the kharif season and among these, marginal & small farmers constituted majority. Whereas more than one-third of them (38.75per cent) cultivated vegetables in rabi season. During the spring season, less than half the respondents/households (42.50per cent) were cultivating vegetables. According to the seasons, they were cultivating *gajar*followed by *gheeya*, *mirch*, *bhindi*, *tinda*, *torri*, *patta-gobhi*, *bengan*,*peeyaj*,*phul-gobhi*, *muli*, *tamatar*,*kheera-kakdi*, *matter*, *shimla mirch* etc. There were 139.5 acres of area under vegetable cultivation by the total respondents/households. Average area under vegetable cultivation was 1.74 acres per family.

Extent of Women's Participation in Decision Making:

High Level of Participation: As regards extent of participation of the respondents in deciding about activities related to vegetable cultivation, it was found that one-third of the total respondents were included in the final decisions about cleaning of vegetables (32.50per cent& 223 scores).Whereas 20 per cent of them were final decision makers regarding nursery-management & raising nursery for seedling (193 scores) followed by packaging (10per cent& 220 scores), loading/unloading (10per cent& 192 scores), picking (8.75per cent& 224 scores), staking (8.75per cent& 209 scores), grading

(7.50per cent& 213 scores) and shifting at distance (7.50per cent& 177 scores). Table27 clearly shows the high level of women' participation in decision making regarding cleaning of vegetables and nursery-management & raising nursery for seedling.Their opinion was also considered in deciding these activities (35per cent and 37.50per cent respectively).It was observed that except these above-mentioned activities, they were not involved in final decisions in any other activities related to vegetable cultivation.

Opinion of majority of the respondents was also considered before deciding about transplanting (81.25per cent& 216 scores) followed by weeding (76.25per cent& 215 scores), picking (68.75per cent& 224 scores), harvesting (61.25per cent& 193 scores), staking (60per cent& 209 scores), hoeing (60per cent& 199 scores), packaging (58.75per cent& 220 scores), thinning-gap filling (58.75per cent&196 scores),grading (57.50per cent& 213 scores), nursery-management & raising nursery for seedling (37.50per cent&193 scores), loading/unloading (37.50per cent& 192 scores),cleaning of vegetables (35per cent& 223 scores)and shifting at distance (25per cent& 177 scores). Decision was made jointly by husband, wife and other family members in such activities. Table 27 clearly showed the women participation in decision making in those activities in which their labour force was more required.

Medium Level of Participation: Opinion of half of the total respondents was considered before deciding shading arrangement after pruning (51.25per cent), sowing of seeds (43.75per cent), winnowing and on-farm sale of produce, (38.75per cent each), cleaning of fields (33.75per cent), preparation of produce for sale (27.50per cent), choice of vegetable crops to be grown/selection of vegetable crops and labour management (26.25per cent each), custom hiring-in/hiring-out of farm machinery (23.75per cent), custom hiring-in/hiring-out of capital stock, leasing-in/leasing-out of farm land and plant protection (22.50per cent each), sale/purchase of land (21.25per cent), storage of vegetables (20per cent) etc. In these cases, decision was made jointly by husband, wife and other family members.

Majority of the farm women were being consulted only in decision making in storage of vegetables (67.50per cent) followed by choice of vegetable crops to be grown/selection of vegetable crops (53.75per cent), labour-management & choice of seeds to be grown/selection of seeds (48.75per cent each), cleaning of fields (43.75per

cent), sale/purchase of land (38.75per cent), custom hiring-in/hiring-out of farm machinery (36.25per cent), custom hiring-in/hiring-out of capital stock (35per cent), investment on farm (33.75per cent), preparation of produce for sale (31.25per cent) etc.

Low Level of Participation: It was observed that majority of the farm women were having low level of participation/no say at all in decision making regarding farm-record maintenance (93.75per cent) followed by spade work during irrigation (92.50per cent),market sale (91.25per cent),fixing price of vegetables (86.25per cent),adoption of HYVs (85per cent),irrigation (82.50per cent),pesticides application &fertilizer/manure application (81.25per cent each),pre-sowing irrigation and preparation of fields, boundary & drain (78.75per cent each),arrangement of inputs & purchase of inputs i.e. seeds, fertilizers, pesticides etc. (77.50per cent each),water management/application of mild irrigation after transplanting & arrangement of transportation (76.25per cent each),attending kisan mela/training /camp/exhibition etc. (73.75per cent),ploughing of fields (72.50per cent),leveling of fields/harrowing (71.25per cent),supervision of farm operations (66.25per cent), seed storage/seed preservation (63.75per cent), plant protection (60per cent each),seedling preparation & seed treatment for sowing (58.75per cent), selection of land (57.50per cent),sale/purchase of farm machinery (56.25per cent), farm credits/loans from bank (55per cent) and investment on farm (48.75per cent).Table 27 shows the least participation of farm women in decision making in above-mentioned activities related to vegetable cultivation. Husband alone made the decisions in this regard. Analysis of the data reveals that none of the farm women was included in final decisions and even their opinion was generally not considered & it was not given weightage before deciding the activities related to vegetable cultivation.

Conclusions: It may be concluded that farm women were final decision makers in cleaning of vegetables (32.50per cent) followed by nursery-management & raising nursery for seedling (20per cent), packaging&loading/unloading (10per cent each), picking & staking (8.75per cent each), grading and shifting at distance (7.50per cent each) only. Opinion of majority of the respondents was also considered before deciding about transplanting (81.25per cent) followed by weeding (76.25per cent), picking (68.75per cent), harvesting (61.25per cent), staking& hoeing (60per cent

each), packaging & thinning-gap filling (58.75per cent each),grading (57.50per cent) etc. Data clearly showed the high level of women' participation in decision making in those activities in which their labour force was more required.

Land is the most important asset and farm women generally did not participate in making decisions pertaining to land i.e.selection of land (57.50per cent), leasing-in /leasing-out of land (48.75per cent) andsale/purchase of land (40per cent) in the farm families. The respondents were not participating in decision making regarding sale/purchase of farm machineries (56.25per cent) and custom hiring-in/hiring-out of farm machineries (40per cent).Similarly farm women did not participate in **financial decisions** i.e. marketing (91.25per cent), fixing price of vegetables(86.25per cent), arrangement of inputs&purchase of inputs i.e. seeds, fertilizers, pesticides etc. (77.50per cent each), arrangement of transportation (76.25per cent), farm credits/loans from bank(55per cent), investment on farm (48.75per cent) and custom hiring-in/hiring-out of capital stock(42.50per cent).On the other hand, farm women were not participating in making **technical decisions** i.e. farm-record maintenance (93.75per cent), adoption of HYVs (85per cent), attending kisan mela/training/camp/exhibition etc.(73.75per cent), seed storage/seed preservation (63.75per cent),plant protection(60per cent), seedling preparation & seed treatment for sowing (58.75per cent) and choices of seeds to be grown/selection of seeds (33.75per cent).

Table 27: Extent of women's participation in decision making regarding different activities related to vegetables cultivation

Vegetables Cultivation Activities	Extent of Participation in Decision MakingN=80					
	Nil	Only Consulted	Opinion Considered	Final Decision	Scores	Rank
Picking	**5 (6.25)**	**13 (16.25)**	**55 (68.75)**	**7 (8.75)**	**224**	**1**
Cleaning of vegetables	**7 (8.75)**	**19 (23.75)**	**28 (35.00)**	**26 (32.50)**	**223**	**2**
Packaging	**3 (3.75)**	**22 (27.50)**	**47 (58.75)**	**8 (10.00)**	**220**	**3**
Transplanting	**9**	**6**	**65**	**-**	**216**	**4**

	(11.25)	**(7.50)**	**(81.25)**			
Weeding	**6 (7.50)**	**13 (16.25)**	**61 (76.25)**	**-**	**215**	**5**
Grading	**5 (6.25)**	**23 (28.75)**	**46 (57.50)**	**6 (7.50)**	**213**	**6**
Staking	**13 (16.25)**	**12 (15.00)**	**48 (60.00)**	**7 (8.75)**	**209**	**7**
Hoeing	**9 (11.25)**	**23 (28.75)**	**48 (60.00)**	**-**	**199**	**8**
Thinning-gap filling	**11 (13.75)**	**22 (27.50)**	**47 (58.75)**	**-**	**196**	**9**
Harvesting	**16 (20.00)**	**15 (18.75)**	**49 (61.25)**	**-**	**193**	**10**
Nursery-management & Raising Nursery for seedling	**29 (36.25)**	**5 (6.25)**	**30 (37.50)**	**16 (20.00)**	**193**	**10**
Loading/unloading	**14 (17.50)**	**28 (35.00)**	**30 (37.50)**	**8 (10.00)**	**192**	**11**
Shifting at distance	**15 (18.75)**	**39 (48.75)**	**20 (25.00)**	**6 (7.50)**	**177**	**12**
Shading arrangement after pruning	**25 (31.25)**	**14 (17.50)**	**41 (51.25)**	**-**	**176**	**13**
Sowing of seeds	**27 (33.75)**	**18 (22.50)**	**35 (43.75)**	**-**	**168**	**14**
Choice of vegetable crops to be grown/selection of veg. crops	**15 (18.75)**	**43 (53.75)**	**21 (26.25)**	**1 (1.25)**	**168**	**14**
Storage of vegetables	**10 (12.50)**	**54 (67.50)**	**16 (20.00)**	**-**	**166**	**15**
Winnowing	**27 (33.75)**	**22 (27.50)**	**31 (38.75)**	**-**	**164**	**16**
Labour-management	**20 (25.00)**	**39 (48.75)**	**21 (26.25)**	**-**	**161**	**17**
Cleaning of fields	**18**	**35**	**27**	**-**	**159**	**18**

	(22.50)	**(43.75)**	**(33.75)**			
On-farm sale of produce	**32 (40.00)**	**17 (21.25)**	**31 (38.75)**	**-**	**159**	**18**
Preparation of produce for sale	**33 (41.25)**	**25 (31.25)**	**22 (27.50)**	**-**	**149**	**19**
Choice of seeds to be grown/ Selection of seeds	**27 (33.75)**	**39 (48.75)**	**13 (16.25)**	**1 (1.25)**	**148**	**20**
Custom hiring-in/hiring-out of farm machinery	**32 (40.00)**	**29 (36.25)**	**19 (23.75)**	**-**	**147**	**21**
Sale/purchase of land	**32 (40.00)**	**31 (38.75)**	**17 (21.25)**	**-**	**145**	**22**
Custom hiring-in/hiring-out of capital stock	**34 (42.50)**	**28 (35.00)**	**18 (22.50)**	**-**	**144**	**23**
Leasing-in/Leasing-out of farm land	**39 (48.75)**	**23 (28.75)**	**18 (22.50)**	**-**	**139**	**24**
Investment on farm	**39 (48.75)**	**27 (33.75)**	**14 (17.50)**	**-**	**135**	**25**
Plant protection	**48 (60.00)**	**14 (17.50)**	**18 (22.50)**	**-**	**130**	**26**
Farm credits/loans from bank	**44 (55.00)**	**23 (28.75)**	**13 (16.25)**	**-**	**129**	**27**
Selection of Land	**46 (57.50)**	**21 (26.25)**	**13 (16.25)**	**-**	**127**	**28**
Sale/purchase of farm machinery	**45 (56.25)**	**24 (30.00)**	**11 (13.75)**	**-**	**126**	**29**
Seedling preparation & Seed Treatment for sowing	**47 (58.75)**	**20 (25.00)**	**13 (16.25)**	**-**	**126**	**29**
Seed Storage/Seed Preservation	**51 (63.75)**	**17 (21.25)**	**12 (15.00)**	**-**	**121**	**30**
Leveling of fields/ Harrowing	**57 (71.25)**	**15 (18.75)**	**6 (7.50)**	**2 (2.50)**	**113**	**31**
Supervision of farm operations	**53 (66.25)**	**21 (26.25)**	**6 (7.50)**	**-**	**113**	**31**

Ploughing of fields	**58 (72.50)**	**15 (18.75)**	**7 (8.75)**	**-**	**109**	**32**
Pre-sowing Irrigation	**63 (78.75)**	**10 (12.50)**	**4 (5.00)**	**3 (3.75)**	**107**	**33**
Attending kisan mela / training /camp/exhibition etc.	**59 (73.75)**	**18 (22.50)**	**3 (3.75)**	**-**	**104**	**34**
Water management/Application of mild irrigation after transplanting	**61 (76.25)**	**15 (18.75)**	**4 (5.00)**	**-**	**103**	**35**
Pesticides application	**65 (81.25)**	**9 (11.25)**	**6 (7.50)**	**-**	**101**	**36**
Fertilizer/Manure application	**65 (81.25)**	**9 (11.25)**	**6 (7.50)**	**-**	**101**	**36**
Arrangement of Inputs (Seeds, fertilizers, pesticides etc.)	**62 (77.50)**	**16 (20.00)**	**2 (2.50)**	**-**	**100**	**37**
Purchase of Inputs (Seeds, fertilizers, pesticides etc.)	**62 (77.50)**	**16 (20.00)**	**2 (2.50)**	**-**	**100**	**37**
Arrangement of transportation	**61 (76.25)**	**19 (23.75)**	**-**	**-**	**99**	**38**
Preparation of fields, boundary & drain	**63 (78.75)**	**17 (21.25)**	**-**	**-**	**97**	**39**
Irrigation	**66 (82.50)**	**11 (13.75)**	**3 (3.75)**	**-**	**97**	**39**
Adoption of HYVs	**68 (85.00)**	**12 (15.00)**	**-**	**-**	**92**	**40**
Fixing price of vegetables	**69 (86.25)**	**11 (13.75)**	**-**	**-**	**91**	**41**
Market sale	**73 (91.25)**	**6 (7.50)**	**1 (1.25)**	**-**	**88**	**42**
Spade work during irrigation	**74 (92.50)**	**6 (7.50)**	**-**	**-**	**86**	**43**

Farm - record maintenance	**75 (93.75)**	**4 (5.00)**	**1 (1.25)**	**-**	**86**	**43**

Note: Figure in parenthesis indicates percentage to total

Scores Range = Low: up to 135 scores, Medium: 136 to 184 scores and High: 185 scores & above

Constraints perceived by Farm Women in Decision Making

In the study area, all of the respondents perceived various kinds of constraints in decision making in performing vegetable cultivation activities.

Constraints perceivedas Very Severe: As regards extent of constraints perceived by the farm women in decision making in performing activities regarding vegetable cultivation, it was found that more than half of the respondents were perceiving constraints very severely i.e. extensive work load due to agril. labour scarcity in villages (60per cent) followed by lack of awareness about new technologiesdue to fast technological advancement in machineries, seeds, fertilizers, pesticides etc. (38.75per cent), traditional beliefs system in society for women i.e. domination of males, gender biasness & sex discrimination in decision making (26.25per cent),low decision making power in vegetable cultivation activities/secondary status in decision making (22.50per cent), poor purchasing capabilities/power of farm women-due to lack of involvement in financial decisions(21.25per cent), underestimated/under-valued/largely ignored role (18.75per cent),considered economically inactive (17.50per cent), work discrimination (12.50per cent), unfavourable social conditions for getting information from extension workers(11.25per cent) and poor technical knowledge due to no link from University/KVK etc. (10per cent) as shown in Table 28.

Constraints perceived as Severe only: It was observed that majority of the total respondents perceived constraints severely, but not very severely in deciding vegetable cultivation affairs i.e. poor access & knowledge to credit institutions for loans/saving/insurance/investment etc. (88.75per cent), extensive work load with dual responsibilities/difficulties to spend time for vegetable cultivation activities due to domestic work/ burden of family work (87.50per cent), social restrictions for attending kisan mela/training/camp/exhibition etc./cultural & social barriers (86.25per cent), poor technical knowledge due to no link from University/KVK etc. (76.25per cent), underestimated/under-valued/largely ignored role (71.25per cent), traditional beliefs system in society for women i.e. domination of males, gender biasness & sex

discrimination in decision making (70per cent), poor purchasing capabilities/power of farm women due to lack of involvement in financial decisions (68.75per cent), low decision making power in vegetable cultivation activities/secondary status in decision making (66.25per cent), absence of opportunity for professional growth and seasonal nature of work (65per cent each), softest target at workplace (62.50per cent), unfavourable social conditions for getting information from extension workers (58.75per cent), health problems due to allergy/blood pressure/headache-migraine etc. (55per cent), harsh work conditions/working under unfavourable conditions (53.75per cent), wage discrimination/lower wage rate (52.50per cent), unglamorous task given/being woman it is difficult to perform certain activities (51.25per cent), lack of awareness about new technologies due to fast technological advancement (48.75per cent), considered economically inactive (47.50per cent), eco-friendly technology rarely available (46.25per cent), invisible worker (42.50per cent), extensive work load due to agricultural labour scarcity in villages (40per cent) and work discrimination (32.50per cent).

Table 28: Constraints perceived by the farm women in decision making in performing vegetable cultivation activities

Constraints in Decision Making	Extent of perceived ConstraintsN=80				
	Very Severe	Severe	Neutral	Scores	Rank
Extensive work load due to agricultural labour scarcity in villages	**48 (60.00)**	**32 (40.00)**	**-**	**208**	**1**
Lack of awareness about new technologies due to fast technological advancement(machineries, seeds, fertilizers, pesticides)	**31 (38.75)**	**39 (48.75)**	**10 (12.50)**	**181**	**2**
Traditional beliefs system in society for women(domination of males, gender biasness & sex discrimination in decision making)	**21 (26.25)**	**56 (70.00)**	**3 (3.75)**	**178**	**3**
Harsh work conditions/ Working under unfavourable conditions	**6 (7.50)**	**43 (53.75)**	**31 (38.75)**	**175**	**4**
Low decision making power in vegetable cultivation activities/Secondary status in decision	**18 (22.50)**	**53 (66.25)**	**9 (11.25)**	**169**	**5**

making					
Poor purchasing capabilities/power of farm women (due to lack of involvement in financial decisions)	**17 (21.25)**	**55 (68.75)**	**8 (10.00)**	**169**	**5**
Underestimated/under-valued/largely ignored role	**15 (18.75)**	**57 (71.25)**	**8 (10.00)**	**167**	**6**
Social Restrictions for attending kisan mela/training/camp/exhibition etc./Cultural &social barriers	**7 (8.75)**	**69 (86.25)**	**4 (5.00)**	**163**	**7**
Poor access & knowledge to credit institutionsfor loans/saving/insurance/investment etc.	**4 (5.00)**	**71 (88.75)**	**5 (6.25)**	**159**	**8**
Extensive work load with dual responsibilities /Difficulties to spend time for vegetable cultivation activities due to domestic work/burden of family work	**4 (5.00)**	**70 (87.50)**	**6 (7.50)**	**158**	**9**
Poor technical knowledge due to no link from University/KVK etc.	**8 (10.00)**	**61 (76.25)**	**11 (13.75)**	**157**	**10**
Considered economically inactive	**14 (17.50)**	**38 (47.50)**	**28 (35.00)**	**146**	**11**
Unfavourable social conditions for getting information from extension workers	**9 (11.25)**	**47 (58.75)**	**24 (30.00)**	**145**	**12**
Absence of opportunity for professional growth	**3 (3.75)**	**52 (65.00)**	**25 (31.25)**	**138**	**13**
Seasonal nature of work	**1 (1.25)**	**52 (65.00)**	**27 (33.75)**	**134**	**14**
Wage discrimination/ Lower wage rate	**4 (5.00)**	**42 (52.50)**	**34 (42.50)**	**130**	**15**
Softest target at workplace	**-**	**50 (62.50)**	**30 (37.50)**	**130**	**15**
Health problems (due to allergy/blood pressure/headache-migraine etc.)	**3 (3.75)**	**44 (55.00)**	**33 (41.25)**	**130**	**15**
Unglamorous task given/being woman it is difficult to perform certain activities	**3 (3.75)**	**41 (51.25)**	**36 (45.00)**	**127**	**16**

Work discrimination	**10 (12.50)**	**26 (32.50)**	**44 (55.00)**	**126**	**17**
Invisible worker	**4 (5.00)**	**34 (42.50)**	**42 (52.50)**	**122**	**18**
Eco-friendly technology rarely available	**-**	**37 (46.25)**	**43 (53.75)**	**117**	**19**

Note: Figure in parenthesis indicates percentage to total

Scores Range = Low:upto 147 scores, Medium: 148 to 177 scores and High: 178 scores & above

Constraints perceivedas Neutral: On the other hand, Table 28 shows that half of the respondents were found to be neutral and they were undecided to express their extent of perceived constraints regarding work discrimination (55per cent),eco-friendly technology rarely available (53.75per cent), invisible worker (52.50per cent), unglamorous task given/being woman it is difficult to perform certain activities (45per cent),wage discrimination/lower wage rate(42.50per cent),health problems due to allergy/blood pressure/headache-migraine etc. (41.25per cent),harsh work conditions/working under unfavourable conditions (38.75per cent),softest target at workplace(37.50per cent),considered economically inactive (35per cent),seasonal nature of work (33.75per cent), absence of opportunity for professional growth (31.25per cent) and unfavourable social conditions for getting information from extension workers (30per cent).

Recommendations/Suggestions:

As the participation of women in **labour-intensive activities** of vegetable cultivation is indispensable and on the increase in rural areas, some important steps need to be taken. Farm women were not involved and/or least involved in the important financial and technical decisions in performing various activities related to vegetable cultivation. Women generally did not participate in **financial decisions** i.e. marketing, fixing prices of vegetables, purchase of inputs (seeds, fertilizers, pesticides etc.), arrangement of inputs, availing farm credits/loans from bank, investment on farm, sale/purchase of land, leased-in/leased-out of land, sale/purchase of farm machineries, custom hiring-in/hiring-out of farm machineries, arrangement of transportation etc. and **technical decisions** i.e. farm-record maintenance/maintaining sale records of

vegetables, adoption of HYVs, attending kisan mela/training /camp/exhibition etc., seed storage/seed preservation, plant protection/use of pesticide, seeds & fertilizers/use of inputs related to vegetable production & vegetable protection, seedling preparation & seed treatment for sowing, selection of seeds, selection of vegetable variety etc. which are a must for the development and progress of farm families.

- Government Departments and other welfare agencies & organizations should specifically conduct more number of need based workshops/ seminars/ trainings/ awareness programmes where the rural farm women are acquainted with the new modern cost effective agricultural techniques/technologies to enhance their knowledge & skill and to encourage them to diversify the agricultural activities. They should specifically develop the programmes for involving farm women in decision making which will increase their exposure and knowledge about the new farm technologies & financial institutions.
- Priority must be given to women in accessing credit on soft terms from banks and other financial institutions for setting up their business related to vegetables.
- Recognition of labour work of working women in the rural economy may be accounted in monetary terms.
- Labour scarcity is bound to increase; therefore mechanization of labour intensive operations is the need of hour.
- Full awareness about intake of healthy diet among the rural farm women should be undertaken on priority basis.

Technical Programme of Work: 2016-17

Title of Sub-Project II:Women's Participation in Polyhouse Cultivation of Vegetablesin KarnalDistrict of Haryana

Objectives:

1. To study the extent of women's participation in various activities related to polyhouse vegetable cultivation
2. To analyse the relationship between different socio-economic factors of women and their extent of participation in activities of polyhouse vegetable cultivation
3. To identify the constraints perceived by the women inpolyhousevegetable cultivation

Year of Start: 2016-17

Period of Study: 2016-17

Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity Profile
Deep Punia	Preparation of Scheduleandcompilation of data.
R.K. Patel	Monitoring and Execution.
Jitender Kumar Bhatia	Compilation, analysis of data and report writing.
Dalip Kumar Bishnoi	Collection of data, analysis of data and report writing.

Methodology:

The present study will be conducted purposively in Karnal district having the highest number of polyhouses in Haryana state. From Karnal district, a cluster of villages of Gharounda block which has highest number of polyhouses (about 50per cent of the total polyhouses of the district) will be selected purposively. Ten polyhouses will be identified and selected from these villages. All the women working in these polyhouses will be the respondents of the study. The primary data pertaining to women's participation in the activities related to cultivation of major vegetable crops in kharif, rabi and spring seasons for the last year will be collected with the help of well structured pre-tested interview-schedule. The extent of women's participation in activities of polyhouse vegetable cultivation will be measured by using a three point continuum namely regular, mostly, occasional. All the activities will be listed under the heads to know (1) in which of these activities the respondents were participating in seasons (2) how many days in the last season they devoted to that particular activity and (3) how many hours in a day they devoted to that particular activity in last season. From this information total hours in the seasons for each activity and contribution of females in hours in the seasons will be calculated. The Chi-square test will be applied to test the association between the variables.

Sub-Project IV: Financial performance of Sarva Haryana Gramin Bank in Hisar District of Haryana State.

Objectives:

i. To study the purpose-wise amount of loan disbursed by the bank.
ii. To examine the demand and supply of loan by the bank.
iii. To study the over dues of loan of selected farmers.
iv. To study constraints faced by farmers in repayment of loans.

Year of Start: 2015-16

Name of the scheme: 2809-C (a) Econ-1 Plan (Agri.)

Name of Investigator(s) with Activity Profile:

Scientist	**Activity Profile**
Dr. V. P. Mehta, Principal Investigator	Planning, Monitoring, Data Collection, Analysis Compilation & Report writing.
Dr. Jitender Kumar Bhatia, Co-Principal Investigator	Preparation of schedule, compilation and report writing.

Methodology

The present study was carried out in Barwala branch of Hisar District of Haryana State purposively. 50 farmers who availed loan from the Barwala branch were selected randomly. The secondary data in respect of loan disbursed by the bank was also collected from the bank. The primary data was collected by personal interview method from the selected respondent during the year 2014-15 in respect of demand, supply and over dues of loan taken by the farmers on pretested schedule. Suitable analytical techniques will be used for analysis of data.

Table 29: Target and Achievement of Agriculture credit(Rs. in Crore)

Year	**Target**	**Achievement**
2004-05	105000	125309
2005-06	141000	180486
2006-07	175000	229400
2007-08	225000	254658
2008-09	280000	287149
2009-10	325000	384514
2010-11	375000	468291
2011-12	475000	511029
2012-13	575000	607376
2013-14	700000	730122
2014-15	800000	845328
2015-16	850000	NA

AGRICULTURAL CREDIT POLICY

The Government of India has initiated several policy measures to improve the accessibility of farmers to the institutional sources of credit. The emphasis of these policies has been on progressive institutionalization for providing timely and adequate credit support to all farmers with particular focus on small and marginal farmers and weaker sections of society to enable them to adopt modern technology and improved agricultural practices for increasing agricultural production and productivity. The Policy lays emphasis on augmenting credit flow at the ground level through credit planning, adoption of region-specific strategies and rationalization of lending policies and procedures. These policy measures have resulted in the increase in the share of institutional credit of the rural households. Progress in regard to flow of agricultural credit is given in Table 29 and 30.

Table 30: Total agricultural credit in India 2000-01 to 2014-2015

(Rs. Crore)

Years	Direct finance	per cent change in Direct finance	Indirect finance	per cent change in Indirect finance	Total Agri. credit	per cent change in Total Agri. credit
2000-01	40485	11.02	18825	45.16	59310	19.97
2001-02	46581	15.05	18238	-3.11	64819	9.28
2002-03	56857	22.06	23690	29.89	80547	24.26
2003-04	70781	24.48	28520	20.38	99301	23.28
2004-05	95565	35.01	36171	26.82	131736	32.66
2005-06	134798	41.05	57175	58.06	191973	45.72
2006-07	172128	27.69	52564	-8.06	224692	17.04

2007-08	214644	24.70	93443	77.76	308087	37.11
2008-09	264893	23.41	110702	18.47	375595	21.911
2009-10	317767	19.96	145554	31.48	463321	23.35
2010-11	360253	13.37	146923	0.94	507176	9.46
2011-12	440758	22.34	142585	-2.95	583343	15.01
2012-13	533431	21.23	143005	0.29	677336	16.11
2013-14	581223	8.77	152310	6.50	733533	8.29
2014-15	684353	17.74	163450	7.31	847801	15.57

Table 31: Agency wise outstanding total agriculture credit in India 2000-01 to 2014-2015 (Rs. Crore)

Years	**Cooperative credit**		**RRBs**		**Commercial bank**		**Other**	**Total**
	Amount	**per cent to total**	**Amount**	**per cent to total**	**Amount**	**per cent to total**		
2000-01	20718	**39.22**	4219	7.98	27807	**52.64**	83	52827
2001-02	23524	37.91	4854	7.82	33587	54.13	80	62045
2002-03	23636	33.98	6070	8.72	39774	57.18	80	69560
2003-04	26875	30.90	7581	8.71	52441	60.29	84	86981
2004-05	31231	24.92	12404	9.89	81481	65.02	193	125309

2005-06	39404	21.83	15223	8.43	125477	69.52	382	180486
2006-07	42480	18.52	20435	8.90	166485	72.57	0	229400
2007-08	48258	18.95	25312	9.94	181088	71.11	0	254658
2008-09	45966	15.23	26765	8.86	228951	**75.83**	226	301908
2009-10	63497	16.51	35217	9.15	285800	74.33	0	384514
2010-11	70105	15.69	43968	9.84	332706	74.47	0	446779
2011-12	87963	17.21	54450	10.65	368616	72.13	0	511029
2012-13	111203	18.31	63681	10.48	432491	71.21	0	607375
2013-14	119963	16.86	82653	11.61	509005	71.53	0	711621
2014-15	138469	**16.47**	102483	12.19	599691	71.34	0	840643

Table 32: Total deposit in Sarv Haryana Gramin Bank, Barwala over the years 2010-11 to 2015-2016

(Rs. Crore)

Years	**Deposit**	**Percentage change in deposit**
2010-11	12.44	-
2011-12	14.73	18.41
2012-13	16.62	12.83
2013-14	17.49	5.23
2014-15	18.61	6.40
2015-16	23.10	24.13

Table 33: Total credit advanced by Sarv Haryana Gramin Bank, Barwala over the years 2010-11 to 2015-2016

(Rs. Crore)

Years	Total agriculture Credit		Total non agriculture credit		Total credit	Percentage change in credit
	STC	LTC	STC	LTC		
2010-11	6.45	0.71	-	1.79	8.97	-
2011-12	7.92	0.88	-	2.20	11.01	22.74
2012-13	11.62	1.22	-	3.23	16.15	46.68
2013-14	11.75	1.30	-	3.26	16.33	1.11
2014-15	12.45	1.38	-	3.46	17.3	5.93
2015-16	13.55	1.50	-	3.76	18.83	8.84

Table 34: Profit of Sarv Haryana Gramin Bank, Barwala 2010-11 to 2015-2016

(Lakh Rs.)

Years	Gross profit	Percentage in profit
2010-11	52	-
2011-12	58	11.53
2012-13	57	-1.72
2013-14	62	8.77
2014-15	66	6.45

Table35: Over-due amount of Sarv Haryana Gramin Bank Barwala

(Rs. Crore)

Years	Over-Due	Over-Due in percent
2010-11	1.79	20
2011-12	1.98	18
2012-13	2.26	14
2013-14	3.59	22
2014-15	4.49	26
2015-16	5.64	30

Table 36: Recovery Percent of Sarv Haryana Gramin Bank Barwala over the years

Years	Recovery in per cent
2010-11	80
2011-12	82
2012-13	86
2013-14	78
2014-15	74
2015-16	70

Table 37: Loan wise Rate of Interest charged by Sarv Haryana Gramin Bank (percent)

Amount and type of loan	**ROI on agriculture Credit**	
	STC	LTC
TERM LOAN		
Advances Up to Rs. 20 Lakh	-	13.00
Advances over Rs.20 Lakh	-	13.50
Agri. Clinics/Agri. Business Centers		
Advances Up to Rs. 20 Lakh	13.00	13.50
Advances over Rs.20 Lakh	13.50	14.00
SHG		
Up to Rs. 50000/-	12.50	13.00
Over Rs.50000/- to Rs.2 Lakh	13.00	13.50
Over Rs.2 Lakh	13.00	13.50
KCC	-	13.50
Advances Upto-3 Lakh	7	-
Above 3 Lakh	11	-
ROI on non agriculture credit	13.00	13.50

Constraints faced by respondentsin getting loan and repayment plan

- Lack of financial knowledge

- Bank staff is less cooperative
- Lack of security of collateral in case of marginal farmers
- Loan amount is not sufficient in case of medium and large farmers.
- Financial crisis in the family because of more expenditure on social ceremonies
- Lack of banks and other authorized loaning agencies in rural areas
- Untimely and inadequate loaning by banks or other authorized loaning agencies
- Long & complicated procedure for taking loans
- High rate of interest on loan above three lakh rupees
- low risk-taking capacity
- Poor saving capacity
- Poor repayment habit
- Extra family expenditures
- Low education level of farmers
- Low income level of farmers
- Attitude problem among the farmers.
- Misuse of fund
- Government policies and political interferences
- Higher dependence of farmers on nature create high risk institution in term of repayment

Technical Programme of Work: 2016-17

Sub-Project III: Financial performance of Sarva Haryana Gramin Bank in Hisar District of Haryana State.

Objectives:

i. To study the purpose-wise amount of loan disbursed by the bank.
ii. To examine the demand and supply of loan by the bank.
iii. To study the over dues of loan of selected farmers.
iv. To study constraints faced by farmers in repayment of loans.

Year of Start: 2015-16

Name of the scheme: 2809-C (a) Econ-1 Plan (Agri.)

Name of Investigator(s) with Activity Profile:

Scientist	Activity Profile
Dr. V. P. Mehta, Principal Investigator	Planning, Monitoring, Data Collection, Analysis & Report writing.
Dr. Jitender Kumar Bhatia, Co-Principal Investigator	Preparation of schedule, compilation and report writing.

Programme of work (2016-17): To fulfill the requirement of the study additional data like will be collected over time and space for further analysis, drawing meaningful conclusion and report writing.

Sub –Project V: Growth and Instability in Area, Production and Productivity of Major crops in Haryana

i) Objectives:

i. To examine the trends and growth over time in area, production and yield of selected major field crops.
ii. To analyze the instability in area, production and productivity of these crops.
iii. To determine the effect of change in area on production of major field crops.

ii) Year of Start : 2015-16

iii) Period of study : 2015-16

Name of scheme : 2809-C (a)Econ.1 Plan(Agri.)

iv) Name of Investigator(s) with Activity Profile:

Scientist/teacher	Activity profile
Dr. K.K.Kundu,(Associate Professor) Principal Investigator	Data collection, compilation, analysis of data and report writing

V) Method of study: The study was conducted at the Department of Agricultural Economics, CCSHAU, Hisar, Haryana. Secondary data was used in the study. Time-series secondary data on area, production and productivity on the selected crops were

collected covering period 1967 to 2014. The data were collected from various issues of published and unpublished source i.e., websites of India stat, FAOSTAT and Agriculture Statistics at a glance, Directorate of Economics and Statistics, GoI. Various statistical analytical techniques like Graphical techniques**,** Quantitative techniques, Parametric models such as Exponential function, Semi logarithmic function, Kinked exponential growth model,Simple linear regression, Cuddy-Della Valle index, Boyce's detrend statistic of instability,Diagnostic Tools like Durbin Watson Statistics were used. The growth rates of different sub periods were estimated by adopting the quadruple kinked semi-logarithmic trend equation since the time series was fragmented into five sub periods with four kinks (breaks).

vi) Results achieved during 2015-16

Trends in performance of wheat in Haryana (1967-2014):

Table 38: Trends in performance of wheat in Haryana (1967-2014)

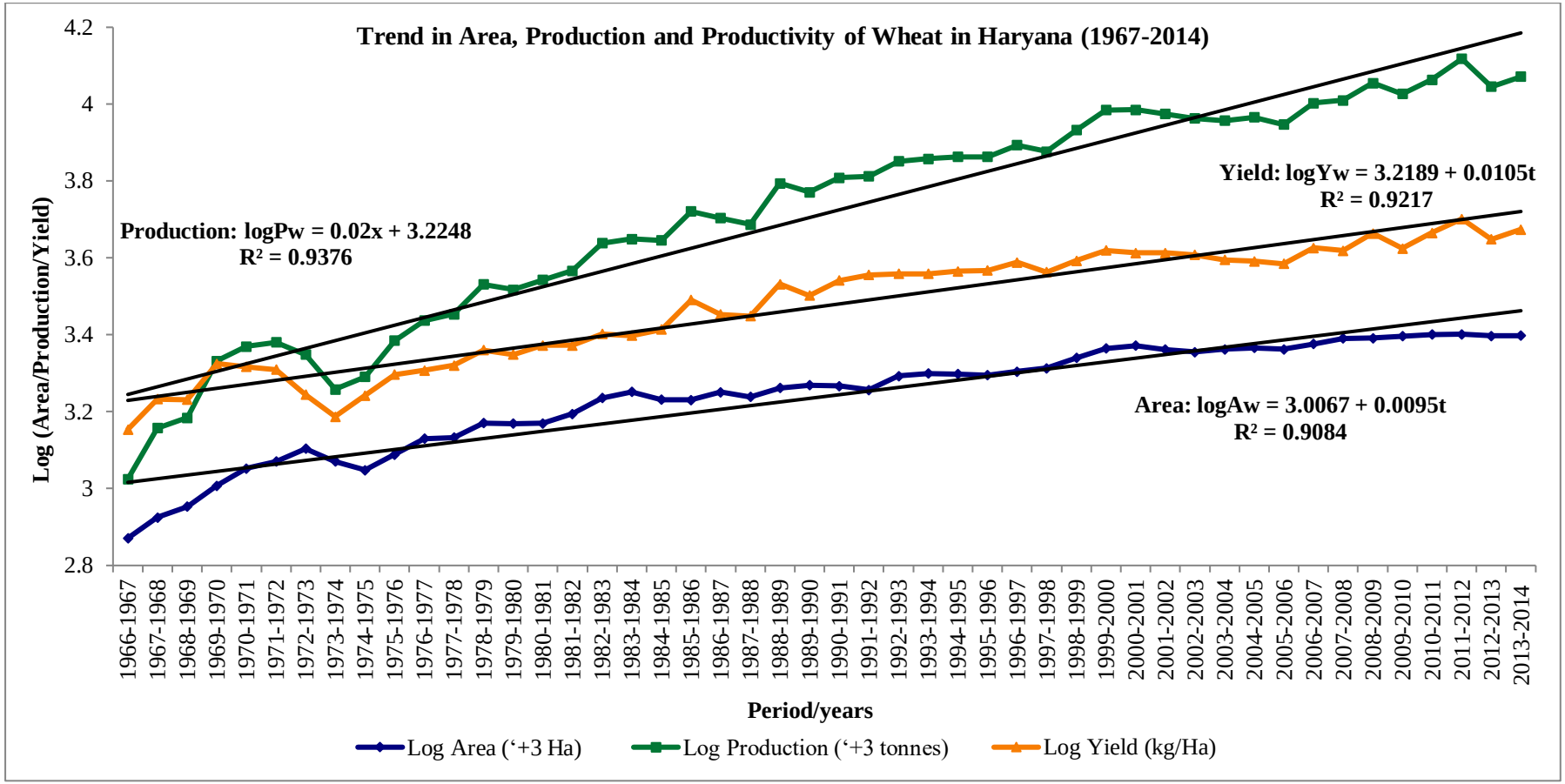
Variables	**Wheat**		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	0.0069***	0.0170***	0.0097***
	(0.0008)	(0.0015)	(0.0009)
Constant	3.0892***	3.3178***	3.2427***
	(0.0259)	(0.0475)	(0.0280)
Observations	47	47	47
R^2	0.6163	0.7293	0.7038
F-Statistic	72.2838***	121.2116***	106.9465***
RMSE	0.0162	0.0402	0.0320
DW-Statistic	1.7861	2.0024	2.0213
ρ	0.7864	0.7201	0.6315

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The estimated trends employing semi log model for area, production and productivity of wheat were shown in Table 38. The overall estimated models of observations of 47 have strong explanatory power. Moreover, the high R^2 values of the 0.6163, 0.7293 and 0.7038 respectively of the models estimating area, production

and productivity imply that 61.63, 72.93 and 70.38% of the variations in the trends of each model were predicted by the independent variable (time). It was observed that, the coefficient of time (overall period of study) for area, production and productivity was positive and highly significant at 1%. Thus the trend in area, production and productivity were increasing. The area, production and productivity of wheat increased by 0.0069, 0.0170 and 0.0097 respectively averagely every year which implies that the long run trends were increasing.

Figure 4: Trends in the performance of wheat in Haryana (1967-2014)



Trends in the performance of paddy in Haryana (1967-2014)

Table 39: Trends in performance of paddy in Haryana (1967-2014)

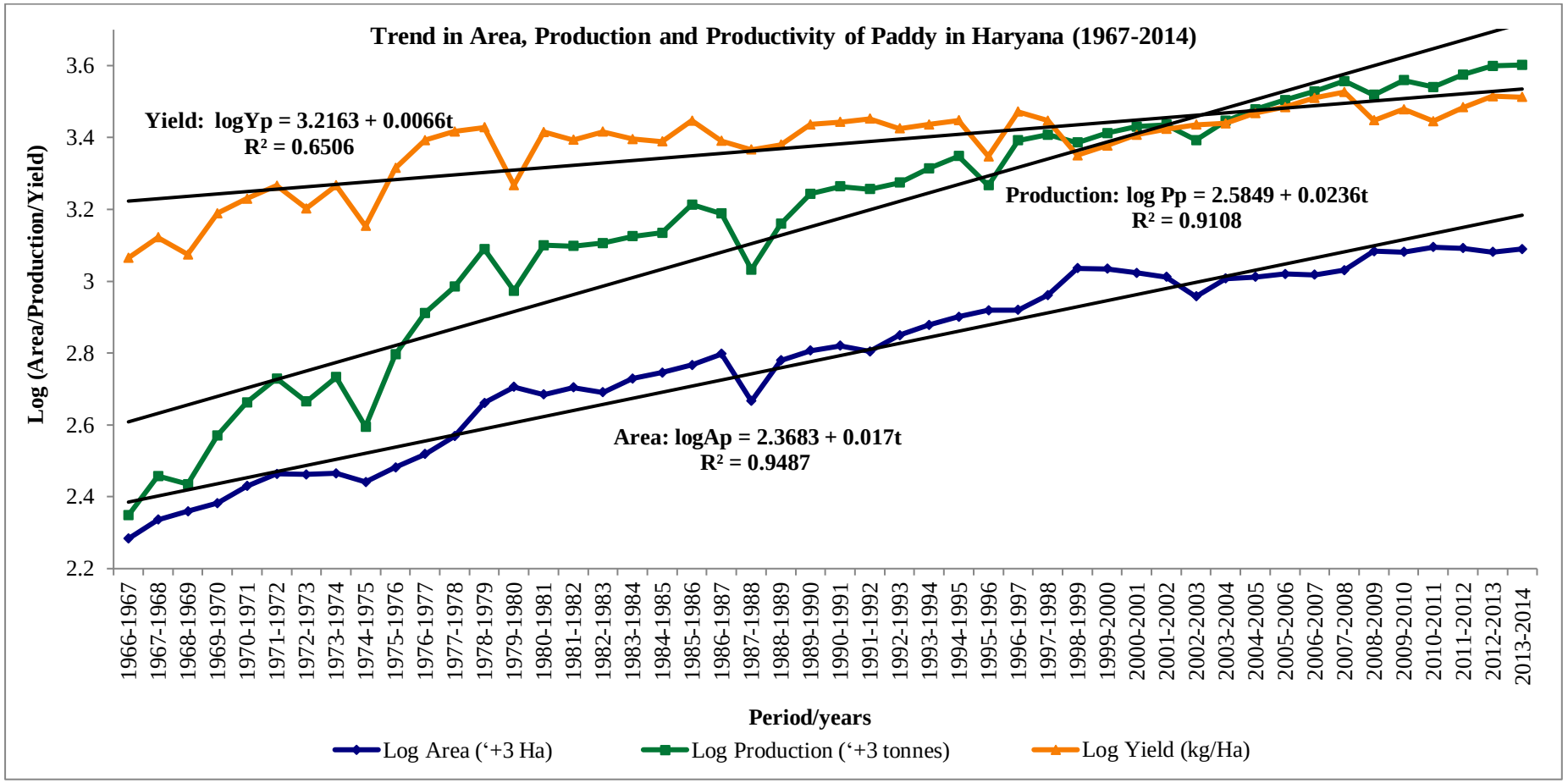
Variables	Paddy		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	0.0150***	0.0203***	0.0056***
	(0.0016)	(0.0024)	(0.0012)
Constant	2.4269***	2.6879***	3.2488***
	(0.0487)	(0.0724)	(0.0359)
Observations	47	47	47
R^2	0.6728	0.6216	0.3222
F-Statistic	92.5431	73.9209	21.3869
RMSE	0.0351	0.0638	0.0539
DW-Statistic	2.1343	2.4026	2.3456
ρ	0.7580	0.7099	0.5251

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The estimated semi log trends for area, production and productivity of paddy were shown in Table 39. Goodness-of-fit measures indicated that the models (observations of 47) were highly significant at P<0.01 withF statistic of 92.5431 (area), 73.9209 (production) and 21.3869 (productivity). Thus that the independent variable (time) was highly reliable in predicting the observed trend of area, production and productivity. Moreover, the high R^2 values of the 0.6728, 0.6216 and 0.3222 respectively of the models estimating area, production and

productivity imply that 67.28, 62.16 and 32.22% of the variations in the trends of each model were predicted by the independent variable (time). Similarly, it was justified that, the time variable in the models other than the intercept term were useful in predicting the trend.

Figure 5: Trends in the performance of paddy in Haryana (1967-2014)



Trends in performance of cotton in Haryana (1967-2014)

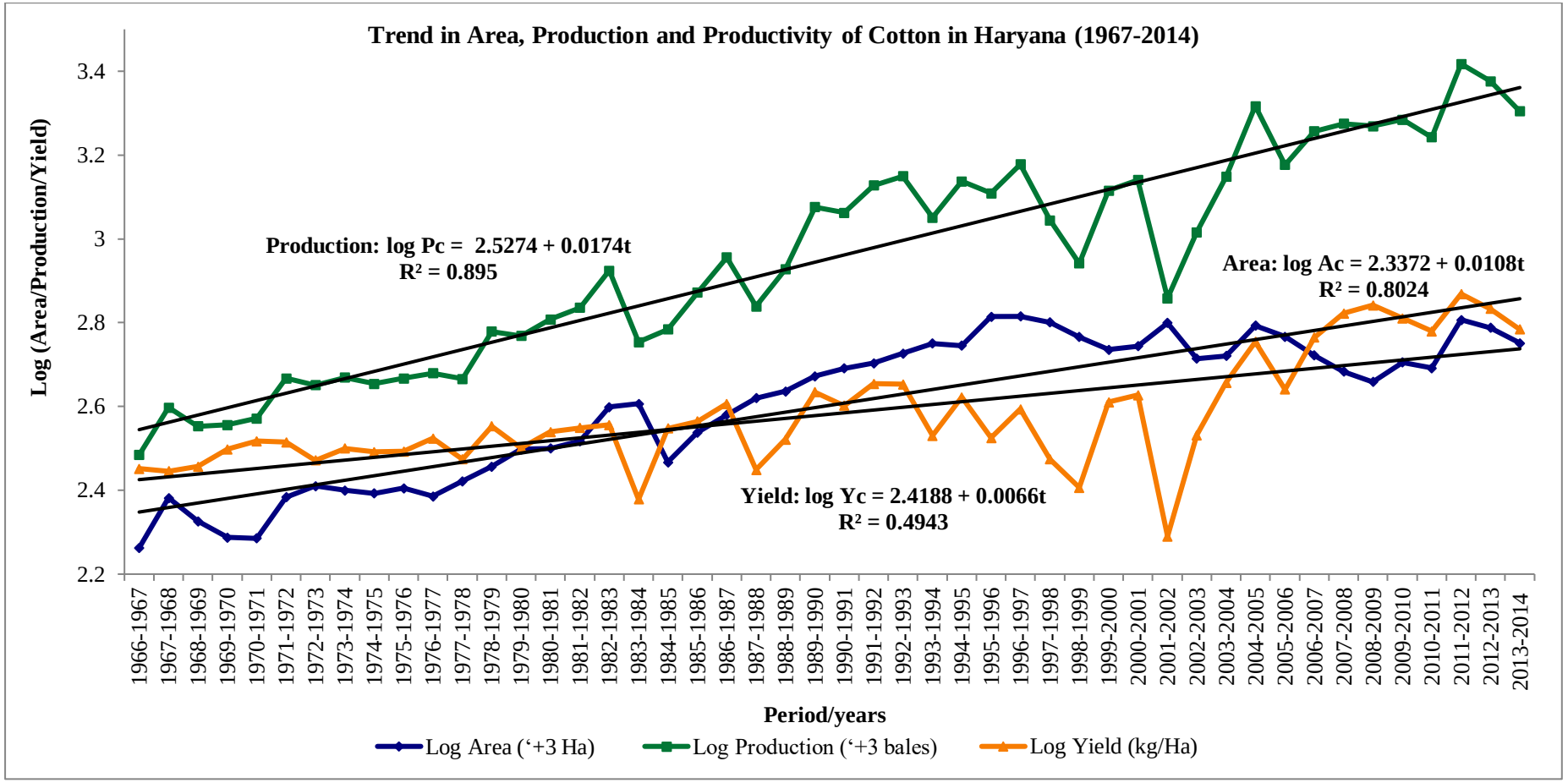
Table 40: Trends in performance of cotton in Haryana (1967-2014)

Variables	Cotton		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	0.0086***	0.0170***	0.0069***
	(0.0024)	(0.0013)	(0.0017)
Constant	2.4029***	2.5372***	2.4127***
	(0.0774)	(0.0374)	(0.0481)
Observations	47	47	47
R^2	0.2161	0.7936	0.2778
F-Statistic	12.4065	173.0233	17.3118
RMSE	0.0468	0.0795	0.0864
DW-Statistic	1.9105	1.9127	2.0702
ρ	0.7929	0.3394	0.4374

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The estimated semi log trends for area, production and productivity of cotton were shown in Table 40. The measure of the goodness-of-fit shows F statistic of 12.4065 (area), 173.0233 (production) and 17.3118 (productivity) and R^2 values of the 0.2161, 0.7936 and 0.2778 respectively of the models estimating area, production and productivity imply that 21.61, 79.36 and 27.78% of the variations in the trends of each model were predicted by the independent variable (time). Hence from the values of F statistic, R^2 and RMSE in Table 40, it was justified that, the time variable in the models other than the intercept term were useful in predicting the trend. It was detected that, the coefficient of time (overall period of study) for area, production and productivity was positive and highly significant at p<0.01. Thus the trend in area, production and productivity of cotton were increasing with increase in the time period. The area, production and productivity of cotton increased by 0.0086, 0.0170 and 0.0069 respectively averagely every year which implies that the long run trends were increasing.

Figure 6: Trends in the performance of cotton in Haryana (1967-2014)



Trends in the performance of pearl millet in Haryana (1967-2014)

Table 41: Trends in performance of pearl millet in Haryana (1967-2014)

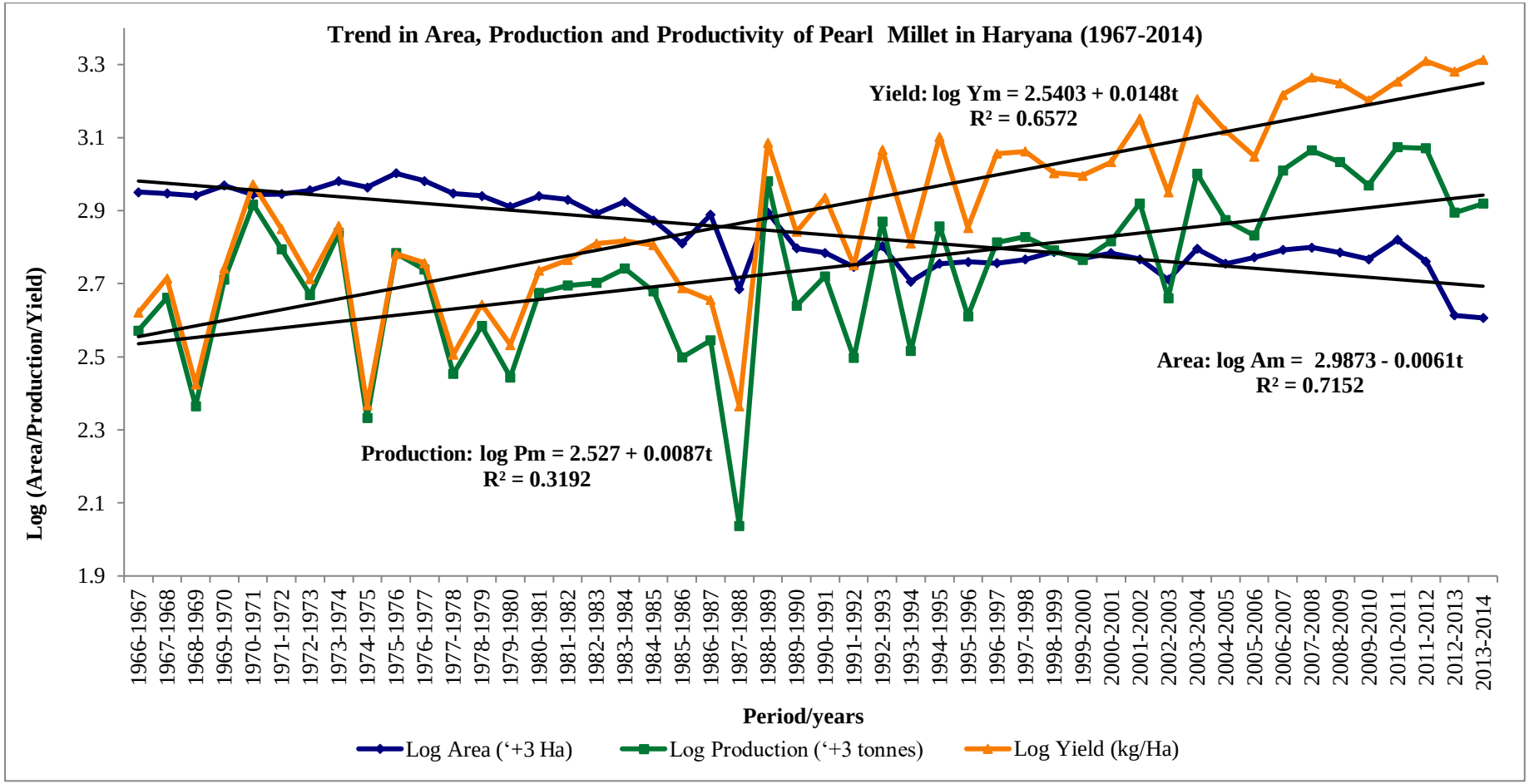
Variables	Pearl Millet		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	-0.0064***	0.0087***	0.0148***
	(0.0009)	(0.0019)	(0.0016)
Constant	2.9940***	2.5270***	2.5403***
	(0.0250)	(0.0525)	(0.0442)
Observations	47	47	47
R^2	0.5488	0.3192	0.6572
F-Statistic	54.7305***	21.5694***	88.1860***
RMSE	0.0517	0.1789	0.1509
DW-Statistic	2.2401	2.1022	2.0056
ρ	0.3567	-	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The trend in the series of pearl millet for Haryana during the whole study period was shown in Table 41. R^2 values of the 0.5488, 0.3192 and 0.6572 respectively of the models estimating area, production and productivity imply that 54.88, 31.92 and 65.72% of the variations in the trends of each model were predicted by the independent variable (time).

It was noticed that, the coefficient of time (overall period of study) for area was negative while that of production and productivity were positive and all were highly significant at $p<0.01$. While the area of harvest decreased from one period to the other, the production and productivity of pearl millet increased with increased in the time period. Quantitatively, the area of harvest of pearl millet decreased averagely by 0.0064 on yearly basis while production and productivity of pearl millet increased by 0.0087 and 0.0148 respectively averagely every year which implies that the long run trends were decreasing for area and increasing for production and productivity.

Figure 6: Trends in the performance of pearl millet in Haryana (1967-2014)



Source: Author's calculation based on data from: 1. Indiastat

2. Department of Agriculture and Cooperation, Government of India (ON682).

Trends in the performance of rapeseed and mustard in Haryana (1967-2014)

Table 42: Trends in the performance of rapeseed & Mustard in Haryana (1967-2014)

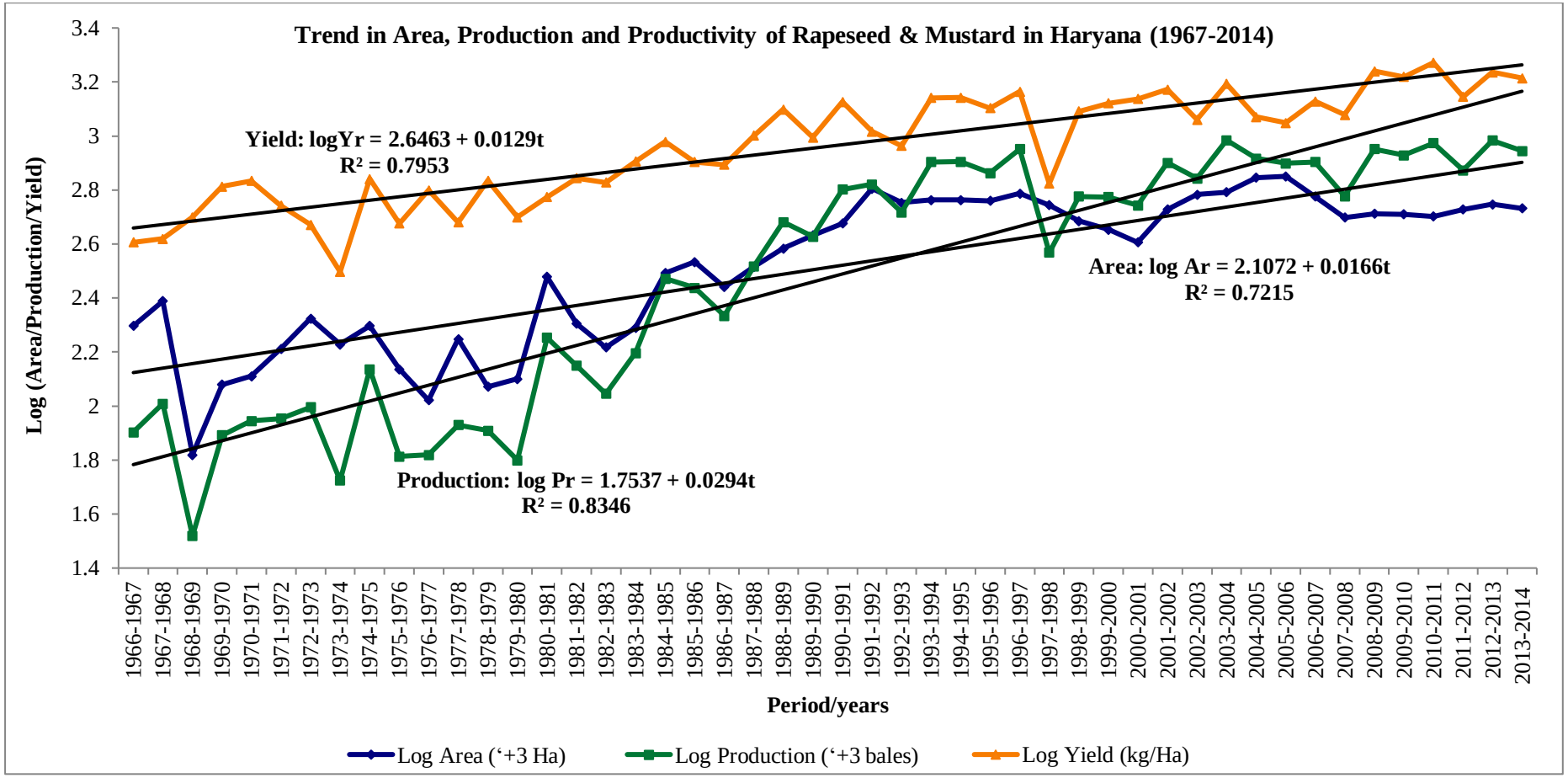
Variables	Rapeseed and Mustard		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	0.0171***	0.0295***	0.0129***
	(0.0028)	(0.0035)	(0.0010)
Constant	2.0822***	1.7425***	2.6463***
	(0.0837)	(0.1029)	(0.0271)
Observations	47	47	47
R^2	0.4448	0.6106	0.7953
F-Statistic	36.0565***	70.5522***	178.6727***
RMSE	0.1220	0.1616	0.0923
DW-Statistic	2.1119	2.3212	1.7830
ρ	0.5381	0.5047	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The estimated semi log trends for area, production and productivity of rapeseed and mustard for Haryana during the whole study period were presented in Table 42. The R^2 values of area (0.4448), production (0.6106 and productivity (0.7953) suggested that 44.48, 61.06 and 79.53% of the variations in the respective trends were predicted by the models (time) and were all highly significant (at P<0.01), which juxtaposed statistically significant relationship between the time variable and the area, production and productivity of rapeseed and mustard.

The trend in area, production and productivity of rapeseed & mustard increased with increase in the time period. The area, production and productivity of rapeseed and mustard averagely increased by 0.0171, 0.0295 and 0.0129 respectively annually which implied that the long run trends were increasing.

Figure 7: Trends in the performance of rapeseed and mustard in Haryana (1967-2014)



Source: Author's construction based on data from: 1. Indiastat

2. Ministry of Agriculture, Govt. of India (14105), (14268), (ON463), and (16361).

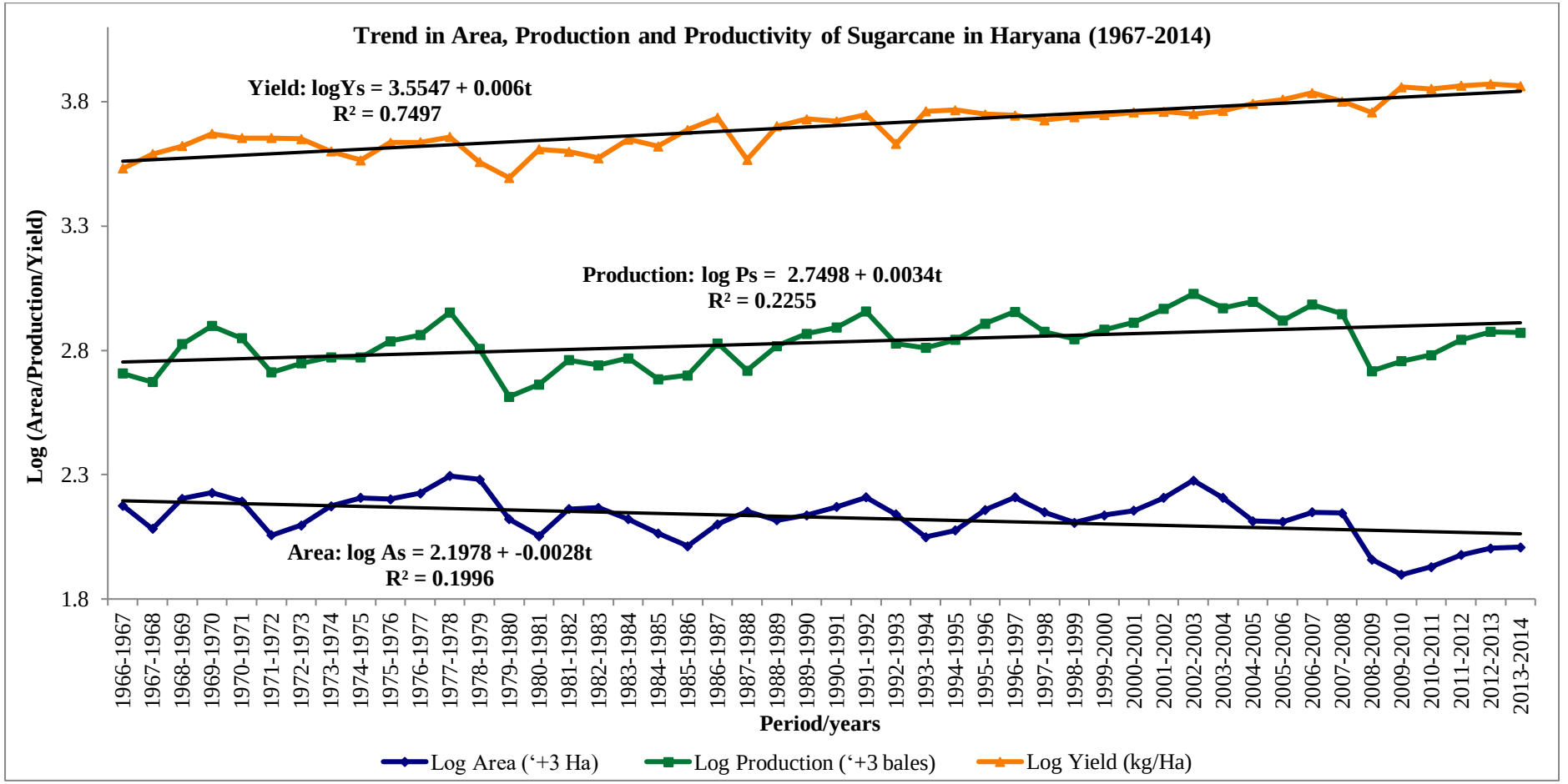
Table 43: Trends in the performance of sugarcane in Haryana (1967-2014)

Variables	Sugarcane		
	Area	**Production**	**Productivity**
Overall Period (1967-2014)	-0.0032*	0.0029	0.0059***
	(0.0018)	(0.0018)	(0.0007)
Constant	2.2076***	2.7625***	3.5581***
	(0.0550)	(0.0539)	(0.0210)
Observations	47	47	47
R^2	0.1996	0.22.55	0.7497
F-Statistic	3.0756*	2.5749*	65.2730***
RMSE	0.0628	0.0730	0.0468
DW-Statistic	1.4360	1.7397	1.9905
ρ	0.6323	0.5689	0.3097

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

The estimated semi log trends for area, production and productivity of sugarcane for Haryana during the whole study period were presented in Table 43. The R^2 values of area (0.1996), production (0.2255) and productivity (0.7497) suggested that 19.96, 22.55 and 74.97% of the variations in the respective trends were predicted by the models (time) and were all highly significant (at P<0.01). The study found out that, the sign of the coefficient of time (overall period of study) for area was negative while that of production was positive. Thus the trend in area decreased while that of productivity increased with increase in the time period. Numerically, the area decreased averagely yearly by 0.0032 where as productivity of sugarcane increased by 0.0059.

Figure 8: Trends in the performance of sugarcane in Haryana (1967-2014)



Source: Author's calculation based on data from: 1. Indiastat

2. Department of Agriculture and Cooperation, Government of India (ON682)

Trends in area, production and productivity of wheat in Haryana in five different sub periods

The estimated trends in area, production and productivity of wheat in five different periods of the log linear model were shown in Table 44.

Table 44: Trends in the performance of wheat in Haryana in different sub periods

Variables	Wheat		
	Area	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	0.0159***	0.0236***	0.0095***
	(0.0023)	(0.0039)	(0.0018)
Period II (1980-81 to 1989-90)	0.0087***	0.0278***	0.0187***
	(0.0020)	(0.0037)	(0.0021)
Period III (1990-91 to 1999-2000)	0.0081***	0.0155***	0.0074***
	(0.0020)	(0.0038)	(0.0021)
Period IV (2000-01 to 2009-10)	0.0049**	0.0089**	0.0037
	(0.0022)	(0.0041)	(0.0024)
Period V (2010-11 to 2013-14).	0.0010	0.0122	0.0118
	(0.0057)	(0.0118)	(0.0079)
Constant	2.9554***	3.1813***	3.2063***
	(0.0240)	(0.0391)	(0.0172)
Observations	47	47	47
$\bar{R}^2$	0.9239	0.9522	0.9558
F-Statistic	112.7614***	184.1124***	204.0479***
RMSE	0.0157	0.0367	0.0321
DW-Statistic	1.6809	1.8818	1.3365
ρ	0.5362	0.3769	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

Moreover, the $\bar{R}^2$ values of 0.9239 (area), 0.9522 (production) and 0.9558 (productivity)

revealed the 92.39, 95.22 and 95.58% of the variations in the trends in area, production and productivity respectively were predicted by the time variable (Period I, II, III, IV and V).

An observation of Table 44 revealed that all the significant explanatory variables were positive which implies an increasing trend in all the significant periods. Considering the trends in area and production, the study noticed that the area of harvest and production of wheat increased at different rates in periods I, II, II and IV at 1% significant level for all the periods except period IV which was observed to 5% significant level. Similarly, the trend in productivity increased only in periods I, II and III at dissimilar rates at 1% significant level (*see* Table 44).

Trends in area, production and productivity of paddy in Haryana in five different sub periods

All the estimated trend models as well as the significant periods showed upward movements for paddy. In terms of the trend in area of harvest of paddy, the study observed a positive and significant (P<0.01) movement in Period I, II and III at different rates. Similarly, upward significant (P<0.01) movements were recorded in Periods I-IV for the production level of paddy. Furthermore, positive significant (P<0.01 and P<0.05) trends were observed in Period I and IV respectively for the productivity of paddy (see Table 45).

Table 45: Trends in the performance of paddy in Haryana in different sub periods

VARIABLES	Paddy		
	Area	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	0.0282***	0.0515***	0.0234***
	(0.0033)	(0.0031)	(0.0026)
Period II (1980-81 to 1989-90)	0.0133***	0.0164***	0.0029
	(0.0032)	(0.0035)	(0.0030)
Period III (1990-91 to 1999-2000)	0.0213***	0.0199***	-0.0013
	(0.0032)	(0.0036)	(0.0031)
Period IV (2000-01 to 2009-10)	0.0057	0.0137***	0.0084**
	(0.0035)	(0.0040)	(0.0034)
Period V (2010-11 to 2013-14)	0.0081	0.0135	0.0025
	(0.0102)	(0.0134)	(0.0114)
Constant	2.2624***	2.3280***	3.0664***
	(0.0334)	(0.0293)	(0.0249)

Observations	47	47	47
$\bar{R}^2$	0.9534	0.9752	0.8383
F-Statistic	189.3437	370.7682	49.7221
RMSE	0.0317	0.0545	0.0463
DW-Statistic	1.9193	1.8074	2.0154
ρ	0.3718	-	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

Trends in area, production and productivity of cotton in Haryana in five different sub periods

Table 46 showed that there were positive significant (p<0.01 for periods I to III and p<0.05 for Period V) trends in all the Periods of area of harvest of cotton except in Period IV which registered a negative significant (P<0.01) trend. In the case of production upward significant (P<0.01) trends were seen in Periods I, II and IV. Nonetheless in terms of productivity an increasing trends were observed in Period II (significant level of P<0.1) and Period IV (significant level of P<0.01) but negative significant (P<0.05) trend was observed in period III.

Table 46: Trends in the performance of cotton in Haryana in different sub periods

Variables	**Cotton**		
	Area	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	0.0136***	0.0162***	0.0026
	(0.0024)	(0.0044)	(0.0041)
Period II (1980-81 to 1989-90)	0.0206***	0.0300***	0.0094*
	(0.0027)	(0.0050)	(0.0047)
Period III (1990-91 to 1999-2000)	0.0124***	0.0017	-0.0107**
	(0.0028)	(0.0052)	(0.0048)
Period IV (2000-01 to 2009-10)	-0.0109***	0.0238***	0.0350***
	(0.0031)	(0.0058)	(0.0054)
Period V (2010-11 to 2013-14).	0.0265**	0.0151	-0.0089
	(0.0103)	(0.0193)	(0.0179)

Constant	2.2771***	2.5154***	2.4682***
	(0.0225)	(0.0421)	(0.0391)
Observations	48	48	48
$\bar{R}^2$	0.9386	0.9067	0.6964
F-Statistic	144.7720***	92.4009***	22.5578***
RMSE	0.0419	0.0785	0.0729
DW-Statistic	1.5006	1.6359	2.0910

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

Trends in area, production and productivity of pearl millet in Haryana in five different sub periods

The trends in the area of pearl millet were characterized by negative movements, however significant (P<0.01) downward movements were observed in Period II and V. On the contrary a positive significant (P<0.05) trend was observed in Period IV. Considering the production levels of pearl millet, even though there were declines in the production levels in Periods I, II and V but was not significant. However, a significant (P<0.05) positive trends were seen in Periods III and IV. What's more the productivity of pearl millet showed positive significant (P<0.05) trends in Period III and a similar significant (P<0.1) upward trends in Periods III and IV (see Table 47)

Table 47: Trends in the performance of pearl millet in Haryana in different sub era

	Pearl Millet		
VARIABLES	**Area**	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	0.0001	-0.0055	-0.0037
	(0.0017)	(0.0076)	(0.0081)
Period II (1980-81 to 1989-90)	-0.0178***	-0.0006	0.0168*
	(0.0018)	(0.0081)	(0.0092)
Period III (1990-91 to 1999-2000)	-0.0025	0.0188**	0.0212**
	(0.0018)	(0.0083)	(0.0095)
Period IV (2000-01 to 2009-	0.0050**	0.0246**	0.0196*

	(0.0020)	(0.0094)	(0.0106)
Period V (2010-11 to 2013-14).	-0.0475***	-0.0287	0.0195
	(0.0073)	(0.0332)	(0.0353)
Constant	2.9564***	2.6923***	2.7147***
	(0.0161)	(0.0743)	(0.0769)
Observations	47	47	47
$\bar{R}^2$	0.9210	0.5489	0.6840
F-Statistic	108.2360***	12.1958***	21.3453***
RMSE	0.0366	0.1620	0.1433
DW-Statistic	2.0445	2.0128	2.4266
ρ	-0.3543	-0.2991	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

Trends in area, production and productivity of rapeseed and mustard in Haryana in five different sub periods

Table 48, depicted that, in explaining the trends in area, production and productivity rapeseed and mustard in Haryana, the $\bar{R}^2$ values indicated that the included variables correctly predicted 84.49, 92.80 and 82.26% of the variations. Among all the periods none recorded a significant trend except Period II which registered a positive significant (P<0.01) coefficient in area, production and productivity of levels of rapeseed and mustard in Haryana.

Table 48: Trends in the performance of oilseeds in Haryana in different sub periods

Variables	**Rapeseed and Mustard**		
	Area	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	-0.0011	0.0053	0.0064
	(0.0061)	(0.0068)	(0.0048)
Period II (1980-81 to 1989-90)	0.0517***	0.0817***	0.0300***
	(0.0069)	(0.0078)	(0.0055)
Period III (1990-91 to 1999-2000)	0.0061	0.0081	0.0021

	(0.0071)	(0.0080)	(0.0056)
Period IV (2000-01 to 2009-10)	0.0001	0.0105	0.0104
	(0.0080)	(0.0090)	(0.0063)
Period V (2010-11 to 2013-14).	-0.0049	0.0048	0.0102
	(0.0265)	(0.0298)	(0.0209)
Constant	2.1849***	1.8536***	2.6688***
	(0.0577)	(0.0649)	(0.0456)
Observations	48	48	48
$\bar{R}^2$	0.8449	0.9280	0.8226
F-Statistic	52.2245***	122.2301***	44.5925***
RMSE	0.1075	0.1209	0.0850
DW-Statistic	1.7447	2.4458	2.2949

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

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Trends in area, production and productivity of sugarcane in Haryana in five different sub periods

An observation of Table 49 revealed a negative significant (P<0.05) trend in the area of harvest in Period II. On the other hand, the trend of productivity of sugarcane in Haryana increased significantly in Periods II and IV at a significance level of 1% and 5% respectively. The study further observed that, none of the variables were significant at least 10% in predicting the trends in production level of sugarcane.

Table 49: Trends in the performance of sugarcane in Haryana in different sub era

Variables	**Sugarcane**		
	Area	**Production**	**Productivity**
Period I (1966-67 to 1979-80)	0.0010	-0.0101	-0.0033
	(0.0082)	(0.0089)	(0.0024)
Period II (1980-81 to 1989-90)	-0.0070	0.0091	0.0122***
	(0.0075)	(0.0083)	(0.0028)

Period III (1990-91 to 1999-2000)	0.0104	0.0135	0.0041
	(0.0075)	(0.0083)	(0.0029)
Period IV (2000-01 to 2009-10)	-0.0212**	-0.0119	0.0081**
	(0.0081)	(0.0089)	(0.0032)
Period V (2010-11 to 2013-14).	0.0050	0.0104	0.0122
	(0.0220)	(0.0248)	(0.0107)
Constant	2.1574***	2.8710***	3.6316***
	(0.0850)	(0.0907)	(0.0233)
Observations	47	47	48
$\bar{R}^2$	0.1275	0.1090	0.7985
F-Statistic	2.3439*	2.1259*	38.2411***
RMSE	0.0622	0.0720	0.0434
DW-Statistic	1.4288	1.7644	1.8703
ρ	0.4919	0.4575	-

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10; Standard errors in parentheses are shown below the coefficients.

Growth rates of major crops in Haryana

Table 50: Compound growth rate of the performance of the major field crops (1967-2014)

Crops	**Compound Growth Rates in Haryana(1967-2014)**		
	Area (%)	**Production (%)**	**Productivity (%)**
Wheat	1.60***	3.99***	2.26***
Paddy	3.51***	4.79***	1.30***
Cotton	2.00***	3.99***	1.60***
Pearl Millet	-1.46**	2.02**	3.47**

		*		
Rapeseed & Mustard		4.02***	7.03***	3.01***
Sugarcane		-0.73*	0.67	1.37***

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10;

The growth rates of area, production and yield of major field crops of Haryana for the entire study period (1967 to 2014), analysed by the log linear model, were presented in Table 50. Considering area of harvest it was identified that, there was positive significant (P<0.01) growth in wheat, paddy, cotton and rapeseed and mustard. On the contrary, pearl millet and sugarcane registered negative growth at significance level of 1% and 10% respectively. Among the crops that recorded positive significant growth in terms of area of harvest, rapeseed and mustard recorded the highest (4.0%) growth and the least growth (1.6%) was achieved by wheat. Likewise, the bracket of crops underpinned negative significant growth rates, pearl millet filed the highest negative rate (-1.46%) while the lowest was sugarcane (-0.73%). Hence within the entire period of the study rapeseed and mustard showed the highest growth rate followed by paddy, cotton, wheat, sugarcane and pearl millet being the least.

Shifting from area of harvest to the production levels of the crops, the study identified that, the annual compound growth rates of production of the crops were significant (P<0.01) excluding the rate of sugarcane which were found non-significant. Among the major crops that were significant, rapeseed and mustard scored the highest production growth rate of 7.03% annually, trailed by paddy (4.79%), cotton (3.99), wheat (3.99), and pearl millet (2.02%). Cotton and wheat recorded the same growth rate.

Limiting the presentation to the yield of the crops, the study found that the compound growth rate of productivity for all the crops were significant at 1%. Considering the individual crops it was isolated that pearl millet scored the maximum productivity growth rate of 3.47% annually. This was followed rapeseed and mustard, wheat, cotton, sugarcane and paddy.

Table 51: Compound growth rates of the performance of the major field crops in Haryana in different sub periods

Economic Variables	Major Field Crops	Compound Growth Rates in the Different Sub periods in Haryana					
		1966-87 to 2013-14	1966-87 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2009-10	2010-11 to 2013-14
		Overall	Period I	Period II	Period III	Period IV	Period V
Area (%)	Wheat	1.60***	3.73***	2.02***	1.88***	1.13**	0.23
	Paddy	3.51***	6.71***	3.11***	5.03**	1.32	1.88
	Cotton	2.00***	3.18***	4.86***	2.90***	-2.48***	6.29**
	Pearl Millet	-1.46***	0.02	-4.02***	-0.57	1.16**	-10.36***
	RM	4.02***	-0.25	12.64***	1.41	0.02	-1.12
	Sugarcane	-0.73*	0.23	-1.60	2.42	-4.76**	1.16
Production (%)	Wheat	3.99***	5.58***	6.61***	3.63***	2.07	2.85
	Paddy	4.79***	12.59***	3.85***	4.69***	3.20***	3.16
	Cotton	3.99***	3.80***	7.15***	0.39	5.63***	3.54
	Pearl Millet	2.02***	-1.26	-0.14	4.42**	5.83**	-6.39
	RM	7.03***	1.23	20.70***	1.88	2.45	1.11

	Sugarcane	0.67	-2.30	2.12	3.16	-2.70	2.42
Productivity (%)	Wheat	2.26***	2.21***	4.40***	1.72***	0.86	2.75
	Paddy	1.30***	5.54***	0.67	-0.30	1.95**	0.58
	Cotton	1.60***	0.60	2.19*	-2.43**	8.39***	-2.03
	Pearl Millet	3.47***	-0.85	3.94*	5.00**	4.62*	4.59
	RM	3.01***	1.48	7.15***	0.48	2.42	2.38
	Sugarcane	1.37***	-0.76	2.85***	0.95	1.88**	2.85

Note:Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10;

Source: Author's calculation based on data from: 1. Indiastat;

Considering, the area of harvest from Table 51 in terms of crop wise; the study observed the CGR of wheat in all the periods were positively significant (at least 5%) except Period V. Moreover, the significance level of Period I, II and III were 1% while that of Period IV was 5%. The significant CGR of area of harvest of wheat was highest in Period I (3.73%) while the least was in Period IV (1.13%). Changing over to paddy, the study identified positive significant CGRs in Period I, II and III. The highest growth in area of harvest of paddy occurred in Period I (6.7%) followed by Period III (5.03%) all at a significance level of 1%. Period II recorded the least growth (3.11%) in area of harvest of paddy at a significance level of 5%. However, in terms of the area of harvest of cotton, significant CGRs were recorded in all the periods where growth in Period IV recorded negative. Period V recorded the highest CGR of 6.29% at 5% significant level followed by PII (4.86), PI (3.18), PIII (2.90%) and PIV (-2.48%) at 1% significant level. Focusing on the area of harvest of pearl millet, significant growth was identified in Period II, IV and V. The growth in area of harvest of pearl millet was poor and was characterized by negative growths however an upward significant growth was observed in Period IV. Table 51 revealed that, the peak CGR of 1.16% at 5% significant level occurred in PIV followed by CGR of -4.02% and -10.36% respectively occurring in PII and PV at 1% significant level. Accentuating on the area of harvest of rapeseed & mustard and sugarcane, significant CGR occurred only in

one period. The growth in rapeseed and mustard occurred in Period II at CGR of 12.64% at a significant level of 1% while that of sugarcane occurred in period IV at CGR of -4.76% at significant level 5%. Considering CGRs in period wise the study observed that in Period I –V, paddy, rapeseed & mustard, paddy, peal millet and cotton respectively recorded the highest CGR. On the contrary in Period I-V, the crops that registered the least growth were cotton, pearl millet, wheat, sugarcane and pearl millet respectively. Among the periods, Period I provided the crops with ambient environment for maximum CGR in area of harvest while Period IV contributed the minimum.

Basing the interpretation of Table 51 on the CGRs of production levels by considering each crop, the study noticed that the CGR of wheat in Period I, II and III were positively significant ($P<0.01$) but CGRs in Period IV and V were not significant. The significant CGR of production of wheat was highest in Period II (6.61%) while the lowest was in Period IV (3.63%). Considering paddy, the study identified positive significant ($P<0.01$) CGRs in Period I-IV. The highest growth of production occurred in Period I (12.59 %) while the least was in Period IV (3.20%). Moreover, in terms of cotton, positive significant ($P<0.01$) CGRs were recorded in Period I, II and IV. The CGR of varies from 3.80% (Period I) to 7.15% (Period II). Focusing on pearl millet, significant ($P<0.05$) CGRs was identified in Period III and IV. The peak CGR of production 5.83% occurred in PIV.

Furthermore, on the production level of rapeseed & mustard significant ($P<0.01$) CGR of 20.7% occurred only in Period II in the upward direction. Nevertheless none of the growth in the periods was significant for sugarcane. Limiting the CGRs of production in period wise the study observed that in Period I –IV, paddy, rapeseed & mustard, paddy and pearl millet respectively recorded the extreme CGR. Contrariwise, in Period I-IV, the crops that registered the least growth were cotton, paddy, wheat, and paddy respectively.

The CGRs of productivity of the major field crops were holistically deliberated in this paragraph with aid of Table 51. The study detected that the CGR of wheat in Period I, II and III were positively significant ($P<0.01$) but CGRs in Period IV and V were not. The significant CGR of productivity of wheat was maximal in Period II (4.40%) while the minimal was in Period III (1.72%). Considering paddy, the study identified positive significant (at least $P<0.05$) CGRs in Period I and IV. The CGR in Period I was greater than that of Period IV. Moreover, in relation to cotton, significant CGRs were recorded in Period II, III and IV at significance levels

of 10%, 5% and 1% respectively. The CGR of the productivity of cotton ranges from 8.39% (Period IV) to -2.43% (Period III). Focusing on pearl millet, positive significant CGRs were recognised in Period II, III and IV at significance levels of 10%, 5% and 10% respectively. The extreme CGR of productivity of 5.00% occurred in PIII while the least was in Period (3.94%). What's more, CGRs of the productivity level of rapeseed & mustard was significant (P<0.01) only in Period II which recorded a rate of 7.15%. The CGRs of the productivity of sugarcane were positively significant in the Periods II and IV where period II the highest CGR of 2.85%. Turning over the CGRs of productivity from crop wise to period wise the study pointed out that, in Period I –IV; paddy, rapeseed & mustard, pearl millet and cotton respectively recorded the maximum CGR. Contrarily, in Period I-IV, the crops that registered the least growth were wheat, cotton (II and III) and sugarcane respectively.

Instability of area, production and yield of the major field crops in (1967-2014) in Haryana

Table 52: Instability in the performance of the major field crops in Haryana (1967-2014)

Crops	Instability levels in Haryana (1967-2014)								
	Area			**Production**			**Productivity**		
	R^2	**CV (%)**	CV_t **(%)**	R^2	**CV (%)**	CV_t **(%)**	R^2	**CV (%)**	CV_t **(%)**
Wheat	0.6163	28.34	17.56***	0.7293	54.35	28.28***	0.7038	32.12	17.48***
Paddy	0.6728	48.57	27.78***	0.6216	60.51	37.22***	0.3222	22.69	18.68***
Cotton	0.2161	34.97	30.96***	0.7936	56.71	25.76***	0.2778	33.00	28.04***
Pearl Millet	0.5488	22.80	15.32***	0.3192	43.93	36.25***	0.6572	55.45	32.46***
Rapeseed & Mustard	0.4448	50.26	37.45***	0.6106	72.95	45.52***	0.7953	42.12	19.06***
Sugarcane	0.064	19.71	19.07*	0.0541	22.53	21.91	0.5919	22.14	14.14***

Note: Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10;

The instabilities in area of harvest, production and yield of major field crops of Haryana were presented in Table 52, area of harvest it was revealed that all the major crops exhibited inclining rate of instability at significance level of 1% except sugarcane which was 10%. Among the crops, rapeseed and mustard experienced the most inclining rate of instability (37.45%) while wheat recorded the least.

In production also, a similar significant (P<0.01) increasing drift of instability was pointed out. The production of sugarcane experienced non-significant rise in instability. However, rapeseed and mustard continued to experience the highest level of instability (of 45.52%) in production while that of cotton reduced to 25.76% being least fluctuation amount among the crops.

The instability in productivity was relatively less compared to area and production. However, the instabilities observed showed increased highly significant (P<0.01) movement. Pearl millet showed the most huge amount variations (32.46%) while sugarcane experienced the least (see Table 52).

Instability in different periods in Haryana

Table 53: Instability in the performance of the major field crops in Haryana in different sub periods

Economic Variables	Major Field Crops	Instability levels in the Different Sub periods in Haryana				
		1966-87 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-2000	2000-01 to 2009-10	2010-11 to 2013-14
		Period I	Period II	Period III	Period IV	Period V
Area (%)	Wheat	-0.0027***	-0.0006	0.0003	-0.0006	0.0003
	Paddy	0.0037	-0.0034	-0.0013	-0.0003	-0.0041
	Cotton	-0.0023	-0.0006	0.0009	-0.0028	0.0088

	Pearl Millet	0.0008	0.0118**	-0.0146***	0.0065	0.0007
	RM	-0.1000*	-0.0397	0.0099	-0.0120	-0.0209
	Sugarcane	0.0144	-0.0166	0.0047	0.0235	-0.1263**
Production (%)	Wheat	-0.0143***	0.0004	-0.0002	0.0003	0.0010
	Paddy	0.0007	-0.0095	-0.0040	-0.0002	-0.0027
	Cotton	0.0056	0.0043	0.0207	-0.0301*	0.0105
	Pearl Millet	-0.0562	0.1947*	-0.2649**	0.0538	-0.0840
	RM	-0.0854	-0.0662	0.0189	-0.0408	0.0122
	Sugarcane	0.0101	-0.0211	0.0020	0.0175	-0.0864*
Productivity (%)	Wheat	-0.0051***	-0.0003	-0.0008	0.0011	-0.0007
	Paddy	0.0056	-0.0106**	0.0037	-0.0018	-0.0032
	Cotton	0.0101	-0.0029	0.0483*	-0.0547*	0.0038
	Pearl Millet	-0.0563	0.0805	-0.1263**	0.0182	-0.0462
	RM	-0.0135	-0.0090	0.0206*	-0.0244	-0.0019
	Sugarcane	-0.0014	0.0021	-0.0059	0.0026	-0.0066

Note:Stars denote significance at *** p<0.01, ** p<0.05, * p<0.10;

The instability in the area of harvest depicted in Table 53 showed a declined effect in all the period of the major crops except in Period II of pearl millet. The result juxtaposed that, the degree of fluctuations in area of harvest were less and almost non significant in the major crops. However, it was significant (at least at P<0.1) in Period I, II and V for wheat, pearl millet and sugarcane respectively at a minifying rate. Moreover, Period II of the area of pearl millet experienced the highest magnitude of instability of 0.0118% at significance level of 1%. The

study further identified that the instability in area of harvest for paddy and cotton was not statistically significant in all the periods.

A similar scenario was also observed in the production levels of the major crops. The production of wheat, cotton, pearl millet and sugarcane experienced significant (at least P<0.1) declined in instability in period II, IV, III and IV respectively. On the other hand, pearl millet experienced a significant (P<0.1) increased in instability in production in Period II which was the highest recorded so far. The study also isolated that the instability in production of paddy and the oilseeds was not statistically significant in all the periods. Among the periods, instability in Period II was the greatest while that of Period I showed the least.

The yield carries both area and production effects. The fluctuations in yield revealed similar picture identified in area and production in the sense that most of the crops experienced a fall in instability, with wheat, paddy, cotton and pearl millet having a significant decrease in Period I, II, IV and III respectively. Nevertheless, cotton and rapeseed & mustard experienced a significant (P<0.1) increased in instability in yield in Period III. The highest rise in instability was observed in the productivity of cotton in period III while the minimum was identified in wheat in Period I.

The effect of change in area of harvest on the production of the major field crops in Haryana

Table 54 unveiled the influence of area of harvest on the production levels of the major field crops. Moreover, the R^2 values of the models indicated that the variations in the production of each model were predicted by the area of harvest. The models labeled wheat (0.8220), paddy (0.9050), RM (0.8630) showed high explanatory power based on the R^2 values. Nonetheless the models labeled pearl millet, cotton and sugarcane showed a below average (weak) explanatory power, which imply that the influence between area of harvest and the production of pearl millet, cotton and sugarcane was weak.

Table 54: The effect of change in area on production of the major field crops in Haryana

Variables	Production					
	Wheat	Paddy	Cotton	Pearl Millet	RM	Sugarcane

Wheat (A)	6.8246***					
	(0.4733)					
Paddy (A)		3.2076***				
		(0.1550)				
Cotton (A)			2.0224***			
			(0.7464)			
Pearl millet (A)				-0.4948**		
				(0.2342)		
RM (A)					1.5814***	
					(0.0929)	
Sugarcane (A)						4.0925***
						(0.6149)
Constant	-6,249.6544***	-367.6457***	274.9553	959.4054***	-156.9144***	176.8740*
	(934.6694)	(123.9599)	(395.5425)	(169.4525)	(39.8612)	(101.8060)
Observations	48	48	48	48	48	48
R^2	0.8220	0.9050	0.1403	0.0884	0.8630	0.4961
F-Statistic	207.8721***	428.5112***	7.3421***	4.4630**	289.8569***	44.3030***
RMSE	526.0896	213.8274	258.7311	259.0860	122.8936	84.2218

From Table 54, the study observed that there was a significant relationship between the area of harvest and production levels of the all the major crops. The area of harvest positively influenced the production levels of wheat, paddy, cotton, rapeseed & mustard and sugarcane at a significance level of 1% for the entire study period. On the contrary the effect of area on production of pearl millet was negative at a significance level of 5%.

Conclusions

Trends and Changes in Growth (Overall period)

- The area of harvest of the major field crops except pearl millet and sugarcane for both Haryana continuous increased trends and growth for the past five decades. The growth rates in area were higher wheat, paddy, cotton, and rapeseed and mustard on acreages. Continuous rising trend and growth in production and production were observed in all the major field crops in the two study areas. Nonetheless, growth rates of wheat, paddy, pearl millet and oilseeds were more prominent .However, in the case of the production of cotton and sugarcane; India production levels were higher than that of Haryana. But also for the productivity of sugarcane, the growth rate was higher in Haryana than in national level.
- Among the periods, Period II and III had the greatest impact on the major field crops in Haryana which were mostly characterized by positive trend except pearl millet.

InstabilityOverall period

- The instability in area, production and productivity for the overall period was relatively high in all the crops. In the entire period the production levels of the major crops except cotton (in Haryana) recorded the highest degree of instability at the state level. The variability in the production of wheat, paddy, rapeseed & mustard and sugarcane as well cotton was mainly due to fluctuation in area of harvest. On the other hand the production fluctuation of pearl millet in Haryana was as a result of mainly yield variations.

Sub Periods

- Instability in area, production and productivity was very low and showed declined effects in all the periods for all the crops except pearl millet which recorded increased variability in some instances in the five sub periods

Effect of Area on production

- The study observed that there was a highly significant positive relationship between the area of harvest and production levels of all the major crops except pearl millet which was otherwise in Haryana.

Policy Implications

- Policies should be directed to minimize area variability via: suitable price policy, Protection of agricultural lands from encroachers (industrialist), Proper risk management, Government policy should focus on developing new high-yielding varieties etc.
- Yield stabilization policies should be strengthen to reduce production variability in the major crops through: extension, efficient management of irrigation, and adoption of less risky technology, assured timely supply of inputs, use of plant protection measures.

B. Other Agencies

Scheme: "Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana" (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Co-operation, Govt. of India)

Name of the Scheme	C (c) Econ.-I.(CS)-Comprehensive Scheme to study the Cost of Cultivation of Principal Crops in India-Haryana
Year of Start	1970
Objective	To provide representative and comparative data on Cost of Cultivation of Principal Crops in Haryana
Period of Study /Location	2015-16 (CCS Haryana Agricultural University, Hisar)
Staff position in the scheme	
Hon. Director-cum- Prof. & Head	Dr. R.K Patel
Principal Scientist / SRO	Dr. V.P. Luhach
Principal Scientist	Dr. Kuldeep Kumar
Principal Scientist	Dr. R.S.Pannu
Principal Scientist	DR. D.P. Malik (on deputation)
Statistician-1	Vacant
Computer Assistants-03	03 vacant
Agril. Inspectors - 29	One vacant

Name of Investigators with Activity Profile:

Scientists	**Activity Profile**
R.K. Patel	Planning, execution, overall supervision and verification of data.

V.P. Luhach	Planning, execution, monitoring, supervision, checking & verification of data.
Kuldeep Kumar	Planning, monitoring, supervision, checking and verification of data.
R.S.Pannu	Planning, monitoring, supervision, checking and verification of data.
D.P. Malik	On deputation in Ministry of Agriculture, GoI for five years.
V.P. Luhach	Compilation, validation and valseas of data

Budget: **(Rs. In lakh)**

Particular	**Allotment 2015-16**	**Expenditure 2015-16**	**Budget 2016-17**
Establishment (Salary)	2,01,26300	1,96,51,637	225.00
T.A.	10.00	4,59,302	10.00
Contingency (Recurring and Non-recurring)	3873700	32,01,1969	15.00
Total	**2500000**	**233,12908**	**250.00**

Salient Achievements during 2015-16

The scheme is being financed by Ministry of Agriculture, Govt. of India. Under this scheme, the cost of cultivation data of seven important crops of Haryana state namely, Paddy, Cotton, Pearl millet, Sugarcane, Wheat, Gram and Rapeseed & Mustard were collected from 30 Centers /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The processed data for the Rabi and Kharif seasons for the year 2014-15 have been submitted in time to the Ministry of Agriculture on C.D. for further analysis, the result of which will be used by the Commission for Agricultural Costs and Prices (CACP) for fixing the minimum support prices of Kharif and Rabi crops at national level.
- Data for Kharif and Rabi seasons of year 2015-16 have been received from the field staff.
- The processing and entry of data for the kharif season of the year 2015-16 has been completed and validation & valseas for kharif season data has been done.

- Trainings/meetings of Agricultural Inspectors were organized at Department of Agricultural Economics during the year 2015-16 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items and keeping daily operation record.
- The scientists working in the scheme also organized meetings of Agricultural Inspectors working under their supervision at their respective headquarters for checking of data entries in the records.
- The scientists working in the scheme supervised the work of Agricultural Inspectors, discussed with selected farmers about crop operations and inputs used at farm level to maintain the accuracy of data.
- The discrepancies in data as reported by funding agency were checked, corrected and re-submitted again.

Plan of Work for the year 2016-17

- Compilation of data for the year 2015-16 is in progress for all the seven crops and will be submitted to the Ministry of Agriculture, Govt. of India in the month of October 2016.
- The data on cost of cultivation of crops Paddy, Cotton, Pearl millet, Sugarcane, Wheat, Gram and Rapeseed & Mustard for the year 2016-17 will be collected from 30 clusters located in different Agro-Climatic Zones of the state by cost accounting method.
- The data will be collected for the year 2016-17 by using both old RT's and new RT's developed by Ministry of Agriculture because if any information lacking in new RT's that can be taken from old one. After completion of Kharif season (2016-17), the entry of the data offline as well as online by AI's at cluster headquarter. This will be forwarded to field supervisor after proper checking of the data and if the data found correct it will be forwarded to the field officer (SRO).Otherwise it can be returned back to the field men for the proper checking and correction. The correct data received by Field Officer/SRO will be thoroughly cross checked, validation and valseas of data and it will be sent online to the Ministry of Agriculture for future processing the data which is required for fixing the MSP of various crops.
- The data entry module of FARMAP 2.0 software has been uploaded in the public domain at URL and hand-on-training to use this software has been taken by the Scientist in the month of January 2016. Now, after allotting the user id and password to Honorary Director/Field

Officer of this centre by NIC. The field officer (SRO) has created the user ID and password to field Supervisor/Scientist and Field man/AI. Although there is no Field Officer/SRO at the centre. Now, from this year 2016-17 onward they are supposed to enter the data online.

- The data entry of both Rabi and Kharif season in the FARMAP 2.0 of all the clusters/centres for all the principle crops of the state for the year 2013-14 is in progress and by the end of July 2016, the online entry of data in FARMAP 2.0 for whole state will be provided to the Agriculture Ministry Govt. of India by the stipulated period i.e. 31st July 2016 to test the results of the FARMAP 2.0 software.
- Strict supervision of data collection work of Agricultural Inspectors will be done by respective scientist to maintain accuracy in data.
- Information from funding agency as well as discrepancies in data will be disseminated to the Agricultural Inspectors.

Table 55: Cost of production and minimum support prices of major crops in Haryana

Crops	**Cost of Production (Rs./q)**		**Minimum Support Price- (Rs./q)**	
	2011-12	**2012-13**	**2011-12**	**2012-13**
Paddy	1251	1248	1080	1250
Pearl millet	1122	1416	980	1175
Cotton	3229	3796	2800* 3300*	3600* 3900*
Wheat	851(50.78)	1048	1285	1350
Gram	3472(5.65)	2830	2800	3000
Rapeseed & Mustard	2046(18.93)	2721	2500	3000
Sugarcane	163	181	145 L266-M271-E276#	170

Source: Agricultural statistics at a glance, 2013, Directorate of Econ. & Stat. Ministry of Agri. Govt. of India

Cost of production includes all actual expenses in cash and kind incurred in production by owner plus interest on value of owned/fixed capital assets (excluding land) plus rental value of owned land plus imputed value of family labour. * Medium staple cotton (mm) of 24.5-25.5 and micronaire value of 4.3-5.1

** Long staple cotton (mm) of 29.5-30.5 and micronaire value of 4.5-4.3

^ Fair and Remunerative Price (FRP) in case of Sugarcane # Prices given by Govt. of Haryana

L -Late variety, M-mid sown, E-early sown.

The cost of production per quintal of paddy, gram, pearl millet and cotton was higher in 2011-12 and in 2012-13 the cost of production per quintal is higher for Pearl millet and Cotton than minimum support prices (MSP). Similarly cost of production of sugarcane was also found higher than FRP in the year 2011-12 and 2012-13 (Table 55).

SCIENTISTS ASSOCIATED WITH PROJECTS OPERATING IN OTHER DEPARTMENTS

Name of Scientist	**Name of Project**	**Name of department operating project**
V.P.Luhach	Centre of Excellence on Pearl Millets	Food & Nutrition (College of H. Sc.)
Dalip Kumar Bishnoi	Zero tillage rice establishment and crop weed dynamics in rice and wheat cropping system in India and Australia (ACIAR project).	Department of Agronomy
	Integrated Farming System Model.	Department of Agronomy
Jitender Bhatia	Optimization of Land resources of marginal/small farmers using LP models.	Department of Math&Statistics
V P Mehta	Problem of debt among small and marginal farmers of southern region of Haryana.	Department of Sociology

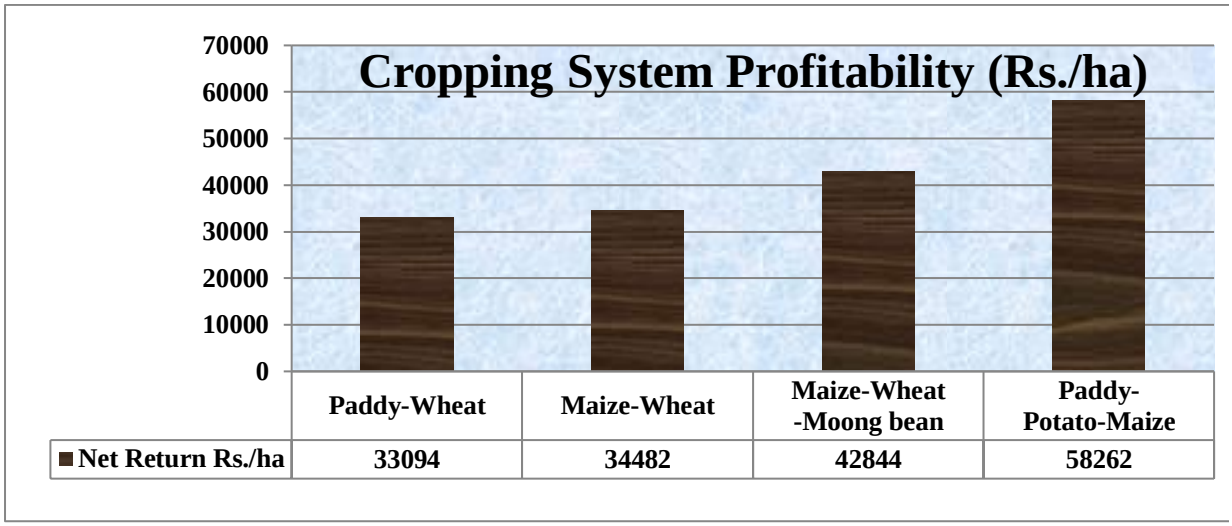
LIST OF PG STUDENTS WITH THEIR THESIS TITLE AND NAME OF MAJOR ADVISORS

S. No.	Name of student	Adm. No.	Research topic	Major advisor
Ph.D. students				
1.	Veer Sain	2013A1D	Market Information System and its application for agricultural commodities in Haryana	Dr. K.K.Kundu
2.	Jitender Kumar	2013A2D	Role of Sarva Haryana Gramin bank in financing farmer of Hisar district	Dr. V.P.Mehta
3.	Sumit	2014A1D	An Economic analysis of Bee-keeping: Production and Marketing of Honey in Haryana	Dr. R.S.Chauhan
M. Sc. Students				
1.	MrityunjayPandey	2014A1M	Estimation of demand for NPK use in Haryana	Dr. U.K.Sharma
2.	Suraj Choudhary	2014A2M	An economic analysis of fish farming and marketing in Haryana introduction	Dr. Neeraj Pawar
3.	Heena	2014A4M	An economic analysis of fertilizer use in Haryana	Dr. V.P.Luhach
4.	Sunita	2014A6M	Diversification of cropping pattern and production in Haryana	Dr. V.P.Mehta
5.	Sanjay	2014A7M	A study on regulated markets of Haryana	Dr. Sanjay Kumar
6.	K. Archana	2015A1M	Dynamics of Production and Marketing of BT Cotton in Haryana vis-à-vis Tamilnadu	Dr. K.K.Kundu
7.	Bidyut Kalia	2015A2M	An Economic analysis of Production and Marketing of Straw berry in Hisar district of Haryana.	Dr. R K Grover

8.	Abhijeet	2015A3M	An Economic Analysis of Prevailing Vegetable crop rotation in Haryana	Dr. R. S. Chouhan
9.	Mohit	2015A4M	Performance and Prospects of Primary Agricultural Credit Societies in Haryana	Dr. V.P.Mehta
10.	Usha	2015A5M	Comparative Economic Analysis of Marketing and Storage of Onion in Haryana	Dr. V.P.Luhach
11.	Kamal	2015A7M	An Economic analysis of Production and Marketing of Pulses in Haryana.	Dr. Jitender Kumar Bhatia
12.	Ashu	2015A8M	An Economic analysis of Potato Seed Production under Contract Farming in Haryana	Dr. Dalip Kumar Bishnoi

Revised (For official use only)

REVIEW OF RESEARCH SCHEMES (2016-17)
and
TECHNICAL PROGRAMME OF WORK (2017-18)



DEPARTMENT
OF
AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE
CCS HARYANA AGRICULTURAL UNIVERSITY
HISAR – 125 004 (HARYANA)

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REVIEW OF RESEARCH SCHEMES (2016-17) AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2017-18

A. REPORT BY THE HEAD OF THE DEPARTMENT

1. Name of the Department: Agricultural Economics

2. Salient Research Findings of the Department during 2016-17:

- In Karnal and Yamunanagar district, the total assets possessed by the respondent farmers, tractor and tractor drawn implements accounted for more than one-fourth (28.98 per cent) of the total investment followed by farm building and cattle shed (19.97 per cent), milch animals (15.69 per cent), tube well (14.94 per cent), transport (14.30 per cent) chaff cutter (2.67 per cent), draught animals (2.46 per cent) and cart (0.99 per cent).
- Paddy (67.21 per cent) followed by sugar cane (20.53 per cent), vegetables (7.97 per cent) andJowar fodder (4.43 per cent) were reported as the important crops in terms of net area sown in kharif season while in rabi season, area allocated under wheat was 63.39 per cent followed by sugar cane (21.42 per cent), vegetables (7.20 per cent) and berseem (4.48 per cent), maize (2.08 per cent) and mustard (1.33 per cent).
- Higher per hectare net returns from Okra-wheat-Cucumber (Rs.94,261), Cauliflower(early)-Wheat-Cucumber (Rs.94,185), Bitter gourd-Wheat-Cucumber (Rs. 89,203) indicates that alternate crop rotations may be feasible options for the marginal and small categories of farmers to switch over some area from paddy towards these vegetable crops.
- Maize – Wheat –Moong bean and Maize –Wheatwere profitable cropping systems over Paddy– Wheat cropping system with net returns of Rs. 42,844 and 34,482 per hectare respectively, as compared to Rs. 33,094 per hectare net returns from Paddy– Wheat cropping system i.e. Rs. 33,094 per hectare during study period. Hence a part of paddy area may be shifted to these alternate cropping systems in the study area.
- Overall average cropping intensity of the study area was 197.59 percent and ranged from 196.25 to 199.00 per cent on different category of farms.
- The return over variable cost in Bt. cotton was observed highest on large farms (Rs.19, 282/ha) followed by small (Rs.16, 827/ha) and medium farms (Rs.14, 915/ha) with benefit cost ratio of (1.35), (1.34) and (1.28) respectively.
- The yield gap analysis in case of Bt. cotton revealed that a wide gap among potential yield, yield attained on farm and the average actual yield and high obtained by the farmers and high infestation of white fly.

3. Emerging/Thrust Areas

- Socio-economic analysis of emerging agricultural problems.
- Demand, supply and price analysis of agricultural input and output.
- Input use efficiency in existing cropping pattern in different agro-climatic zones.
- Economic analysis of diversification, marketing and value addition in farm products.
- Organic farming and vermi-compost.

4. Action taken Report of the last year's proceedings:

Sr.No.	Observations/ Suggestions made	Action Taken
1	In salient achievements , use of crop specific inputs be mentioned, latest data on cost of production and MSP of crops be given, research projects funded by different agencies be mentioned (Point vi) and action taken on last year's proceedings (point 6and 7),be reflected in the Technical Programme 2016-17.**(Action:HOD, Agricultural Economics)**	Necessary corrections have been incorporated.
2.	The text in document be based on the results of the experiments only. Write title in place of sub-project and uniformity in font size (page 81)be maintained in the document. **(Action: HOD, Agricultural Economics)**	Necessary Action has been taken.
3.	Joint experiments be planned on adoption of crop diversification vi-a-viz expenditure by government agencies (last 10 year) and constraints in adoption of DSR **(Action: HOD, Ag. Econ. and Extension Education)**	Study is to be given to Ph.D. student
4.	Experiments planned on demand, supply and price index of different crops.**(Action: HOD, Agricultural Economics)**	Similar work was already done in the department.
5.	Experiment 1, (Page 8)the number of farmers in different categories should be same; the name of zones to be corrected and write selected villages in place of Hisar district. **(Action: Concerned Scientist)**	Checked and Necessary corrections have been incorporated.
6.	In sub-project II (Page 25), the information on area, production and productivity should either be decadal or plan-wise. **(Action: Concerned Scientist)**	Necessary changes made accordingly.
7.	In sub-project III (Page 40), data in tables be presented on the basis of extent of participation in decision making. **(Action: Concerned Scientist)**	Necessary changes made accordingly.
8.	The sub-project II (Page 52)be dropped. The	Dropped as the

	experiment on empowerment of women in villages adopted by CCSHAU, Hisar be planned. **(Action: Concerned Scientist)**	concerned scientist (sociology)superannuated in November 2016
9.	Sub-project IV (Page 53) socio economic profile and loan repayment pattern of farmers to be assessed. **(Action: Concerned Scientist)**	Necessary action has been taken.
10.	Sub-project V (Page 58)the last row mentioned under tables be deleted, equations in tables and graphs be same and testing be done up to 1%. In future, the data be compiled on the basis of block years and role of land mark CCSHAU varieties in production and productivity be assessed. New experiment (page 74) be planned on Rapeseed and Mustard**(Action: Concerned Scientist)**	Deleted and Corrected.
11.	In other agency scheme, (page 76), correct the name of Ministry and figures in budget table under TA head. **(Action: Concerned Scientist)**	Corrections made accordingly.

5. Research projects (both from state as well as outside agencies) in operation along with sanctioned budget (2016-17)

Sr. No.	Number and name of the scheme	Sanctioned Budget (In Rupee)	Funding Agency
A.	**State Funded Schemes**		
1.	**C (a) Econ.1 Plan (Agri.) /C (a) Dte-R-1-Agri. (A)-1140 (Ag. Econ.)** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	1,21,60,900	State Govt.
B.	**Other Agencies**		
2.	**Govt. of India C(c) Econ.1 (CS)** Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India-Haryana.	2,50,00,000	Ministry of Agriculture & Farmers Welfare, GOI.

6. Research project completed during 2016-17

-Nil-

7. Research projects sanctioned during 2016-17

-Nil-

8. Recommendations generated

-Nil-

9. IPR/Patent filed if any: - Nil-

B. Details of Each Research Scheme(s) for Review:

1. Scheme No. : C (a) Econ-1 Plan (Agri.) (old**)**

C (a) Dte-R-1-Agri. (A)-1140 (Ag.Econ**.)**

Title : Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

2. Year of Start : 2002-2003

3. Location : Haryana

4. Objectives of the scheme:

1. To analyse the resource use efficiency in Haryana farming.

2. To carry out studies into different marketing aspects of major farm inputs and products.

3. To study the possible agricultural diversification in different zones of Haryana.

5. Any need to modify the objectives as per the need of the state

- No-

6. Staff provided in the scheme including name of the faculty members

Sr. No	Sanctioned posts	Status
1.	Economist (FM) -1	**Vacant**
2.	Assistant Scientist (Ag. Econ.) - 6	1. JitenderKumar Bhatia
		2. Dalip Kumar Bishnoi
		Vacant- 4
3.	Assistant Scientist (Sociology)/ - 1	**Vacant**
4.	Assistant Scientist (Statistics) - 1	**Vacant**
5.	Research Associate (Rural Sociology)-1	**Vacant**

7. Budget for the year 2016-17 (head-wise sanction and expenditure details)

(inRs.)

Sub Head	2016-17		2017-18
	Allotment	Expenditure	Allotment
Pay	37,60,400	37,60,392	43,03,400
ADA	45,09,600	45,09,568	49,62,800
CPF/GPF	1,84,800	1,84,782	7,84,400
Gratuity	30,00,000	30,00,000	-
OE & Others	20,000	10,382	22,500
TA	3,000	2,104	16,200
M & S	5,300	5,289	5,850
Other Charges	99,000	98,200	6,750
POL	-	-	-
Medical	2,00,000	,87,670	-
LTC	3,78,800	3,78,456	1,80,000

Total	**1,21,60,900**	**1,21,37,143**	**1,01,01,900**

8. ACHIEVEMENTS OF THE SCHEME:

Experiment: Economic Analysis of Existing and Alternative Cropping Pattern in Different Zones of Haryana

- The level of education of head of the families varied across farm sizes. In particular, share of illiterate heads was observed higher in small category (18.92 per cent) in comparison to other categories.
- The average size of family was 7.45 persons in selected farm households. The category of large farm households indicated higher size (around 9 persons) in comparison to other categories. It could be due to prevalence of joint family system on large category of farms in the study area.
- Among livestock, 48 per cent were milch animals comprising 32.12 per cent of cow and 16.44 per cent of buffaloes with a 34 per cent of young stock.17.50 per cent of total livestock were draught animals.
- Operational holdingsize of small, medium and large farmers was 1.60, 3.50 and 7.07 hectare per household respectively. Thus, disparities in operational holdings across farm categories were found significant.
- More than 90 per cent of land operated by farmers at the aggregate level was found irrigated. The land rent in case of irrigated landwas in the range of Rs. 88,000-92,000perhectare in the study area.
- The sampled farm households on an average possessed assets withworth of about Rs. 10.00 lakhs.
- Higher net returns from cropping system i.e. Okra – Wheat – Cucumber (Rs.94, 261/ha), Cauliflower (early) – Wheat – Cucumber (Rs.94, 185/ha), Bitter gourd – Wheat – Cucumber (Rs. 89,203/ha) indicates that alternate crop rotations may be feasible options for the farmers to switch over some area from paddy towards these vegetable crops to enhance farm income.
- Maize – Wheat –Moong bean, Maize –Wheatwere foundprofitable cropping system over Paddy– Wheat cropping system with net returns of Rs. 42,844 and 34,482 per hectare respectively as compared to net returns from Paddy-Wheat cropping system (Rs. 33,094)
- Comparative economic analyses of Paddy - Wheat cropping system vis-a-vis different vegetable cropping systems revealed that Cauliflower (early) – Green pea – Cucumber cropping system were found most profitable with net returns Rs.

1,44,716 per hectare followed by Okra – Cauliflower – Cucumber (Rs 128690/ha), Cauliflower (early) – Carrot – Cucumber (Rs 1,24,521/ha), Bitter gourd – Tomato – Cucumber (Rs 95,674/ha), Cauliflower (early) – Potato – Cucumber (Rs. 90,776/ha) with benefit cost ratio of these cropping system were 1.40, 1.33, 1.36, 1.26 and 1.21 respectively over Paddy – Wheat cropping systems (Rs. 33,094/ha with B-C cost ratio 1.18).

- Paddy - potato - sugarcane ratoon - wheat were found profitable cropping system with highest net returns (Rs. 34,792 /ha) followed by paddy - autumn sugarcane – sugarcaneratoon - wheat (Rs. 33,958 /ha) over paddy - wheat cropping system (Rs. 33,094 /ha) among sugarcane based cropping system.
- Foot rot and neck blast diseaseshoot borer,stem borer, sucking insect/pest and weeds likemandusi, makra and mothawere observed as major problems faced by the farmers in the study area.

9. Justification for continuation of the scheme

Objectives of the scheme are of continuous in nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers in Haryana over the period.

10. Constraints, if any: Shortage of faculty in the scheme.

11. Technical programme for the year 2017-18 and Review of Research Scheme during the Year2016-17

i) Experiment No.1:"Economic Analysis of Existing and Alternative Cropping Pattern of DifferentZones in Haryana"

Project period: 2016-17 Location: Karnal and Yamuna Nagar

ii) Objectives:

1. To examine the existing cropping pattern of selected farmers.
2. To analyse the economics of existing cropping patterns.
3. To suggest the alternative cropping patterns.

iii) Name(s) of Investigator(s) with Activity Profile:

Scientists	Activity profile
Jitender Bhatia	Data collection, analysis of data and report writing.
Dalip Kumar Bishnoi	Data collection, compilation and report writing.
J. C. Karwasra	Monitoring and report writing

iv) Collaborator: None

v) Year of Start : 2015-16

Work done during 2016-17

vi) Location of Experiment and Statistical Design: Karnal and Yamunanagar District

From Karnal and Yamunanagar district, Nilokheri and Radour blockwereselected randomly and from each selected block, two villages i.e. TaraoriandSandhir from Nilokheri (Karnal) and KanjnuandDhaulrafromRadaur (Yamunanagar) were selected, with a sampled of total eighty farmers of different categories (Table 1).Selected farmer respondents were personally interviewed through a pre-structured schedule.

Table 1: Distribution of sampled farmers according to farm size groups in selected villages:2016-17

District		**Karnal**		**Yamunanagar**		**Overall Total**
Block		**Nilokheri**		**Radaur**		
Villages		**Taraori**	**Sandhir**	**Kanjnu**	**Dhaulra**	
Farmers category	**Small**(up to 2ha)	6	8	7	7	**28**
	Medium(2 to 4 ha)	7	6	6	9	**28**
	Large(> 4 ha)	4	6	8	6	**24**
Total		**17**	**20**	**21**	**22**	**80**

vii) Observations recorded

Data on farm inventory (resource structure), cropping pattern, input use, labor use, productivity, returns from different crops and problems as well as constraints faced by selected farmers were collected by survey method. Tabular analysis was applied to draw the inferences of the study.

viii) Results achieved during 2016-17

Demographic Characteristics: The general characteristics of sampled households were presented in Table 2. The study reveals that only 9.28 per cent of heads were found below 30 in age group. More than 60 per cent of the heads were found in the age group of 30-50 years while about 28 per cent were observed above 50 years at the overall level.

Table 2: Demographic characteristics of sampled households:2016-17

Particulars	**Small (n= 28)**	**Medium (n= 28)**	**Large (n=24)**	**Overall (n=80)**
Age of head (Years)(%)				
Up to 30	7.15	17.86	4.17	9.28
30 – 50	60.71	53.57	37.50	62.54
Above 50	32.14	28.57	58.33	28.18
Educational status of head of the family (%)				

Illiterate	21.43	14.29	8.33	15.30
Primary	25.00	7.14	12.50	15.11
Secondary	35.71	46.43	41.67	41.23
Sr. Secondary	7.14	17.86	25.00	15.86
Graduate and above	10.71	14.29	12.50	12.50
Average family size (Nos.)				
Males	3.29	4.14	5.04	4.11
Females	2.78	3.43	3.88	3.34
Total	6.07	7.57	8.92	7.45
Occupation of head of family (%)				
Agriculture as main occupation	85.71	89.29	95.83	90.00
Agriculture as subsidiary occupation	14.29	10.71	4.17	10.00

The range of age group of head of selected farm households showed significant variations across farm sizes.

Among the selected households, more than 80 per cent of them attained education up to senior secondary level. Around 15and 41 per cent heads studied up to primary and secondary level. It is depressing to note that 15.30 per cent heads at the overall level were illiterate in the study area. The level of education of heads varied across farm sizes.

The main occupation of head of selected farm households was agriculture i.e. 90 per cent whereas only 10 per cent were engaged in subsidiary occupation at the overall level. Only 14.29 per cent of the heads in small farm category took up agriculture as subsidiary occupation while around 10.71 per cent of medium and only 4.17 per cent in large category farmers adopted supportive activities to augment their family income. The average size of family was around 7.45 persons in selected farm households. The category of large farm households indicated higher size (around 9 persons) in comparison to other categories. The average size of family was 6.07 persons in small category while it was 7.57 persons in case of medium category.

Land Resources:

The status of land holdings of sampled households indicates that the selected farm households owned 3.56 hectares per household at the aggregate level. Among all categories of farmers leased in land was observed higher in the case of large farmers in comparison to other categories of farmers. At overall basis land operated aggregate level was 3.91 hectares followed by large category farmers (7.07 ha.) medium farmers (3.50

ha.) and small farmers (1.60 ha) per household respectively. The land rent ranged between Rs. 88,000 to 92,000 per hectare in the study area (Table 3).

Table 3: Land holding and average area irrigated on sampled farms in selected villages2016-17 **(ha/ farm)**

Farm Size Category	Owned	Leased in	Irrigated Canal/TW	Unirrigated	Total Operational Holding	Land Rent Rs. / ha
Small	1.49 (93.13)	0.11 (6.88)	1.47 (91.88)	0.13 (8.13)	1.60 (100.00)	92350
Medium	3.03 (86.57)	0.47 (13.43)	3.18 (90.86)	0.32 (9.14)	3.50 (100.00)	90250
Large	6.60 (93.35)	0.47 (6.65)	6.57 (92.93)	0.50 (7.07)	7.07 (100.00)	88750
Overall	3.56 (91.05)	0.35 (8.95)	3.60 (92.07)	0.31 (7.93)	3.91 (100.00)	90535

Figures in parentheses show per cent to the total operational holding

Resource structure of sampled farmers:

The sampled farm households on an average possessed assets worth Rs. 9, 84,076 at the overall level. The farm size disparities were very wide. The small category of farm households owned farm assets worth Rs. 4, 12,069 against Rs.17, 75,898by the large farm category. The investment per unit of area per acre declined with an increase in farm size. Tractor and tractor drawn implements (S.No. 4-10) accounted for more than one-fourth (28.98 per cent) of the total investment followed by farm building and cattle shed (19.97 per cent), milch animals (15.69 per cent), tube well (14.94 per cent), chaff cutter (2.67 per cent), draught animals (2.46 per cent) and cart (0.99 per cent). Investment in remaining farm assets including transport means was very low (14.30 per cent) in the study area.

Crop - Livestock Integration

Among livestock, 48.56 per cent were milch animals comprising 32.12 per cent of cow and 16.44 per cent of buffaloes with nearly 34 per cent of young stock while 17 per cent of total livestock were used as draught animals on the sampled farms in the study area (Table 5).

Table 5: No. of livestock maintained on sampled farms in selected Villages: 2016-17

Category of Animals	Small	Medium	Large	Overall
Milch cow	1.00 (30.31)	2.00 (34.78)	1.22 (29.83)	1.41 (32.12)
Milch buffalo	0.30 (9.09)	0.75 (13.04)	1.11 (27.14)	0.72 (16.44)
Cow heifer	0.57 (17.27)	1.75 (30.43)	0.55 (13.45)	0.96 (21.84)
Buffalo heifer	0.43 (13.03)	0.50 (8.70)	0.66 (16.14)	0.53 (12.10)
Drought animals	1.00 (30.30)	0.75 (13.05)	0.55 (13.45)	0.77 (17.50)
Total	**3.30 (100.00)**	**5.75 (100.00)**	**4.09 (100.00)**	**4.38 (100.00)**

Figures in parentheses show per cent to the total livestock

Cropping Pattern: Cropping patterns being practiced by the farmers' in the study area are presented in Table 6.In Kharif season paddy(67.21 per cent) followed by sugar cane (20.53 per cent), vegetables (7.97 per cent) was observed as the important crops in terms of net area sown devoted by the sampled households while area allocated under fodder crop i.e. Jowar was (4.43 per cent). In Rabi season, area allocated under wheat was (63.39 per cent) followed by Sugar cane (21.42 per cent), Vegetables (7.20 per cent) and berseem (4.48 per cent) while area sown under maize was (2.08 per cent) and mustard (1.33 per cent).Overall average cropping intensity of the study area was 197.59 percent ranged between 196.250 to 199.00 per cent on different category of farms.

Table 6: Cropping pattern on sampled farms in selected Villages:2016-17(ha/ farm)

Crop	Small	Medium	Large	Overall
Paddy	1.00 (65.02)	2.20 (64.24)	4.17 (69.53)	2.37 (67.21)
Sugarcane	0.36 (23.15)	0.77 (22.59)	1.31(18.75)	0.79 (20.53)
Vegetables	0.10 (6.41)	0.26 (7.52)	0.60 (8.59)	0.31 (7.97)
Jowar	0.08 (5.42)	0.19 (5.65)	0.22 (3.12)	0.17(4.43)
Kharif	**1.54 (100.00)**	**3.42 (100.00)**	**7.00 (100.00)**	**3.84 (100.00)**
Wheat	0.96 (60.18)	2.11 (60.33)	4.68 (66.21)	2.48(63.39)
Sugarcane	0.39 (24.22)	0.82 (23.33)	1.38 (19.55)	0.84(21..42)
Mustard	0.03 (1.76)	0.05 (1.50)	0.08 (1.08)	0.05 (1.33)
Maize	0.04 (2.43)	0.09 (2.50)	0.12 (1.65)	0.08(2.08)

Vegetables	0.11 (7.07)	0.24 (6.78)	0.53 (7.52)	0.28 (7.20)
Berseem	0.07 (4.36)	0.19 (5.56)	0.28 (3.99)	0.18(4.48)
Rabi	**1.60 (100.00)**	**3.50 (100.00)**	**7.07 (100.00)**	**3.91 (100.00)**
Total cropped area	3.14	6.92	14.07	7.74
Total cultivable area	1.60	3.5	7.07	3.91
Cropping intensity	**196.25**	**197.71**	**199.00**	**197.59**

Figures in parentheses show per cent to the total cropped area in respective season

Economics of existing cropping pattern of the sampled farms in selected districts

The details of cost incurred by the selected respondents on various inputs in crop grown in Kharifseason are presented in Table8.The per hectare total cost of cultivation of paddy (basmati), paddy (dwarf), sugarcaneratoonwere observed Rs. 99,051, 94,147 and 1,94,679 respectively, whereas highest net returns over total cost were observed from sugarcane ratoon(Rs. 65,634) followed by paddy dwarf (Rs. 14,603) and paddy basmati (Rs. 9,761) per hectare respectively.

Table 8: Costs and returns of existing kharif crops on sampled farms in selected villages: 2016-17 (Rs. /ha)

Particulars	Paddy Basmati	Paddy Dwarf	Sugarcane Ratoon
Variable cost	43101	38498	72024
Total cost	99051	94147	194679
Gross returns	108813	108750	260313
Returns over variable cost	65711	70252	188288
Net Returns	9761	14603	65634
B: C Ratio	1.10	1.16	1.34
Average Yield (Kg./ha)	4938	7250	81250

The details of cost incurred by the selected respondents on various inputs and returns from crops grown in Rabi season are presented in Table 9.The per hectare total cost to cultivate wheat, mustard and maize and sugarcane were found to be Rs. 87,839, 80,327, 87,048and 2,61,230 whereas highest net returns over total cost were observed from maize followed by sugarcane and wheat i.e. Rs. 43,578, 18,145 and 5,911per hectare respectively whereas, negative returns over total costs were found in case of mustard i.e. Rs. – 13,140 per hectare.

Table 9: Costs and returns of existing rabi crops onsampled farms in selected villages:2016-17 (Rs. /ha)

Particulars	Wheat	Mustard	Maize	SugarcanePlanted
Variable cost	33803	27544	42518	125400
Total cost	87839	80327	87048	261230
Gross returns	93750	67188	130625	279375

Returns over variable cost	59947	39644	88108	153975
Net Returns	5911	-13140	43578	18145
B: C Ratio	1.07	0.84	1.50	1.07
Average Yield (Kg./ha)	5000	1875	8750	87500

The details of cost incurred by the selected respondents on various inputs and returns from all vegetable crops grown in the study area are presented in Table 10 and 11. Per hectare highest net returns were found fromgreen peas i.e. Rs. 56,442 followed by cucumber (Rs. 47,934), Okra (Rs. 40,416), carrot (Rs. 36,248), bitter gourd (Rs. 35,358) whereas least net returns was observed in bottle gourd i.e.Rs. 10,526 respectively.

Table 10: Costs and returns of kharif season vegetables crops on sampled farms in selected villages: 2016-17 (Rs. /ha)

Particulars	**Cucumber**	**Bottle gourd**	**Bitter gourd**	**Okra**
Variable cost	62138	81229	135119	115799
Total cost	102066	126974	189642	172084
Gross returns	150000	137500	225000	212500
Returns over variable cost	87862	56272	89882	96701
Net Returns	47934	10526	35358	40416
B: C Ratio	1.47	1.08	1.19	1.23
Average Yield (Kg./ha)	18750	27500	27500	20000

Highest total cost were observed in case of bitter gourd i.e. Rs. 1,89,642 followed byokra (Rs.1,72,084), tomato (Rs. 1,67,618), green peas (Rs. 1,43,558), potato (Rs, 1,32,498), bottle gourd (Rs. 1,26,974), carrot (Rs. 1,26,253) whereas least total cost was observed in case of cucumber i.e. Rs. 1,02,066 per hectare respectively.

Table 11:Costs and returns of rabiseason vegetables crops on sampled farms in selected villages: 2016-17 (Rs. /ha)

Particulars	**Potato**	**Green Pea**	**Carrot**	**Tomato**
Variable cost	81248	96715	82294	100098
Total cost	132498	143558	126253	167618
Gross returns	135000	200000	162500	180000
Returns over variable cost	53752	103285	80206	79902
Net Returns	2502	56442	36248	12382
B: C Ratio	1.02	1.39	1.29	1.07
Average Yield (Kg./ha)	37500	31250	37500	45000

The cost of cultivation as well as returns from fodder crops are presented in Table12 .The total cost to cultivate the berseem as well as jowar fodder crop was observed Rs. 92,141

and 78,012 per hectare respectively. Net returns over total cost were observed Rs. 2,109 and10, 801 from berseem and jowar, respectively.

Table 12: Costs and returns of existing fodder crops on sampled farms in selected villages: 2016-17(Rs. /ha)

Particulars	Berseem	Jowar
Variable cost	32722	23447
Total cost	92141	78012
Gross returns	94250	88813
Returns over variable cost	61528	65365
Net Returns	2109	10801
B: C Ratio	1.02	1.14
Average Yield (Kg./ha)	65000	61250

Alternative Cropping Patterns

Comparative profitability as well as cost and returns analysis of paddy – wheat cropping system vis – a - vis possible alternative cropping system are presented in Table 13. It was clearly indicated from the results that paddy – potato – maize, maize – wheat – moong bean and maize – wheat were found profitable cropping system over paddy – wheat cropping system with net returns of Rs. 58,262, 42,844 and 34,482 per hectare respectively, as compare to net returns from paddy – wheat cropping system i.e. Rs. 33,094per hectare. As far as per unit total cost of cultivation was concerned, paddy – potato – maize cropping system (Rs. 3,16,145/ha)was found costlier as compare to maize – wheat – moong bean paddy - wheat, and maize – wheat cropping system i.e. Rs. 2,27,031, 1,84,438 and 1,69,806 respectively.

Table 13: Cropping system profitability of paddy-wheat vis-à-vis alternative cropping patterns in sampled farms of selected villages2016-17 (Rs./ha)

Particulars	Paddy-Wheat	Maize - Wheat	Maize -Wheat - Moongbean	Paddy - Potato-Maize
Variable cost	74603	72088	98086	164565
Total cost	184438	169806	227031	316145
Gross returns	217532	204288	269875	374407
Returns over variable cost	142929	132200	171789	209842
Net Returns	33094	34482	42844	58262
B: C Ratio	1.18	1.20	1.19	1.18

Comparative profitability as well as cost and returns analysis of three years sugarcane based cropping system are presented in Table 14 (a).Itwasclearly indicated that paddy - potato - sugarcane ratoon-wheat were found profitable cropping system with highest net returns (Rs. 1, 04,375/ha) followed by paddy - autumn sugarcane–sugarcaneratoon -

wheat (Rs. 1, 01,873/ha) and paddy-mustard- sugarcane - sugarcane ratoon-wheat (Rs. 88,733/ha) in sugarcanebased croppingsystem.

Table 14(a): Cropping system profitability of three years sugarcane based cropping patterns in selected villages:2016-17(Rs. /ha)

Particulars	P-M-S-SR-W	P-AS-SR-W	P-P-S-SR-W
Variable cost	299570	272027	353275
Total cost	720674	640347	772845
Gross returns	809407	742220	877220
Returns over variable cost	509837	470193	523945
Net returns	88733	101873	104375
B: C Ratio	1.12	1.16	1.14

P – M – S – SR-W = Paddy – Mustard – Sugarcane - Sugarcane ratoon–Wheat (Three Years)
P–AS – SR - W = Paddy– Autumn sugarcane – Sugarcane ratoon– Wheat (Three Years)
P – P – S – SR – W = Paddy – Potato – Sugarcane – Sugarcane ratoon– Wheat (Three Years)

Comparative profitability as well as cost and returns analysis of paddy – wheat cropping system vis – a - vis sugarcane based cropping system per year basis are presented in Table 14 (b). However, the farmers' practising three yearly sugarcane based cropping in the study area . the comparative economic analysis of prevalent paddy - wheat cropping system with sugarcane based cropping system on yearly basis, it was observedthat paddy -potato - sugarcane ratoon - wheat were found profitable cropping system with highest net returns (Rs. 34,792 /ha/annum) followed by paddy - autumn sugarcane - sugarcaneratoon - wheat (Rs. 33,958 /ha/annum) over paddy - wheat cropping system (Rs. 33,094 /ha/annum) whereas paddy - mustard - sugarcane - sugarcane ratoon - wheat (Rs. 29,578 /ha/annum)was not profitable as compare to paddy –wheat.

Table 14 (b):Cropping system profitability of paddy-wheat vis-à-vis alternative sugarcane based cropping patterns in selected villages: 2016-17 (Rs. /ha)

Particulars	Paddy-Wheat	P-M-S-SR-W*	P-AS-SR-W*	P-P-S-SR-W*
Variable cost	74603	99857	90676	117758
Total cost	184438	240225	213449	257615
Gross returns	217532	269802	247407	292407
Returns over variable cost	142929	169946	156731	174648
Net returns	33094	29578	33958	34792
B: C Ratio	1.18	1.12	1.16	1.14

Note * Calculate on per year basis to compare the prevalent paddy – wheat cropping system
P – M – S – SR-W = Paddy – Mustard – Sugarcane - Sugarcane ratoon–Wheat (One Year)
P–AS – SR - W = Paddy– Autumn sugarcane – Sugarcane ratoon– Wheat (One Year)
P – P – S – SR – W = Paddy – Potato – Sugarcane – Sugarcane ratoon– Wheat (One Year)

Comparative economic analyses of paddy –wheat cropping system vis-a-vis different vegetable cropping system are presented in Table 15. The result revealed that cauliflower (early) – green pea – cucumber vegetable cropping system were found most profitable cropping system with net returns Rs. 1,44,716 per hectare followed by okra –

cauliflower–cucumber(Rs.1,28,690/ha), cauliflower(early)–carrot–cucumber(Rs. 1,24,521/ha), bitter gourd – tomato–cucumber (Rs 95,674/ha), cauliflower (early) – potato–cucumber (Rs. 90,776 / ha) over paddy–wheat(Rs. 33,094 /ha) cropping system.

Table 15: Cropping system profitability of paddy-wheat vis-à-vis alternative vegetable crops in selected villages: 2016-17 (Rs. /ha)

Particulars	Paddy - Wheat	Bitter gourd - Tomato - Cucumber	Okra – Cauliflower (Mid) - Cucumber	Cauliflower (early) -Potato - Cucumber	Cauliflower (early) - Carrot – Cucumber	Cauliflower (early) – Green Pea - Cucumber
Variable cost	74603	297355	236257	201706	202752	217173
Total cost	184438	459326	388070	348484	342239	359544
Gross returns	217532	555000	516760	439260	466760	504260
Returns over variable cost	142929	257645	280503	237554	264008	287087
Net Returns	33094	95674	128690	90776	124521	144716
B: C Ratio	1.18	1.21	1.33	1.26	1.36	1.40

Whereas per hectare highest cost of cultivation were observed in case bitter gourd – tomato – cucumber (Rs. 4,59,326/ha) followed by okra – cauliflower – cucumber (Rs. 3,88,070/ha), cauliflower (early) – peas – cucumber (Rs. 3,59,544/ha), cauliflower (early) – potato – cucumber (Rs. 3,48,484/ha) and cauliflower (early) – carrot – cucumber(Rs. 3,42,239/ha), respectively.

Comparative economic analyses of paddy - wheat cropping system vis-à-vis wheat – vegetables cropping system are presented in table 16. It was clearly evident from the table that okra – wheat – cucumber vegetable cropping system were found most profitable cropping system with net returns Rs. 94,261 per hectare followed by cauliflower (early) – wheat - cucumber (Rs. 94,185 / ha), bitter gourd – wheat - cucumber (Rs. 89,203 / ha), over paddy – wheat copping system (Rs. 33,094 /ha) respectively.

Table 16: Cropping System profitability of paddy-wheat vis-à-vis alternative wheat-vegetable crops in selected villages: 2016-17 (Rs. /ha)

Particulars	Paddy - Wheat	Bitter gourd - Wheat - Cucumber	Okra - Wheat - Cucumber	Cauliflower (early) - Wheat - Cucumber
Variable cost	74603	231060	211740	154261
Total cost	184438	379547	361989	303825
Gross returns	217532	468750	456250	398010
Returns over variable cost	142929	237690	244510	243749

Net Returns	33094	89203	94261	94185
B: C Ratio	1.18	1.24	1.26	1.31

Whereas per hectare highest cost of cultivation were observed in case bitter gourd – wheat – cucumber (Rs. 3,79,547) followed by okra – wheat – cucumber (Rs. 3,61,989/ha) and cauliflower (early) – wheat – cucumber (Rs. 3,03,825/ha) respectively.

Problems and constraints faced by the farmers

Problems as well as constraints faced by the farmers in the study area are presented in Table17. Fifty percent of the farmers rated that bakanae as major disease in paddy basmati, followed by neck blast in paddy basmati (40 per cent). In case insect pest, more than half of the respondents stated that shoot borer as major insect pest problem in maize followed by sucking pest and fruit borer in vegetables, shoot borer, termite and black bug in sugarcane (30 per cent). Seventy percent of the cultivators opined that mandusi in wheat, followed by makra,motha and doobin sugarcane (50 per cent) were observed as major weed problem. Nearly 70 percent of the farmers opined that environmental factors like less, untimely and uneven distribution of rains, higher temperature at sowing, fruiting and maturity stage affects the productivity of the respective crops. Shortage of labor and fragmented of land holding was also observed major problems in the study area. Difficulty in accessing information regarding demand, supply and prevailing market prices of agricultural commodities (70 per cent), highly fluctuating market prices of commodities (50 per cent), and lack of scientific storage facilities (40 per cent) were observed as problems related to marketing in study area.

Table 17: Problems/constraints faced by the farmers in existing cropping system in selected villages: 2016-17

Sr. No.	**Particulars**	**Overall (Per cent response)**
Disease		
1	Foot rot (bakanae) in paddy (Basmati)	50
2	Neck blast in paddy (Basmati)	40
3	Late blight in potato	25
4	Viral diseases in vegetables (Tomato and Cucurbits)	25
Insects/pests		
1	Shoot borer in maize	55
2	Sucking pest and fruit borer in vegetables	35
3	Shoot borer termite and black bug in sugarcane	30
4	Stem borer in paddy	25
Weeds		

1	Mandusiin wheat	70
2	Makra, motha,sawank and doob in sugarcane	50
3	Sawank in paddy	20
4	Bathu in wheat	20
Environmental problems		
1	Less, untimely and uneven distribution of rains	70
2	Higher temperature at sowing, fruiting and maturity stage	40
Non-availability of inputs		
1	Shortage of farm labour	70
2	Small and fragmented land holding	50
3	Non-availability of quality seeds, chemicals/Pesticides & fertilizers	25
4	Poor credit facilities	20
Marketing problems		
1	Difficult to access information regarding demand, supply and market price of agricultural commodities	70
2	Variability in the prices of agricultural produce	50
3	Lack of storage facilities	40

Salient findings:

- Maize-wheat, maize-wheat-moong bean andpaddy – potato-maize cropping system were observed profitable over paddy- wheat cropping system.
- Paddy - potato - sugarcane ratoon - wheat were found profitable cropping system with highest net returns (Rs. 34,792 /ha) followed by paddy - autumn sugarcane – sugarcaneratoon - wheat (Rs. 33,958 /ha) over paddy - wheat cropping system (Rs. 33,094 /ha) among sugarcane based cropping system.
- As concerned total cost of cultivation, highest cost of cultivation was observed in case of paddy – potato – sugarcane – sugarcane ratoon – wheat cropping system i.e. Rs. 7,72,845 followed by paddy – mustard – sugarcane – sugarcane ratoon – wheat and autumn sugarcane – sugarcane ratoon – wheat cropping system.
- Vegetable crops like bitter gourd, potato, tomato, cucumber,okra, cauliflower, carrot and green pea may be feasible options for the marginal and small categories of farmers to switch over some area from paddy towards these vegetable crops.
- Foot rot (bakanae) as well as neck blast in paddy(basmati), late blight in potato and viral diseases in vegetables was identified as major problems in the study area.

- Shoot borer in maize, sucking pest and fruit borer in vegetables, shoot borer, termite and black bug in sugarcane and stem borer in paddy were observed as major insect-pest in the study area.
- Mandusi, makra, motha, bathu, sawank and doob were found as major weeds of different crop in the study area.

TECHNICAL PROGRAM OF WORK FOR THE YEAR 2017-18

i) Experiment No. 1: "Economic Analysis of Existing and Alternative Cropping Patterns in different zones of Haryana" (Continued for Arid zone of the state)

ii) Objectives:

1. To examine the existing cropping patterns of selected farmers
2. To analyse the economics of existing cropping patterns.
3. To suggest the alternative cropping patterns.

iii) Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
R. K. Grover	Planning and Monitoring
J. C. Karwasra	Data interpretation and Report writing
Jitender Bhatia	Data collection, analysis of data and Report writing.
Dalip Kumar Bishnoi	Data collection, compilation and Report writing.

iv) Collaborator: None

v) Year of Start **:** 2015-16

vi. Location: Bhiwani and Mahendergarh

Method of Study:

The study was planned for different agro-climatic zones of the state during three consecutive years i.e. 2015-16 to 2017-18. During the year 2015-16 and 2016-17, the study was undertaken into semi-arid and humid zones respectively. During the year 2017-18, the study will be conducted into arid zone. Two districts (i.e. Bhiwani and Mahendergarh) will be selected. Further one block from each selected district will be selected and from each selected block, two villages will be selected randomly and a sampled of twenty respondent farmers from per village will be taken for detailed data on socio-economic aspects, cost and returns, resource structure, cropping patterns followed in the study area. Thus total eighty (80) farmers of different categories will be

interviewed through pre-structured schedule. Suitable statistical techniques will be used to analyze the data and to draw meaningful inferences from the study.

Experiment No. 2: Financial performance of Sarva Haryana Gramin Bank in Hisar District of Haryana.

Objectives:

i. To study the purpose-wise amount of loan disbursed by the bank.
ii. To examine the demand and supply of loan by the bank.
iii. To study the over dues of loan of selected farmers.
iv. To study constraints faced by farmers in repayment of loans.

Year of Start : 2015-16

Location : Block Barwala (Hisar)

Name of Investigator(s) with Activity Profile:

Scientist	**Activity Profile**
Dr. V. P. Mehta, Principal Investigator	Planning, Monitoring, Data Collection, Analysis & Report writing.
Dr. Jitender Kumar Bhatia, Co-Principal Investigator	Data compilation and report writing.

Work done during 2016-17

Methodof study

The present study was carried out in Barwala branch of Hisar District of Haryana State purposively. Fifty farmers who availed loan from the Barwala branch were selected randomly. The secondary data in respect of loan disbursed by the bank were also collected from the bank. The primary data were collected by personal interview method from the selected respondent during the year 2016-17 in respect of demand, supply and constraints faced by the farmers in taking loan. Suitable analytical techniques were used for analysis of data.

Table 18: Target and Achievement of Agriculture credit overperiod(Rs. in Crore)

Year	**Target**	**Achievement**
2004-05	105000	125309
2005-06	141000	180486
2006-07	175000	229400
2007-08	225000	254658
2008-09	280000	287149

2009-10	325000	384514
2010-11	375000	468291
2011-12	475000	511029
2012-13	575000	607376
2013-14	700000	730122
2014-15	800000	845328
2015-16	850000	877527
2016-17	900000	NA

Table 19: Total deposit in Sarv Haryana Gramin Bank, Barwala over the period(2010-11 to 2015-2016)(Rs. Crore)

Years	Deposit	Percentage change in deposit
2010-11	12.44	-
2011-12	14.73	18.41
2012-13	16.62	12.83
2013-14	17.49	5.23
2014-15	18.61	6.40
2015-16	23.10	24.13

Table 20: Total credit advanced by Sarv Haryana Gramin Bank, Barwala over the period (2010-11 to 2015-2016) (Rs. Crore)

Years	Total agriculture Credit		Total non agriculture credit		Total credit	Percentage change in credit
	STC	LTC	STC	LTC		
2010-11	6.45	0.71	-	1.79	8.97	-
2011-12	7.92	0.88	-	2.20	11.01	22.74
2012-13	11.62	1.22	-	3.23	16.15	46.68
2013-14	11.75	1.30	-	3.26	16.33	1.11
2014-15	12.45	1.38	-	3.46	17.3	5.93
2015-16	13.55	1.50	-	3.76	18.83	8.84

STC = Short term credit, LTC = Long term credit

Table 21: Recovery percent of Sarv Haryana Gramin Bank Barwala over the years

Years	Recovery in per cent
2010-11	80
2011-12	82
2012-13	86
2013-14	78
2014-15	74
2015-16	70
2016-17	81

Table 22: Loan wise Rate of Interestcharged by Sarv Haryana GraminBank: 2016-17 (per cent)

Amount and type of loan	ROI on agriculture Credit	
	STC	LTC
TERM LOAN		
Advances Up to Rs. 20 Lakh	-	12.05
Advances over Rs.20 Lakh	-	13.50
Agri. Clinics/Agri. Business Centres		
Advances Up to Rs. 20 Lakh	12.00	13.50
Advances over Rs.20 Lakh	13.50	14.00
SHG		
Up toRs. 50000/-	12.50	13.00
Over Rs.50000/- to Rs.2 Lakh	13.00	13.50
Over Rs.2 Lakh	13.00	13.50
KCC	-	13.50
Advances Upto-3 Lakh	7*	-
Above 3 Lakh	11	-
ROI on non agriculture credit	13.25	13.50

** three per cent subsidy*

Constraints faced by respondents in getting loan and repayment plan: 2016-17

Constraints faced	No. of Respondents (Percent)
Expectation of Loan waiver as in other states	37 (74)
Lack of security of collateral in case of marginal farmers	42 (84)
Loan amount is not sufficient in case of small and marginal farmers.	31(62)
Lack of banks and other authorized financial institution in rural areas	26 (52)
Long & complicated procedure for taking loans	41(82)
High rate of interest on loan above three lakh rupees	18(36)
Low risk-taking capacity	38(76)
Poor saving capacity	26(52)
Poor repayment habit	30(60)
Low education level of farmers	44(88)
Low income level of farmers	43(86)
Misuse of funds	40(80)
Higher dependence of farmers on nature create high risk in term of repayment	34(68)

Conclusion: The total deposit in the study area has increased by 24.30 per cent in the year 2015-16 in comparison to 2014-15. The loans advanced by the Grameen bank also showed an increase of 8.84 percent during the study period. The recovery of loans was found to be 81 percent. It is expected that recovery of loan advanced may decrease in future as farmers of the study area are hopeful of waiver of loans as done in other states like Punjab, Uttar Pradesh, and Andhra Pradesh recently.

Experiment No. 3: Dynamics of Production and Marketing of Bt. Cotton in Haryana.

i) Objectives:

i. To study the cost and returns of Bt. cotton cultivation.

ii. To analyze the marketing patterns and price spread through different marketing channels.

iii. To examine the yield gap and constraints in production and marketing

ii) Year of Start : 2016-17

Location : Hisar &Sirsa

iii) Name of Investigator(s) with Activity Profile:

Scientist/teacher	**Activity profile**
Dr. K.K.Kundu,(Associate Professor) Principal Investigator	Planning, data collection, compilation, analysis of data and report writing

Method of the study

Sirsaand Hisar districts of Haryana were randomly selected for study. Then, one block was randomly selected from each selected districts of Haryana for the present study i.e. Uklana block from Hisar district and MandiDabwali block from Sirsa district. From each selected blocks, two villages were also randomly selected. Thus in total following four villages were selected for present study. From the selected villages, random sampled of 15 respondents from each village were selected. Then selected farmers were divided into three categories i.e. small, medium and large based on their size of operational holdings as per classification given in agricultural statistics at a glance. Five wholesalers and five processors were selected from the each market namely Uklana and MandiDabwali cotton markets from Haryana.

From these selected farmers, the primary data regarding production cost and returns, marketing charges, marketing pattern, price received, various types of risks, risk mitigating strategies and constraints faced by them were collected by conducting the personal interview. The data regarding various marketing cost and marketing margins were also collected from the various selected market intermediaries such as wholesalers and commission agents of that particular area. The secondary information required for study was collected from various published and unpublished sources. To fulfil the objectives of the study, the data collected was analysed with appropriate statistical techniques.

Results and discussions

Growth rate analysis

Table 23: CGR of area, production and productivity of cotton in Haryana

	Before Introduction of Bt. Cotton 1986-87 to 2004-05	After Introduction of Bt. Cotton 2005-06 to 2015-16	Overall 1986-2016
Haryana			
Area	1.92	1.96	0.76
Production	0.33	4.19	3.08
Productivity	-1.85	2.63	2.09

The area, production and productivity of cotton in Haryana showed positive trend in overall period (1986-87 to 2015-16). The growth rate in area and production during the first phase i.e. before the introduction of Bt. cotton (1986-87 to 2004-05), it was observed that there was sharp decline in productivity due to severe accidence of American bollworm and other insect-pests and diseases.Thegrowthrate of area, production and productivity of cotton in 2ndphase i.e.after introduction of Bt-cotton (2005-06 to 2015-16) indicated similar trend in cotton acreage, however production revealed higher growth rate as result of significant increase in productivity. This increase in production and productivity of cotton is due to adoption ofBt-cotton seeds by majority of farmers in the state and improved management practices to protect the crop.

Costs and Returns from Bt. cotton in Haryana

The costs and returns of Bt. cotton production in Haryana have been shown in Table 24. The cost of production on small farms was Rs. 34,433 per acre. The rental value of land, irrigation, picking, plant protection and fertilizer use were the major items of total cost constituting 28.89, 5.39, 13.54, 5.12 and 6.06 per cent, respectively followed by management charges (5.77 per cent), risk factor (5.77 per cent), seed cost (5.37 per cent), hoeing/weeding (6.32 per cent) and preparatory tillage (4.07 per cent).

Table 24: Costs and Returns from Bt. cotton in Haryana:2015-16 (Rs. /acre)

Sr. no.	Item	Small	Medium	Large	Haryana
1	**Variable cost (A)**	19877 (57.72)	21489 (59.08)	21894 (70.93)	21087 (58.75)
2	**Fixed cost (B)**	14556 (42.27)	14885 (40.92)	14972 (40.61)	14803 (41.24)
3	**Total cost (A+B)**	34433 (100.00)	36374 (100.00)	36866 (100.00)	35890 (100.00)
4	**Production (qtl)**	5.86	6.05	6.54	6.15

	A. Main product	25198	26015	28122	26445
	B. By-product	1410	1440	1485	1445
5	**Gross return**	**26608**	**27455**	**29607**	**27890**
6	**Return over variable cost**	6731	5966	7713	6803
7	**Net return**	**-7825**	**-8919**	**-7259**	**-8000**
8	**Cost of production/qtl.**	5879	6010	5637	5836
9	**Return per rupee of investment***	**1.34**	**1.28**	**1.35**	**1.32**

Note: Figures in the parentheses indicate percentage to the total cost
**Over variable cost*

The comparative analysis of expenditure incurred on different items on small, medium and large farms shows that per acre expenditure incurred on picking, hoeing/ weeding, plant protection, management charges and risk factor were highest on large farms as compared to that of medium farms followed by small farms. But in case of preparatory tillage, seed cost, fertilizer use and irrigation per acre expenditure incurred on these items was found highest in small farms followed by medium and large farms. The average gross income per acre on large farms (Rs. 29,607) was highest as compared to medium farms (Rs.27, 455) and small farms (Rs.26, 608). This may be attributed to highest production on larger farms (6.54 quintals) followed by medium farms (6.05 quintals) and small farms (5.86 quintals). Consequentlyper acre net returns over total cost shows negative trend on small (Rs.-7,825), medium (Rs. -8,919) and large farms (Rs.-7,259). Whereas, the return over variable cost was highest on large farms (Rs.7, 713) followed by small farms (Rs.6, 731) and medium farms (Rs.5, 966). The cost of production per quintal on large, medium and small farms wasRs.5,637, Rs. 6,010 and Rs. 5,879, respectively. The return per rupee of investment on small, medium and large farms was 1.34, 1.28 and 1.35 respectively.

Price spread of Bt. cotton through different marketing channels

The observed marketing channels in Haryana were producer → ginning mill, producer → wholesaler → ginning mill and producer → commission agent → ginning mill. . The Table 25 showed that among the three marketing channels, the net price per quintal received by producer was higher in channel-I (Rs. 3,914.50), followed by channel-II (Rs. 3,763.50) and channel-III (Rs. 3,743.50), respectively. Farmers received better price in channel-I, because of non-existence of middleman. In channel-II, the producers sold the Bt. cotton to the wholesalers directly. The expenses incurred by the producer wereRs. 206.50 (4.80 per cent) per quintal of produce that included transportation costs,

loading charges, cleaning and dressing. The channel-II was predominant one and around 80 per cent of farmers sold their produce only through this channel. In channel-III, the expenses incurred by producer were alsoRs. 206.50 (4.77 per cent) per quintal and the net price received by producer was much lower, that was only Rs. 3,743.50 (86.45 per cent) per quintal. This was due to existence of more number of intermediaries in the channel. Hence, channel-I was more efficient when compared to channel-II and channel-III.

Table 25: Price spread of Bt. cotton through different marketing channels :2015-16

(Rs. / q)

Sr. No.	Particular	Channel I	Channel II	Channel III
I				
A	Net Price received by the producer	3914.50 (95.47)	3763.50 (87.52)	3743.50 (86.45)
B	Expenses incurred by the producer	185.50 (4.52)	206.50 (4.80)	206.50 (4.77)
	i) Transportation	30.00	45.00	45.00
	ii) Loading charges	35.00	40.00	40.00
	iii) Cleaning and dressing	100.00	100.00	100.00
	iv) Losses @ 0.5%	20.50	21.50	21.50
II				
A	Purchase Price of the wholesaler	-	3970.00 (92.32)	-
B	Expenses incurred by the wholesaler	-	207.37 (4.82)	-
	i)Commission (Rs. 2.50 per Rs. 100)	-	107.50	-
	ii)Brokerage (Rs. 0.16 per Rs. 100)	-	6.88	-
	iii) Auction (Rs. 0.08 per Rs. 100)	-	3.44	-
	iv) Unloading (Rs. 5.15 per qtl.)	-	5.15	-
	v) Filling& placing on balance(Rs. 5.15/qtl.)	-	5.15	-
	vi) Weighing (Rs. 5.00 per qtl.)	-	5.00	-
	vii) Unloading from balance, stitching & loading (Rs. 9.75 per qtl.)	-	9.75	-
	viii) Market fees (Rs. 1.50 per Rs. 100)	-	64.50	-
C	Margin of Wholesaler	-	122.63 (2.85)	-
III				
A	Sale Price of producer	-	-	3950.00 (91.22)
B	Cost incurred by Commission agent	-	-	12.00

				(0.27)
	i) Weighing charges (Rs. 5.00 per qtl.)	-	-	5.00
	ii) Taxes (Rs. 2.00 per qtl.)	-	-	2.00
	iii) Unloading charges (Rs.5.00 per qtl.)	-	-	5.00
C	Commission Paid @ 2.5% of the value of produce by miller	-	-	130.00
D	Commission agents margin	-	-	368.00 (8.50)
IV	**Purchase Price of the miller**	**4100 (100.00)**	**4300 (100.00)**	**4330 (100.00)**

Note: Figures in parentheses are the percentage to the miller's price

Marketing efficiency of Bt. cotton in different marketing channels

The Table 26 revealed that marketing efficiency of marketing efficiency of Haryana was 21.10. In Haryana, the marketing channel-I (21.10) was more efficient than channel-II (7.01) and channel-III (6.38). Hence, the channel-I was more efficient which may be due to lack of intermediaries involved whereas, the channel-III was less efficient due to more number of market intermediaries like commission agent.

Table 26: Marketing efficiency of Bt. Cotton in different marketing channels(Rs. / q)

Sr. No.	State	Channels	MC	MM	MC+MM	NP_F	ME(Ratio)
1	Haryana	I	185.50	-	185.50	3914.50	21.10
		II	413.87	122.63	536.50	3763.50	7.01
		III	218.50	368.00	586.50	3743.50	6.38

MC-Marketing cost, MM-Marketing margin, ME-Marketingefficiency,NP_F-Net price received by the farmer.

Yield gap analysis

Table 27 depicts the information regarding potential yield of major Bt. cotton varieties grown in study area which also reported that the average potential yield of Bt. cotton varieties in Haryana was 14.50 quintals per acre. There have been always yield gaps on the farmer's field. There exist some factors responsible for low yields compared to potential yield and highest yield attained on particular farms.

Table 27: Potential yield of major Bt. cotton varieties

S.No.	Varieties	Potential yield (q/ha)
1	RCH-134	32
2	SP 7007	28
3	Bio 6488	37
4	Bio 6588	38
5	RCH 650	35

6	RCH 773	40
7	RCH 776	40
8	US 51	51
Average potential yield/ha		**36.25**
Average potential yield/acre		**14.5**

Information regarding attainable yield gap in Bt. cotton production in study area are presented in Table 28. The yield gap I is denoted by gap between potential yield and average actual yield of respondent farmers and yield gap II is denoted by gap between highest yield attained on farm of respondent farmers and actual average yield on the farms. A wide gap existed in the Bt. cotton productivity are given in Table 28. The per acre magnitude of yield gap I and yield gap II for Bt. cotton were found to be 8.50 and 2.50 quintals per acre, respectively. The index of yield gap I and II for Bt. cotton were observed to be 0.59 and 0.29.

Table 28: Attainable yield gap in Bt. cotton production:2015-16

(q /acre)

S. No.	Particulars	Hisar	Sirsa	Overall
1	**Potential yield**	14.00	15.00	14.50
2	**Actual average yield**	5.20	6.80	6.00
3	**Highest yield**	8.00	9.00	8.50
4	**Yield gap - I**	8.80	8.20	8.50
5	**Yield gap - II**	2.80	2.20	2.50
6	**Index of yield gap - I**	0.63	0.55	0.59
7	**Index of yield gap - II**	0.35	0.24	0.29

The yield gap was observed due to inadequate crop stand, seedling burning due to high temperature at emergence, late rainfall coinciding with flowering and boll formation, sucking pests especially the whitefly, mealy bug, cotton leaf curl virus (CLCuV) disease and wilting at maturing.

Constraints in production and marketing of Bt. cotton

The major production constraints were non-availability of good quality insecticides/pesticides (96.66 per cent) followed by non-availability of labour (86.66 per cent), non-availability of adequate good quality seed (81.67 per cent) and lack of technical knowledge (80.00 per cent). Similarly, major problems in marketing of Bt.cotton were low price of Bt. cotton produce at market (91.66) followed by lack of extension and marketing services (75.00 per cent) and high regulation by market inter-mediates (66.66 per cent).

Farmers' perceptions towards risk

Table 30 showed that 33.33 per cent of risk bearers, 48.33 per cent of risk neutral and 18.33 per cent of the risk averters were in Haryana. In Haryana, most of the farmers were risk neutral (48.33 per cent) followed by risk bearer (33.33 per cent). Risk-averters were trying to avoid the impact of risk involved in farming by employing risk management strategies like crop diversification, crop rotation, the use of fertilizer instead of manure to increase the nutrients in the soil, use of weedicides, pesticides to control weeds and pests, and they were not only focusing on farming activities for the survival of their families. Risk neutral respondents neither agree nor disagree with the risk management statement i.e. a risk-neutral attitude due to lack of awareness. Risk bearers believed and used the business slogan that says "high risk high returns" and were always amongst the first producers in the area to adopt new technology.

Table 30: Farmers' perceptions toward Risk: 2015-16

Particular	Risk Bearers	Risk Neutral	Risk Averters	Total
Small (N=16)	4 (25.00)	11 (68.75)	1 (6.25)	16 (100.00)
Medium (N=17)	7 (41.18)	8 (47.06)	2 (11.76)	17 (100.00)
Large (N=27)	9 (33.33)	10 (37.04)	8 (29.63)	27 (100.00)
Overall (N=60)	20 (33.33)	29 (48.33)	11 (18.33)	60 (100.00)

Note: Figures in the parentheses indicate the percentage to the total number

Major risks experienced by farmers in Bt. cotton cultivation

Table 31 depicts the information regarding the sources of major risks experienced by cotton growers in cultivation of Bt. cotton during past three years in Haryana. Bt. cotton growers, major yield loss occurred due to pest and disease incidence (80 per cent of total yield loss) followed by low price of output (45 per cent of the total yield loss) and drought/ moisture stress (40 per cent of the total yield loss). Non-availability of inputs (seeds, fertilizers and insecticides) and high price of inputs were the minor factors responsible for the yield loss in Bt. cotton cultivation.

Table 31: Major risks experienced by farmers in Bt. cotton cultivation during past 3 years

S. No.	Particulars	Rank* (Based on severity)	Per cent yield loss occurred
1	Drought/moisture stress	2	40
2	Pest and disease incidence i) Sucking pests (particularly the whitefly) ii) Boll worms	1	80
3	High price of inputs	3	20

4	Low price of output	2	45
5	Major risk factors at harvesting stage (lodging, rainfall)	3	20
6	Non-availability of inputs (seed, fertilizers & insecticides)	3	10

***1-High, 2-Medium, 3-Low**

Risk mitigating strategies

Complementing the farm income with off-farm income, planting pest resistance cultivars, going for low cost inputs, availing credit and investing on other crops, crop insurance enrolment, keeping one season fallow, mixed crops and obtaining market information before the sale of farm produce were the various risk mitigating strategies adopted by Bt. cotton growers (Table 32). The strategies like planting pest resistance cultivars (86.67 per cent of the total farmers), availing credit and investing on other crops (71.67 per cent of the total farmers), keeping one season fallow (65.00 per cent of total farmers) and obtaining market information before the sale of produce (56.67 per cent of the total farmers) were adopted by most of the farmers in Haryana. But the sampled respondents in the study area were not aware of crop insurance programmes.

Table 32: Risk mitigating strategies adopted by farmers in Bt. cotton cultivation

S. No	Risk mitigating strategies	Number of farmers (N=60)	Respondent's response (%)
1	Complementing farm income with off-farm income	30	50.00
2	Planting pest resistance cultivars	52	86.67
3	Going for low cost inputs	20	33.33
4	Availing credit and investing on other crops	43	71.67
5	Enrolled in crop insurance	5	8.33
6	Keeping one season fallow	39	65.00
7	Mixed crops	15	25.00
8	Obtaining market information before sale of farm produce	34	56.67

Major findings of the study

- The return over variable cost in Bt. cotton cultivation were observed highest on large farms (Rs.7, 713/acre) followed by small farms (Rs.6,731/acre) and medium farms (Rs.5,966/acre) with benefit cost ratio on large farms (1.35) followed by small (1.34) and medium farms (1.28) respectively.

- The yield gap analysis in case of Bt. cotton revealed that the economic losses were found to be more in the study area due to wide gap existed between potential yield, highest yield attained on farm and the average actual yield.
- The study of marketing pattern of Bt. cotton showed that most of the Bt. cotton growers in Haryana prefer to sale their produce in the market rather than within village itself.
- The channel-I (Producer → ginning mill) was found to be more efficient with farmers, receiving highest share in miller's price followed by channel-II(Producer → Wholesaler → Ginning mill)and channel-III (Producer → Commission agent → Ginning mill).
- The main production constraints in Bt. cotton noticed were non-availability of adequate good quality seed, non-availability of labour, poor quality insecticides/pesticides, unfavourable climatic conditions and lack of technical knowledge. Whereas problems in marketing were lower price, large number of market intermediates and lack of extension and marketing services.
- The major risk mitigation strategies adopted by farmers in Bt. cotton cultivation were planting plant resistance varieties, availing credit and investing on other crops, complementing farm income with off-farm income and keeping one season fallow.
- Majority of the farmers in the study area were not enrolled in any formal risk mitigating measures such as crop and weather based insurance schemes.

12. New Experiments planned for the year 2017-18

i) Experiment No. 1: "Zone-wise Economic analysis of Crop Cultivation in Haryana"

ii) Objectives:

1. To examine the costs, returns and profitability of selected crops over the period.
2. To analyse the resource use efficiency in the production of principal crops.
3. To analyse the trends in farm harvest price (FHP) and minimum support price (MSP).

iii) Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
R. K. Grover	Planning and finalization of Report
V. P. Luhach	Monitoring in Data collection
Jitender Bhatia	Analysis of data and Report writing.
Dalip Kumar Bishnoi	Data Compilation and Report writing.
Dr.NitinBhardwaj	Statistical Data Analysis

iv) Year of Start **:** 2017-18

v. Method of Study: The study will be based on secondary data primarily compiled from various publications.

vi) Observations to be recorded:

The profitability and net returns of crops will be calculated through tabular analysis with the help of farm management costs like A_1, A_2, B& C to draw meaningful inferences from the study.To analyse the dataand appropriate statistical tools will be applied.

i) Experiment No. 2: "Economic Analysis and Prospectus of Organic Farming in Haryana"

ii) Objectives:

1. To analyse the comparative economics of organic produce vis-à-vis inorganic produce
2. To study the marketing practices and preferences for organic produce.
3. To study the problems faced by the farmers in production and marketing of organic produce

iii) Name(s) of Investigator(s) with Activity Profile:

Scientists	**Activity profile**
R. K. Grover	Planning, Monitoring and Finalization of Report
J. C. Karwasra	Data interpretation and Report writing
Jitender Bhatia	Analysis of data and Report writing.
Dalip Kumar Bishnoi	Data Collection and Report writing.
Dr. NitinBhardwaj	Statistical Data Analysis

v. **Location of Study and Statistical design:** Department of Agricultural Economics, CCS HAU, Hisar. Area of the Haryana practicing organic farming will be selected based on the information collected from Department of Agriculture and Farmers Welfare, Govt. of Haryana, Regional Centre of the centrally sponsored scheme namely; National Project on Organic Farming Panchkula of for primary data collection.

vi) Observations to be recorded:

The study will cover sufficient number of both the adopter as well non-adopter of organic farming production practices in the selected villages by adopting appropriate sampling procedure. Data will be collected through personal interview method with the

help of well-structured pre-tested schedule. Appropriate analytical tools will be used to analyse the data.

Detailed primary data on each and every aspect of production costs, returns and marketing aspects will be collected from selected farmers. Information on marketing channels and marketing costs will also be collected from various agencies involved. Detailed primary data on each and every aspect of production costs, returns and marketing aspects will be collected from selected farmers. Information on marketing channels and marketing costs will also be collected from various agencies involved.

B. Other Agencies

Scheme: "Comprehensive Scheme for studyingthe Cost of Cultivation of Principal Crops in India-Haryana" (funded byDirectorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, Govt. of India)

No. and Title of the Scheme	C(c) Econ.-I.(CS)-Comprehensive Scheme for studying the Cost of Cultivation of Principal Crops in India-Haryana
Year of Start	1970
Objective	To provide representative and comparative data on Cost of Cultivation of Principal Crops in Haryana
Period of Study /Location	2016-17 (CCS Haryana Agricultural University, Hisar)
Staff position in the scheme	
Hon. Director-cum- Prof. & Head	Dr. R.K Grover
Principal Scientist / SRO	Dr. V.P. Luhach
Principal Scientist	Dr. R.S. Pannu
Principal Scientist	Vacant –Due to superannuation of Dr. Kuldeep Kumar
Principal Scientist	Vacant (Due to transfer of Dr. D.P. Malik to DHRM)
Statistician-1	Nitin Bhardwaj (Recently Joined)
Computer Assistants-03	Three vacant
Agril. Inspectors - 26	Four vacant due transfer and superannuation

Name of Investigators with Activity Profile:

Scientists	**Activity Profile**
R.K. Grover	Planning, execution, monitoring and overall supervision.
V.P. Luhach	Planning, execution, monitoring, supervision, checking & verification, validation and valseas of data.
R.S. Pannu	Planning, monitoring, supervision, checking and verification of data.

Budget: **(Rs. in lakh)**

Particular	**Allotment 2016-17**	**Expenditure 2016-17**	**Budget 2017-18**

Establishment (Salary)	224.73	184.15	180.00
T.A.	10.00	5.08	8.00
Contingency(Recurring and Non-recurring)	15.27	15.12	12.00
Total	**250.00**	**204.35**	**200.00**

Work done during 2016-17

The scheme is being financed by Ministry of Agriculture and Farmers' Welfare, Govt. of India. Under this scheme, the cost of cultivation data of seven important crops of Haryana state namely, Paddy, Cotton, Pearl millet, Sugarcane, Wheat, Gram and Rapeseed & Mustard were collected from 30 Centres /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The processed data for the Rabi and Kharif seasons for the year 2015-16 have been submitted in time to the Ministry of Agriculture and Farmers Welfare on C.D. for further analysis, the result of which will be used by the Commission for Agricultural Costs and Prices (CACP) for fixing the minimum support prices of Kharif and Rabi crops at national level.Data for Kharif and Rabi seasons of year 2016-17 have been received from the field staff.
- The processing and entry of data for the kharif season of the year 2015-16 has been completed and validation &valseas for kharif season data has been done.
- Trainings/meetings of Agricultural Inspectors were organized at Department of Agricultural Economics during the year 2016-17 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items and keeping daily operation record.
- The scientists working in the scheme also organized meetings of Agricultural Inspectors working under their supervision at their respective headquarters for checking of data entries in the records.
- The scientists working in the scheme supervised the work of Agricultural Inspectors, discussed with selected farmers about crop operations and inputs used at farm level to maintain the accuracy of data.

- The discrepancies in data as reported by funding agency were checked, corrected and re-submitted again.
- The laptops' has been purchased and distributed to all the Agriculture Inspectors' (AIs) working in the scheme to provide the online cost of cultivation data of principle crops to the Ministry of Agriculture and Farmers' Welfare as the GOI initiative for strengthening digital India. For online submission of data the package/scheme for internet connectivity will be provided to all the AIs at their respective cluster headquarters from this year onward.

Table 33: Cost of production and minimum support prices of major crops in Haryana during 2012-13 and 2013-14

Crops	**Cost of Production (Rs./q)**		**Minimum Support Price- (Rs./q)**	
	2012-13	**2013-14**	**2012-13**	**2013-14**
Paddy	1248	1389	1250	1310
Pearl millet	1416	1264	1175	1250
Cotton	3796	4183	3600* 3900*	3700* 4000*
Wheat	1048	1045	1350	1400
Gram	2830	3346	3000	3100
Rapeseed & Mustard	2721	2539	3000	3050
Sugarcane	181	198	170	210

Source: Agricultural statistics at a glance, 2013, Directorate of Econ. & Stat. Ministry of Agri1.and Farmers Welfare Govt. of India

* Medium staple cotton (mm) of 24.5-25.5 and micronaire value of 4.3-5.1
** Long staple cotton (mm) of 29.5-30.5 and micronaire value of 4.5-4.3
^ Fair and Remunerative Price (FRP) in case of Sugarcane # Prices given by Govt. of Haryana
L -Late variety, M-mid sown, E-early sown.

Cost of production includes all actual expenses in cash and kind incurred in production by owner plus interest on value of owned/fixed capital assets (excluding land) plus rental value of owned land plus imputed value of family labour.

The cost of production per quintal of gram, pearl millet and cotton was higher in 2012-13 and in 2013-14 the cost of production per quintal was higher for Pearl millet and Cotton than minimum support prices (MSP). Similarly cost of production of sugarcane and paddy was also found higher than FRP and MSP in the year 2012-13 and 2013-14 for paddy crops (Table 33).

Technical Programme for the year 2017-18

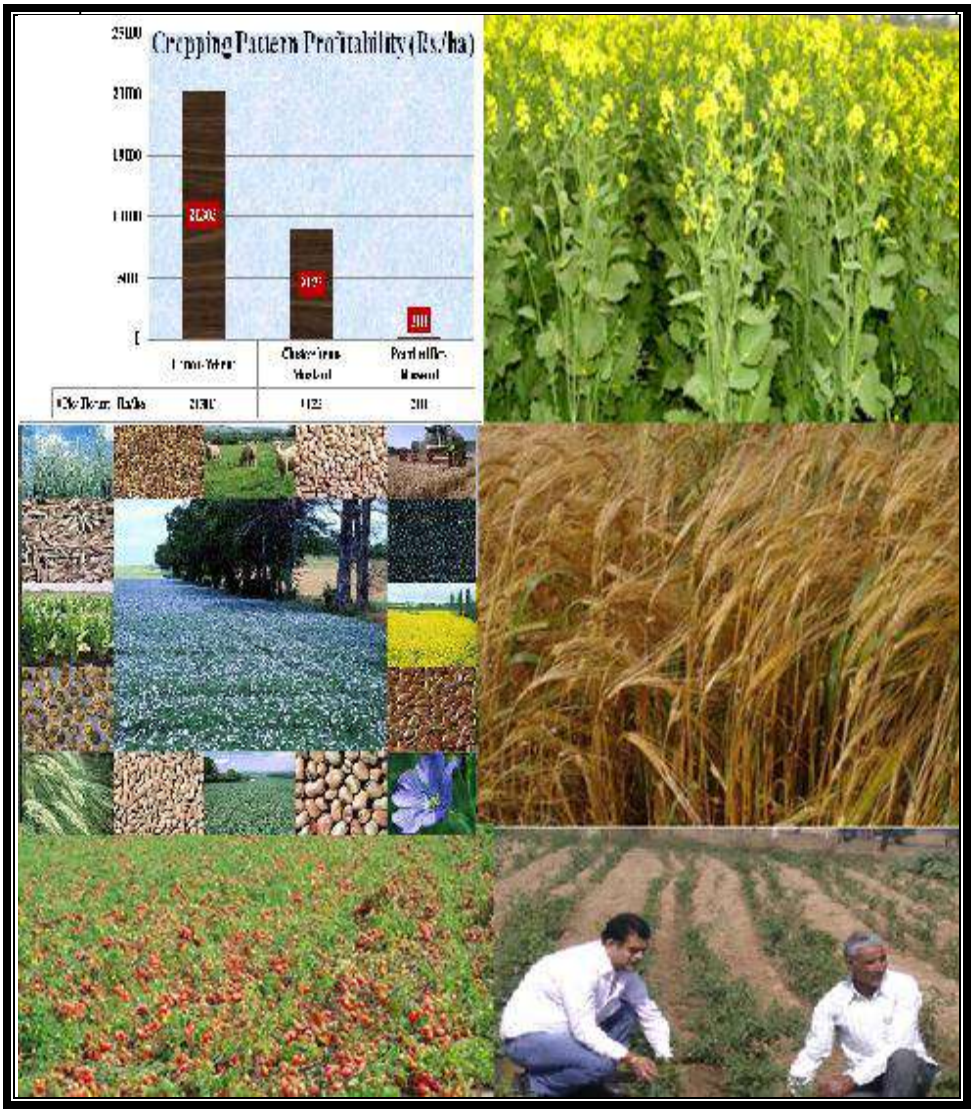
- Compilation of data for the year 2016-17 is in progress for all the seven crops and will be submitted to the Ministry of Agriculture and Farmers Welfare, Govt. of India in the month of October 2017.
- The data on cost of cultivation of principal crops namely Paddy, Cotton, Pearl millet, Sugarcane, Wheat, Gram, Rapeseed & Mustard, Summer moong and Onion for the year 2017-18 will be collected from 30 clusters located in different Agro-Climatic Zones of the state by cost accounting method. From this year onward summer moong and onion, these two crops are included for the data collection by Ministry of Agriculture and Farmers Welfare, Govt. of India for fixation of MSP.
- The data will be collected for the year 2017-18 from farmers fields by AI's and it will be submitted online by AI's at cluster headquarter. The same will be forwarded to field supervisor after proper checking of the data and if the data found correct it will be forwarded to the field officer (SRO) by supervisor.Otherwise it can be returned back to the field men for the proper checking and correction. The correct data received by Field Officer/SRO will be thoroughly cross checked if found correct, the data will be passed for validation and valseas of data and it will be sent online to the Ministry of Agriculture for future processing of the data which is required for fixing the MSP of various crops. In case the data found in correct, it will be returned backto the supervisor/ fieldmen for correction.
- The data entry module of FARMAP 2.0 software has been uploaded in the public domain at URL. Now, the user id and password to Honorary Director/Field Officer of this centre by NIC has been allotted. The field officer (SRO) has created the user ID and password to field Supervisor/Scientist and Field man/AI. Now, from this year 2017-18 onward they are supposed to enter the data online.
- Strict supervision of data collection work of Agricultural Inspectors will be done by respective scientist to maintain accuracy in data.
- Information from funding agency as well as discrepancies in data will be disseminated to the Agricultural Inspectors for further corrections and resubmission.

13. LIST OF PG STUDENTS, THEIRRESEARCH TITLE& NAME OF MAJOR ADVISORS

S. No.	Name of student	Adm. No.	Research topic	Major advisor
Ph.D. students				
1	Veer Sain	2013A1D	Market Information System and its application for agricultural commodities in Haryana	Dr. K.K.Kundu
2	Jitender Kumar	2013A2D	Role of Sarva Haryana Gramin bank in financing farmer of Hisar district	Dr. V.P.Mehta
3	Sumit	2014A1D	An Economic analysis of Bee-keeping: Production and Marketing of Honey in Haryana	Dr. R.S. Chauhan
4	Sadhanala	2015A2D	Dynamics of major oil seeds and pulses in India under future aspects	Dr. V.P.Mehta
5	Kavita	2015A3D	An analytical study on Impact of WTO on Agricultural Trade in India	Dr. V.P.Mehta
6	Raj Kumar	2015A4D	Estimation of Effective Demand and Economic analysis of fruit and vegetable crops in Haryana	Dr. Anil Kumar Rathee
7	Parveen Kumar	2015A5D	Economic analysis of vegetable cultivation under protected structures in Haryana	Dr. R. S. Chauhan
8	Meenu Punia	2015A6D	Agricultural Insurance in India vis-à-vis in Haryana Problems and Prospects	Dr. K.K.Kundu
9	Swamy, H.	2016A1D	Yet to be decided	Dr. U.K.Sharma
10	Sunita	2016A2D	Yet to be decided	Dr. V.P.Luhach
11	Sanjay	2016A3D	Yet to be decided	Dr.R.S.Pannu
12	Heena	2016A4D	Yet to be decided	Dr.D.P.Malik
M. Sc. Students				
1	Mrityunjay Pandey	2014A1M	Estimation of demand for NPK use in Haryana	Dr. U.K.Sharma
2	K. Archana	2015A1M	Dynamics of Production and Marketing of BT. Cotton in Haryana vis-à-vis T. Nadu	Dr. K.K.Kundu
3	Bidyut Kalita	2015A2M	An Economic analysis of Production and Marketing of Straw berry in Hisar district of Haryana.	Dr. R K Grover
4	Mohit	2015A4M	Performance and Prospects of Primary Agricultural Credit Societies in Haryana	Dr. V.P.Mehta
5	Usha	2015A5M	Comparative Economic Analysis of Marketing and Storage of Onion in Haryana	Dr. V.P.Luhach
6	Kamal	2015A7M	An Economic analysis of Production and Marketing of Pulses in Haryana.	Dr. Jitender Kumar Bhatia
7	Ashu	2015A8M	An Economic analysis of Potato Seed Production under Contract Farming in Haryana	Dr. Dalip Kumar Bishnoi
8	Neelam Kumari	2016A2M	Role of Haryana State in food security of India	Dr. V.P.Mehta
9	Sonu Ram	2016A04M	Economic analysis of production and marketing of Baby corn in Sonepat district of Haryana	Dr. Parminder Singh
10	Mahesh, V.	2016A1M	Market integration and price volatility of cotton in Haryana	Dr. R.K.Grover
11	Sachin Kumar	2016A5M	Economic analysis of production and marketing of spices in Haryana	Dr. Gurnam Singh

Revised (For official use)

REVIEW OF THE RESEARC SCHEMES 2017-18



TECHNICAL PROGRAMME OF WORK 2018-19

DEPARTMENT OF AGRICULTURAL ECONOMICS
COLLEGE OF AGRICULTURE
CCS HARYANA AGRICULTURAL UNIVERSITY
HISAR - 125 004 (HARYANA)

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REVIEW OF RESEARCH SCHEMES 2017-18 AND FINALIZATION OF TECHNICAL PROGRAMME FOR THE YEAR 2018-19

A. Report by the Head of the Department

1. **Name of the Department:** Agricultural Economics
2. **Staff position**

Title and Number of scheme	Sanctioned post with number	In position	Name of faculty/staff with designation	Vacant
Research Schemes				
(a)1202-Dte-R-1-Agri (A)-Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming				
1.	Economist (FM)-01	Nil	Vacant	1
2.	Assistant Scientist-06 (Ag. Econ.)	03	Dr. D. P. Malik, P.S. Dr. D. K. Bishnoi, A.S. Dr. Vinay Mehala, A.S.	3
3.	Assistant Scientist- 01 (Sociology)	Nil	Vacant	1
4.	Assistant Scientist -01 (Statistics)	01	Dr. Monika Devi	Nil
5.	Research Associate -01 (Rural Sociology)	Nil	Vacant	1
6.	Assistant	02	Sh Rajpal Bagri* Sh. OmParkash**	Nil
7.	Messenger	01	Sh. Krishan Kumar	Nil
(b) 3066-C(c) Econ-1 CS-Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana.				
1.	Field Officer/ Assistant Scientist (Ag. Econ.)-01	1	Dr. V.P. Luhach, PS	Nil
2.	Assistant Scientist-03 (Ag. Econ.)	3	Dr. R.S.Pannu, PS Dr. Neeraj Pawar, AS Dr. Nirmal Kumar, AS	Nil
3.	Assistant Scientist-01 ((Statistics)	1	Dr. Nitin Bhardwaj, AS	Nil
4.	***Computer/clerk-05	01	Sh. Naveen Kumar	04

5.	Field men/ -30 Agri. Inspectors	29	Vacant	01
6.	Messenger -01	Nil	Vacant	01
(c) 3615/ C(b) Ag. Econ-1 ICAR-NIAP-Resource Use Planning For Sustainable Agriculture				
1.	Senior research Fellows-02 (SRFs)	02	Sh. Sumit Sh. Raj Kumar	Nil
Teaching Scheme				
(a) 541/T-1 (B) state – Teaching scheme				
1.	Assistant Professor -06 (Ag.Econ.)	02	Dr. V.P. Mehta, Professor Dr. K.K.Kundu, Assoc..Professor	04
2.	Junior scale stenographer-01	01	vacant	Nil
3.	Sweeper-01	01	Vacant	01

* First half in department and second half in Centre of Excellence of Organic Farming, ** working in department of Business Management, *** contractual basis as per funding agency

3. Research Achievements (2017-18):

- Cotton-wheat in semi-arid zone, paddy-wheat in wet zone and cotton-wheat/ pearl millet-mustard in arid zone of state are most prevalent cropping patterns.

- Cultivation of vegetable crops in all three zones of state is one of feasible options particularly for small and marginal cultivators for increasing farm income.

- Various insect-pests like leaf blight in cluster bean, LCV, whitefly, leaf hopper and jassid in cotton, foot rot ,stem borer in rice and weeds (mandusi in wheat, orobanche and bathu in mustard reported in existing cropping patterns in different zones of state affected crop yield to certain extent.

- Depletion of ground water, erratic and adequate supply of electricity, procurement of produce particularly mustard and pearl millet, lack of awareness about incentives/subsidies were the major constraints.

- Cost of cultivation and per quintal cost of production increased invariably over the period due to escalation in prices/wages of machine/ human labour and of purchased inputs (seed, agro-chemicals)

- Material costs, human labour, machine labour, irrigation etc. were major contributing variables of gross returns.

- The value of B-C ratio of all crops was higher than one except pearl millet indicating sustainability of crops cultivation.

- MSP of all crops was found higher than cost of production A_2 and A_{2+} $_{+}F_L$. However it was less than C_2 in case of gram and pearl millet as cultivation of these crops confined to rain fed areas.

- FHPs of all crops during period 2004-2015 were found higher than MSPs except mustard in few years.

- The online data of cost of cultivation of principal crops and farm inventory from all 30 clusters of the state for the year 2016-17 was submitted to funding agency and for 2017-18, online data entries are in progress and will be submitted well in time.

4. Emerging/Thrust Areas

- Socio-economic analysis of emerging agricultural problems.
- Demand, supply and price analysis of agricultural inputs and output.
- Resource use efficiency in farm enterprises in different agro-climatic zones.
- Diversification in agriculture, sustainable agriculture , utilization of natural resources
- Marketing of agricultural produce and value addition in agriculture.

5. Action taken Report of proceedings of technical program meeting held on 05.07.2018:

The following observations and suggestions were given by the Chairman for improving and strengthening the Research activities in general		
1.	The number of experiments conducted by faculty members posted in research schemes be increased. **(Action: HOD, Agril. Economics and Concerned Scientist)**	Needful done
2.	Major crops of Haryana be included under scheme on cost of cultivation. **(Action: HOD, Agril. Economics and Concerned Scientist)**	Crop complex is decided by funding agency
3.	Studies on cost of cultivation and economics of poly houses be conducted. **(Action: HOD, Agril. Economics and Concerned Scientist)**	Project report in progress and study was conducted in 2016-17
4.	Scientists posted in C(c) Econ.1-(CS) be also associated in the experiments under state plan scheme. **(Action: HOD, Agril. Economics and Concerned Scientist)**	Associated in research projects
5.	Under treatment details of various experiments, the word 'statistics' be used	Needful done

	in place of statistical tools. The word 'etc' be removed from the document as the work has actually been conducted and thus specific observations be given. **(Concerned Scientist)**	
Research work of 2017-18 was reviewed and technical programme for 2018-19 was discussed and approved following observations and suggestions		
1.	In HOD's report staff position (page 1) mentioned under point 2 of scheme (b) be corrected. Data based information be included in research achievements. **(Action: HOD, Agril. Economics)**	Needful done
2.	Expt. 1 (page 3-16), the number of farmers actually adopting existing and alternate cropping patterns be specified Data in table 1 (Page 4) regarding farm size categories and land rates in table 2 (page 5) be checked and corrected as discussed. Discrepancies in table3(page6) and Table 4 (page 7) with respect to value of cow as farm asset and number of milch cow, respectively, be checked and corrected. The word 'Aphid (page14) in table as well as in text be replaced with 'Leaf Hopper'. Major findings (page15)be deleted and tangible findings on the basis of three year data be provided in concluding remarks. **(Action :Concerned Scientist)**	Needful done
3.	Expt.2 (page17) ,in the third objective, replace the word 'analyze' with 'obtain'/ 'examine . In Table 18 (page 25), title be corrected as discussed and correlation values be also provided with the regression values. Under conclusion (page26), tangible findings be provided. **(Action :Concerned Scientist)**	Needful done
4.	Expt.3 (page), number, year of start and budget (2017-18) of the scheme be provided. Association of CCPIs be done zone wise. Treatment details in terms of district, villages and respondents be specified. **(Action :Concerned Scientist)**	Needful done
5.	Expts.1, 2 and 3 (page29-31), the number of associated scientist be reduced and activity profile be specified as discussed. **(Action :Concerned Scientist)**	Needful done
6.	Expt.2(page 30), treatment details and observations be corrected as discussed.**(Action :Concerned Scientist)**	Needful done
7.	Expt.3 (page31), HOD Agril. Meteorology be associated as collaborator. **(Action: Concerned Scientist and HOD, Deptt. of Agri. Meteorology)**	Associated
8.	Experiments under C(c) Econ.1 (CS) be planned in the prescribed format by the concerned scientists as discussed	Planned for each season

	(Action :Concerned Scientist)	

6. List of research projects (from State as well as outside agencies) in operation along with sanctioned budget (2018-19)

S. No.	Number and name of the scheme	Sanctioned Budget (In Rs.)	Funding Agency
Research Schemes			
a.	**State Funded Schemes**		
1.	**1202-Dte-R-1- Agri (A)-state scheme** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	51030.00	State
b.	**Other Agencies**		
2.	**3066-C(c) Econ-1 CS** Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana.	2,70,00,000.00	Ministry of Agri. & Farmers Welfare, GOI.
c.	**ICAR**		
1.	**3615/ C(b) Ag. Econ-1 ICAR-NIAP** Resource Use Planning For Sustainable Agriculture	14,56,000.00	NIAP, New Delhi
Teaching scheme			
1.	541/T-1 (B) state – Teaching scheme	2700.00	State
2.	1051/T-1(A) state-Teaching scheme	44000.00	State

7. Research Project completed during 2017-18 giving briefly the tangible conclusions drawn**:**

Experiment No 1: Economic Analysis of Existing and Alternative Cropping Pattern of Different Zones in Haryana

1st year (2015-16): The study was conducted in Hisar district in semi-arid zone.

- Cotton-wheat was the dominating cropping pattern.
- In suggestive cropping patterns, vegetable crops like bottle gourd, okra, ridge gourd, onion and cauliflower were found to be feasible options for the marginal and small categories of farmers to switch over some area from cotton towards these vegetable crops.
- Lack of irrigation facility and poor quality underground water, shortage of labour, small and fragmented land holding, lack of credit and non-availability of farm inputs were major constraints observed in the study area.

2nd year (2016-17): The study was conducted in Karnal and Yamunanagar districts of wet zone

- Paddy –wheat was the dominating cropping pattern.

- In suggested cropping patterns, maize–wheat–moongbean, and vegetable cropping patterns, cauliflower (early)–green pea–cucumber cropping patterns were observed profitable over paddy – wheat in study area.

3rd year (2017-18): The study was conducted in Bhiwani and Mahendergarh districts of arid zone.

- Cotton- wheat cropping patterns was found profitable as compared to pearl millet-wheat, and pearl millet- mustard.

- In suggestive cropping patterns, cauliflower (early) – green onion – cauliflower (mid) were found most profitable over cotton-wheat cropping pattern. Among the wheat-vegetables cropping patterns, okra-wheat-cucumber cropping pattern was found profitable in the study area.

- The major constraints observed in the study were depletion of ground water, erratic supply of electricity, inadequate procurement of farm produce especially bajra and mustard by the govt. agencies, lack of awareness about various crop development programmes, cumbersome procedure in getting credit.

Experiment No 2: Economic Analysis of Crop Cultivation in Haryana

- Cost of cultivation as well as cost of production of all principal crops in the state increased considerably.

- Major factors contributing to gross returns are human labour, animal labour, machine labour, material cost and irrigation.

- The value of B-C ratio of all crops was higher than one except pearl millet indicating sustainability of crops cultivation.

8. Research projects sanctioned/submitted during 2017-18: Two

Sr. No.	Title of the Project	Principal Investigator(s)	Funding Agency	Amount (in lakh)	Status
1.	Market Interventions For Sustaining Vegetable Cultivation In Haryana	Dr. D. P. Malik, P.I. Dr. S.K. Goyal, Co-P.I.	RKVY	27.90	Submitted and approval is still awaited
2.	Resource Use Planning For Sustainable Agriculture	Dr. D. P. Malik, P.I. Dr. D.K. Bishnoi, Co-P.I.	ICAR	34.52	Sanctioned

9. Scheme-wise summary of experiments

Scheme/project	No. of Experiments				
	Planned (2017-18)	Conducted (2017-18)	Concluded (2017-18)	Continued (2018-19)	New Expt. (2018-19)
1202-Dte-R-1- Agri (A)-state scheme Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	**2**	**2**	**2**	**-**	**8**
3066- C(c) Econ.1 (CS) Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana	**1**	**1**	**1**	**-**	**2**
3615/ C(b) Ag. Econ-1 ICAR-NIAP Resource Use Planning For Sustainable Agriculture	**1**	**1**	**-**	**1**	**-**

10. List of equipments (last three years)

Year	Name of equipment	Quantity	Cost (in Rs.)	Status
2015	Desktop Computer	5	270498.00	Functional
	Laptop	5	284400.00	Functional
2016	Projection screen	1	14208.00	Functional
2017	Laptop	29	1486446.00	Functional

11. Recommendations generated for field application : Nil

12. Protection of IPR instruments, if any (patents, registration of variety/germplasm, copyright etc.)

:Nil

B. Details of Each Research Scheme(s) for Review:

1. Scheme No. : 1202-Dte-R-1-Agri (A)

Title : Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

2. Year of Start : 2002-2003

3. Location : Haryana

4. Objectives of the scheme:

1. To analyse the resource use efficiency in Haryana farming.
2. To carry out studies into different marketing aspects of major farm inputs and products.
3. To study the possible agricultural diversification in different zones of Haryana.

5. Any need to modify the objectives as per the need of the state

- No-

6. Budget for the year 2017-18 (head-wise sanction and expenditure details)

(in Rs.)

Sr. No.	SOE	Allotment	Expenditure	Balance
1	O.E. (NR)	0	0	0
2	LTC	0	0	0
3	TA	6200	2972	3228
4	O.E. (Others)	22500	22363	137
5	Other Charges	6750	6731	19
6	M & S	5850	5564	286
	TOTAL	**41300**	**37630**	**3670**

7. Salient Research Findings of the Scheme during 2017-18

- In *Kharif* season highest area accounted by cotton crop, i.e. 50.51 per cent followed by pearl millet (26.30 %), vegetables (12.80 %) cluster bean (5.20 %) and fodder crops (5.19) at aggregate level.

- During the *Rabi* season, area allocated under wheat was 43.18 per cent followed by mustard (42.20 %), vegetables (8.77 %) and fodder crop (4.55 %).The least share area was devoted to barley (1.30 %) in the study area.

- Cotton- wheat cropping pattern was found profitable with net returns of Rs. 20305 per hectare.

- Highest net returns were observed from green onion i.e. Rs. 43950/ha followed by the other vegetables like cauliflower (Rs. 39448/ha), summer squash (Rs. 29375/ha), tomato (Rs. 28207/ha) and green pea (Rs. 27083) grown in the study area.

- Among the wheat- vegetables cropping pattern, okra – wheat – cucumber cropping pattern was found most profitable with net return of Rs. 1, 00,688 per hectare.

- In suggestive cropping patterns, cauliflower (early) – green onion – cauliflower (mid) was found most profitable cropping pattern with net returns of Rs. 1, 22,846 per hectare.

- The major constraints observed in the study are depletion of ground water, erratic supply of electricity, inadequate procurement of farm produce, cumbersome procedure in getting credit from financial institutions.

- Inclusion of vegetable cropping pattern in existing cropping pattern may be feasible options to enhance the income of the marginal and small categories of farmers.

- The cost of cultivation of all major crops increased due to use of higher doses of chemical fertilizers and HYV seeds, increased use of agro-chemicals, higher prices of farm inputs and higher wages of human labour.

- The cost of mechanical labour was higher due to increase in prices of machines as well as fuel.

- The increasing trend in yield was observed for all the selected crops except gram during the study period.

8. Justification for continuation of the scheme

Objectives of the schemes are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers, sustainable utilization of natural resources, diversification in agriculture; resource use is farm enterprise in Haryana.

9. Constraints, if any: Shortage of faculty in the scheme.

10. TECHNICAL PROGRRAME OF WORK DURING 2017-18

i	**Experiment No.1:** Economic Analysis of Existing and Alternative Cropping Pattern of Different Zones in Haryana	
ii	**Objectives of the experiment**	• To examine the existing cropping pattern of selected farmers. • To analyse the economics of existing cropping patterns • To suggest the alternative cropping patterns
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring and report writing • Dr. Jitender Kumar Bhatia Preparation of schedule, data collection, analysis of data. • Dr. Dalip Kumar Bishnoi Data collection, compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Nil
v	**Year of start**	**2015-16**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :**Bhiwani and Mahendergarh from western zone of the state • **Block covered:** Bawani Khera and Mahendergarh • **Village covered:** Milakpur, Sikanderpur (Bhiwani), Malda and Meghanwas (Mahendergarh) • **Number and type of respondents :**80 farmers • **Statistical design/methods :** The statistical tools like mean, percentage, averages etc. were used to draw the inferences of the study
vii	**Observation recorded**	• Personal interaction with 40 farmers of two villages of each district • Information pertaining demographic attributes, land resources, livestock inventory, farm machinery collected from selected farmers. • Information related to cropping pattern, inputs used, output attained of prevalent crops as well as crops suggested for cultivation • Information regarding production constraints like biotic stresses, supply of electricity, status of groundwater etc extracted from selected respondents

viii) Results achieved during 2017-18

Demographic Characteristics: General characteristics of sample households were presented in table 1. The study reveals that only 10.00 per cent of heads of family were found below 30 in age group. 65 per cent of the heads were found in the age group of 30-50 years while about 25 per cent were observed above 50 years at the overall level.

Table 1: Demographic characteristics of sampled households: 2017-18

Particulars	Small (N= 48)	Medium (N= 22)	Large (N=10)	Overall (N=80)
Age of head of family (Years) (%)				
Up to 30	10.42	9.09	0.00	10.00
30 – 50	64.58	63.64	80.00	65.00
Above 50	25.00	27.27	20.00	25.00
Educational status of head of the family (%)				
Illiterate	4.17	10.18	0.00	7.50
Primary	10.42	8.00	13.00	7.50
Matriculation	58.33	56.02	60.52	57.50
Sr. Secondary	12.50	10.08	18.02	20.00
Graduate and above	14.58	15.72	8.46	8.75
Average family size (Nos.)				
Males	3.07	3.15	3.50	3.15
Females	2.33	2.37	2.40	2.35
Total	5.40	5.52	5.90	5.50
Occupation of head of family (%)				
Agriculture as main occupation	91.66	86.36	90.00	89.99
Agriculture as subsidiary occupation	8.34	13.64	10.00	10.01

The range of age group of head of selected farm households showed significant variations across farm sizes. Particularly, medium farm households showed higher share i.e. 27.27 per cent of heads above 50 years of age in the study area.

Among the selected households, more than 70 per cent of them attained education up to senior secondary level at overall as well as across the farm size. The level of education of heads varied across farm sizes. In particular, percent share of illiterate as well as graduate and above, heads was observed higher in medium category (10.18 & 15.72 % respectively) in comparison to other categories.

The average size of family was around 5.50 persons in selected farm households. The category of large farm households indicated higher size (on around 6 persons) in comparison to other categories. It could be due to prevalence of joint family system on large category of farms. The number of males and females was also observed higher in medium size category.

The main occupation of head of selected farm households was agriculture i.e. 89.99 per cent and only 10.01 per cent had adopted agriculture as subsidiary occupation at the overall level. Only 8.34 per cent of the heads in small farm category took up agriculture as subsidiary occupation while around 13.64 per cent of medium and 10.00 per cent in large category farmers adopted supportive activities to augment their family income.

Land Resources:

The status of land holdings of sampled households indicated that the selected farm households owned 3.11 ha. per household at the aggregate level. Large category farmers operated 8.10 ha. per household while medium and small farmers operated around 3.14 and 2.06 ha. of land respectively. Thus, variation in operational holdings across farm categories was found significant. More than 98 per cent of land operated by farmers at the aggregate level was found under irrigation. The land rent ranged approximately between Rs. 54375 to 57500 per ha. in the study area (Table 2).

Table 2: Land holding and average area irrigated on sampled farms in selected villages: 2017-18

(ha./ farm)

Farm Size Category	Owned	Leased in	Irrigated Canal/TW	Unirrigated	Total Operational Holding	Land Rent Rs. / ha.
Small	1.43 (69.42)	0.63 (30.58)	1.93 (93.69)	0.13 (6.31)	2.06 (100.00)	56302
Medium	3.00 (95.54)	0.14 (4.46)	3.14 (100.00)	0.00 (0.00)	3.14 (100.00)	57500
Large	6.74 (83.21)	1.36 (16.79)	8.10 (100.00)	0.00 (0.00)	8.10 (100.00)	54375
Overall	2.52 (81.03)	0.59 (18.97)	3.06 (98.39)	0.05 (1.61)	3.11 (100.00)	56250

Figures in parentheses show per cent to the total operational holding

Farm assets of sampled farmers:

Data related to the value of major farm assets excluding land was collected. These assets include tractor, trolley, harrow, cultivator, tube well and pumping set, farm building, cattle shed etc. in the study area. The sampled farm households on an average possessed assets worth Rs. 6, 44,498 at the overall level. The farm households owned farm assets worth Rs. 4, 38,573, Rs. 7, 07,135 and Rs. 14, 95,137 in small, medium and the large farm categories respectively. However the tractor and tractor drawn implements (S.No. 4-12) accounted near to one-third i.e. (31.64%) of the total investment followed by farm building and cattle shed (20.88 %), milch animals

(17.42%), tube well & pumping set (8.98%), draught animals (1.95%), cart (1.44%) and chaff cutter (1.69%). Investment in remaining farm assets including transport means also was not very low i.e. (16.47%). It may be highlighted that the present value of farm assets increased with an increase in size of farm holding and indicated a positive sign. Other results about the ownership of per household assets for the entire sample covering all categories were on expected lines since large category indicated the highest value of farm assets in the study area (Table 3).

Table 3: Farm assets at sampled farms in selected villages: 2017-18

(Rs./farm)

Sr. no.	Particulars	Farm Size			
		Small	Medium	Large	Overall
		Per Farm	Per Farm	Per Farm	Per Farm
1.	Farm Building & Cattle shed	94833 (21.62)	110364 (15.61)	378460 (25.31)	134558 (20.88)
2.	Tube well & Pumping Set	40750 (9.29)	54386 (7.69)	148000 (9.90)	57906 (8.98)
3.	Draught Animals	8906 (2.03)	13134 (1.86)	29000 (1.94)	12581 (1.95)
4.	Tractors	63021 (14.37)	166091 (23.49)	275400 (18.42)	117913 (18.30)
5.	Cultivators	4979 (1.14)	13136 (1.86)	21600 (1.44)	9300 (1.44)
6.	Harrow	6094 (1.40)	14882 (2.10)	25020 (1.67)	10876 (1.69)
7.	Leveller	1104 (0.25)	4855 (0.69)	4330 (0.29)	2539 (0.39)
8.	Thresher	5625 (1.28)	12727 (1.80)	59660 (3.99)	14333 (2.22)
9.	Bund Maker	1208 (0.28)	2523 (0.36)	4600 (0.31)	1994 (0.31)
10.	Seed Drill	2685 (0.61)	11045 (1.56)	20600 (1.38)	7224 (1.12)
11.	Plough	4433 (1.01)	7743 (1.09)	16250 (1.09)	6821 (1.06)
12.	Trolley	14308 (3.26)	42273 (5.98)	82500 (5.52)	30523 (4.74)
13.	Bullock Cart	9500 (2.16)	8405 (1.19)	9867 (0.66)	9245 (1.43)
14.	Chaff-Cutter	8292 (1.89)	8763 (1.24)	22850 (1.53)	10241 (1.59)
15.	Buffaloes	90833 (20.71)	85036 (12.02)	148500 (9.93)	96448 (14.96)
16.	Cow	14208 (3.24)	26591 (3.76)	0 (0.00)	15838 (2.46)
17.	Others	67792 (15.45)	125182 (17.70)	248500 (16.62)	106163 (16.47)
Total		438573 (100.00)	707135 (100.00)	1495137 (100.00)	644498 (100.00)

Figures in parentheses show per cent to the total investment on different categories.

Livestock Inventory

It was evident from the table 4 that among the livestock51.94 per cent were milch animals comprising 41.60 per cent of buffaloes and 10.34 per cent of cow with 36.17per cent of young stock. About 12 per cent of total livestock were used as draught animals on the sampled farms in the study area.

Table 4: Livestock maintained on sampled farms in selected villages: 2017-18

Category of Animals	Small	Medium	Large	Overall
Milch animals				
Milch cow	0.42 (11.63)	0.55 (13.32)	0.00 (0.00)	0.40 (10.34)
Milch buffaloes	1.31 (36.29)	1.86 (45.04)	2.50 (56.82)	1.61 (41.60)
Other animals				
Cow heifer	0.44 (12.20)	0.27 (6.54)	0.00 (0.00)	0.34 (8.78)
Buffalo heifer	0.92 (25.48)	1.09 (26.39)	1.70 (38.64)	1.06 (27.39)
Drought animals	0.52 (14.40)	0.36 (8.72)	0.20 (4.55)	0.46 (11.89)
Total	**3.61 (100.00)**	**4.13 (100.00)**	**4.40 (100.00)**	**3.87 (100.00)**

Figures in parentheses show per cent to the total livestock

Existing Cropping Pattern:

Cropping pattern of the study area is presented in table 5. The result shows that in *Kharif* season, highest area accounted by cotton crop *i.e.* 50.51 percent followed by pearl millet (26.30 %), vegetables (12.80 %), cluster bean and fodder crops (5.20 %) at aggregate level. Similar trend were also observed across the farm sizes. In *Rabi* season, area allocated under wheat was 43.18 per cent followed by mustard (42.20 %), vegetables (8.77 %) and fodder crop (4.55 %) while least share of area were devoted to barley (1.30 %).

Table 5: Cropping pattern on sampled farms in selected villages: 2017-18

(ha./ farm)

Crop	Small	Medium	Large	Overall
Cotton	0.84 (45.16)	1.63 (53.97)	4.04 (54.30)	1.46 (50.51)
Pearl millet	0.57 (30.64)	0.82 (27.15)	1.50 (20.16)	0.76 (26.30)
Cluster bean	0.09 (4.84)	0.17 (5.63)	0.40 (5.38)	0.15 (5.20)
Vegetables	0.24 (12.90)	0.26 (8.61)	1.20 (16.13	0.37 (12.80)
Fodder crops	0.12 (6.45)	0.14 (4.64)	0.30 (4.03)	0.15 (5.19)
Kharif	**1.86 (100.00)**	**3.02 (100.00)**	**7.44 (100.00)**	**2.89 (100.00)**
Wheat	0.96 (47.52)	1.47 (46.37)	2.84 (35.42)	1.33 (43.18)
Mustard	0.84 (41.58)	1.39 (43.85)	3.28 (40.89)	1.30 (42.20)
Barley	0.00 (0.00)	0.02 (0.64)	0.24 (2.99)	0.04 (1.30)
Vegetables	0.10 (4.95)	0.14 (4.41)	1.40 (17.45)	0.27 (8.77)
Fodder crops	0.12 (5.95)	0.15 (4.73)	0.26 (3.25)	0.14 (4.55)
Rabi	**2.02 (100.00)**	**3.17 (100.00)**	**8.02 (100.00)**	**3.08 (100.00)**
Total cropped area	3.88	6.19	15.46	5.97
Operational area	2.02	3.17	8.02	3.08
Cropping intensity	**192.08**	**195.27**	**192.77**	**193.83**

Figures in parentheses show per cent to the total cropped area in respective season

Economics of the existing crops on sampled farms

The details of cost incurred by the selected respondents on various inputs in crops grown in *Kharif* season are presented in table 6.The per hectare total cost of cultivation of cotton, pearl millet and cluster bean were observed Rs. 89,817, 61,090 and 51,010 respectively, whereas variable cost was Rs. 53,252, 28,675 and 24,365 per hectare respectively on sampled farms. A highest net return over total cost was observed from cotton (Rs. 4690) whereas, in case of pearl millet and cluster bean, net returns were found negative.

Table 6: Cost and returns of existing *Kharif* crops on sampled farms in selected villages: 2017-18

(Rs. /ha)

Particulars	Cotton	Pearl millet	Cluster bean
Variable cost	53252	28675	24365
Total cost	89817	61090	51010
Gross returns	94507	51572	50417
Returns over variable cost	41255	22897	26052
Net Returns	4690	-9518	-593
B: C Ratio	1.05	0.84	0.99
Average Yield (Kg./ha)	2030	3455	1375

The details of cost incurred by the selected respondents on various inputs and returns attained from crops grown in *Rabi* season are presented in table 7. The per hectare total cost of wheat, mustard and barley on sampled farms were found to be Rs. 78,900, 59,847 and 57,925, respectively whereas variable cost were observed Rs. 43,615, 27,947 and 29,520. Highest net return over total cost per ha. was observed from wheat crop i.e. Rs. 15,615 followed by mustard and barley.

Table7: Cost and returns of existing *Rabi* crops on sampled farms in selected villages: 2017-18

(Rs. /ha)

Particulars	Wheat	Mustard	Barley
Variable cost	43615	27947	29520
Total cost	78900	59847	57925
Gross returns	94515	69565	64500
Returns over variable cost	50900	41618	34980
Net Returns	15615	9718	6575
B: C Ratio	1.20	1.16	1.11
Average Yield (Kg./ha)	4852	1930	4250

The details of cost incurred by the selected respondents on various inputs and returns from all vegetable crops grown in the study area are presented in table 8. Per hectare net returns from green onion were found highest i.e. Rs. 43,950 followed by cauliflower (Rs. 39,448), summer squash (Rs. 29,375), tomato (28,207) and green pea (Rs. 27,083), respectively. Whereas, total cost worked out was highest in case of cauliflower i.e. Rs. 1,66,242 followed by green onion (Rs.1,43,550), tomato (Rs. 1,37,080) summer squash (Rs. 1,36,875), and green peas (Rs. 1,20,417).

Table 8: Cost and returns of *Kharif* and *Rabi* season vegetables crops on sampled farms in selected villages: 2017-18

(Rs. /ha)

Particulars	*Kharif* Season	*Rabi* Season			
	Cauliflower	Green Pea	Tomato	Green Onion	Summer Squash
Variable cost	119827	84512	97917	103790	98230
Total cost	166242	120417	137080	143550	136875
Gross returns	205690	147500	165287	187500	166250
Returns over variable cost	85863	62988	67370	83710	68020
Net Returns	39448	27083	28207	43950	29375
B: C Ratio	1.24	1.22	1.21	1.31	1.21
Average Yield (Kg./ha)	33500	23750	36500	37500	23750

The cost of cultivation as well as returns from fodder crops are presented in table 9. The total expenses incurred in cultivation of berseem as well as jowar were Rs. 67,345 and 48,150 per hectare, respectively. Whereas, variable cost of these fodder crops was found Rs. 37,500 and 22,500 per hectare. Net returns over total cost attained from berseem and jowar were Rs. 1,550 and 4,120.

Table 9: Cost and returns of existing fodder crops on sampled farms in selected villages: 2017-18

(Rs. /ha)

Particulars	Berseem/Oat	Jowar
Variable cost	37500	22500
Total cost	67345	48150
Gross returns	68895	52270
Returns over variable cost	31395	29770
Net Returns	1550	4120
B: C Ratio	1.02	1.08
Average Yield (Kg./ha)	56750	51250

Economics of existing cropping patterns

Comparative profitability of existing cropping patterns presented in table 10 and Fig.1. It was clearly indicated from the results that cotton – wheat cropping pattern was found profitable with net returns of Rs 20305.As far as per unit total cost of cultivation was concern, cotton – wheat cropping pattern(Rs. 1,68,717 /ha)was found costlier as compared to cluster bean – wheat and pearl millet – wheat cropping pattern i.e. Rs. 1,29,910, and 1,39,990, respectively.

Table 10: Economics of existing cropping patterns at sampled farms of selected villages: 2017-18

(Rs./ha)

Particulars	Cotton - Wheat	Cluster bean - Wheat	Pearl millet - Wheat
Variable cost	96867	67980	72290
Total cost	168717	129910	139990
Gross returns	189022	144932	146087
Returns over variable cost	92155	76952	73797
Net Returns	20305	15022	6097
B: C Ratio	1.12	1.12	1.04

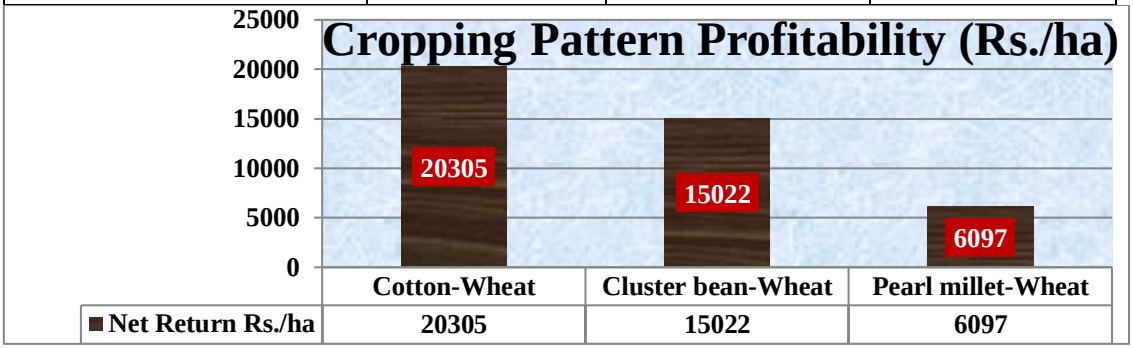

Fig. 1: Comparative profitability analysis of different cropping patterns

Comparative profitability of existing cropping patterns in the study area are presented in table 11 and Fig.2. It was clearly indicated from the results that cotton – wheat cropping pattern was found profitable with net return of Rs. 20305 over cluster bean – mustard and pearl millet – mustard cropping patterns. As far as per unit total cost of cultivation was concern, cotton – wheat cropping pattern (Rs. 1,68,717 /ha) was found costlier as compared to cluster bean – mustard (Rs. 1,10,857) and pearl millet – mustard (1,20,937) cropping system.

Table 11: Economics of existing cropping pattern at sampled farms of selected villages: 2017-18

(Rs./ha)

Particulars	Cotton - Wheat	Cluster bean - Mustard	Pearl millet - Mustard
Variable cost	96867	52312	56622
Total cost	168717	110857	120937
Gross returns	189022	119982	121137
Returns over variable cost	92155	67670	64515
Net Returns	20305	9125	200
B: C Ratio	1.12	1.08	1.00

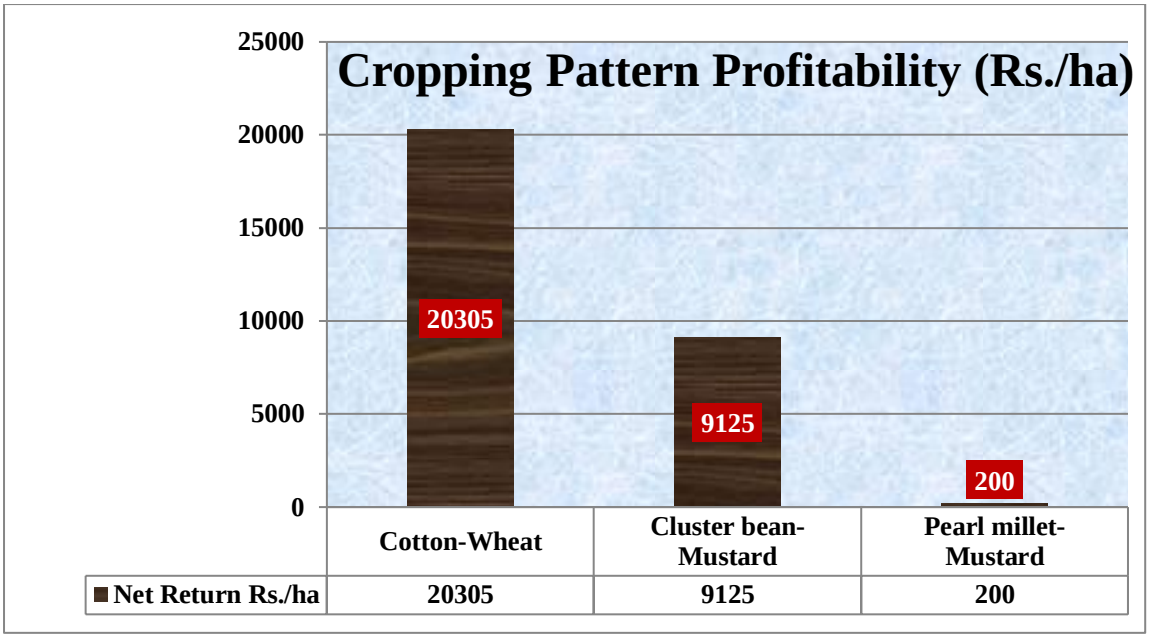

Fig. 2: Comparative profitability analysis of different cropping patterns

Economics of alternate cropping pattern

Among sampled eighty (80) farmers, thirty three (33) farmers adopted alternative cropping pattern including high value crops like vegetables. Comparative economic analysis of cotton - wheat vis-a-vis different vegetable cropping patterns is presented in table 12 and Fig.3. The result revealed that cauliflower (early) – green onion – cauliflower (mid) (Rs. 1,22,846), cauliflower (early) – summer squash – cauliflower (mid) (Rs 10,82,71/ha), cauliflower (early) – tomato – cauliflower (mid) (Rs. 10,71,03/ha), cauliflower (early) – carrot – cucumber (Rs. 99,496/ ha),cauliflower (early) – green pea – cucumber (Rs 98,701/ha) were found profitable cropping patterns over existing cotton – wheat (Rs. 20,305/ha) cropping patterns.

Table 12: Cropping pattern profitability of cotton-wheat vis-à-vis alternative vegetable crops: 2017-18

(Rs. /ha)

Particulars	Existing cropping pattern	Alternate cropping patterns				
	Cotton - Wheat	Cauliflower (early)- Tomato - Cauliflower (Mid)	Cauliflower (early)- Summer – Squash Cauliflower (Mid)	Cauliflower (early)- Onion– Cauliflower (Mid)	Cauliflower (early) - Carrot - Cucumber	Cauliflower (early) – Green Pea - Cucumber
Variable cost	96867	337571	337884	343444	262077	265864
Total cost	168717	469564	469359	476034	374944	379489
Gross returns	189022	576667	577630	598880	474440	478190

Returns over variable cost	92155	239096	239746	255436	212363	212326
Net Returns	20305	107103	108271	122846	99496	98701
B: C Ratio	1.12	1.23	1.23	1.26	1.27	1.26

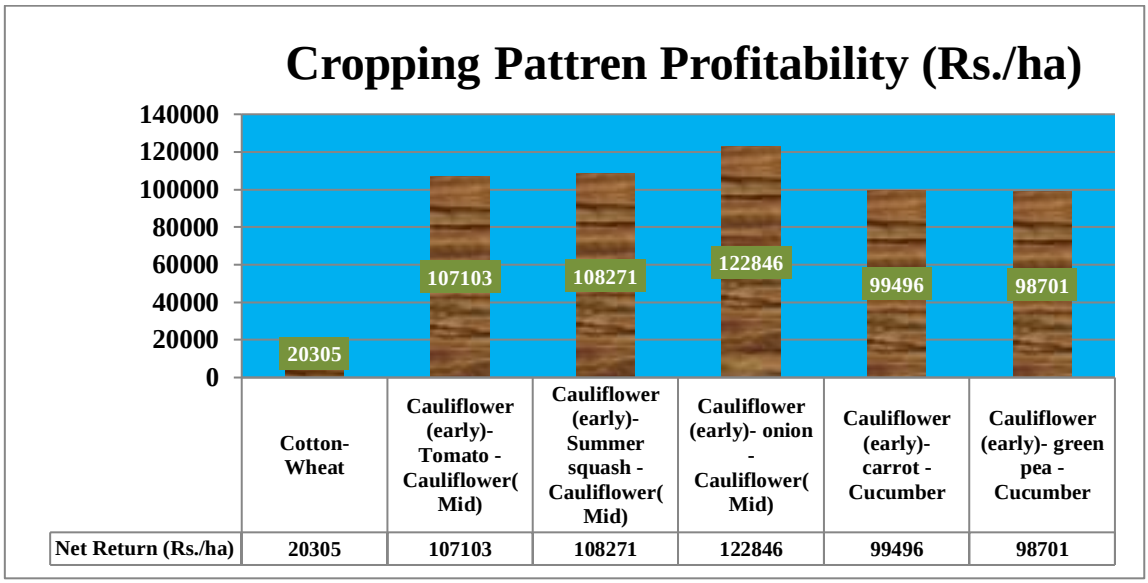

Fig. 3: Comparative profitability analysis of different cropping patterns (Vegetables)

Comparative economic analysis of cotton - wheat vis-à-vis wheat – vegetables cropping patterns is presented in table 13 and Fig.4. It was clearly evident from the table that okra – wheat – cucumber vegetable cropping patterns were found most profitable cropping pattern with net returns of Rs. 1,00,688 per ha. among other vegetables – wheat cropping pattern i.e. cauliflower (early) – wheat - cauliflower (mid) (Rs. 94,511/ ha) and cauliflower (early) – wheat– cucumber (Rs. 87,233/ha). The per hectare net returns of vegetables –wheat based cropping patterns were observed profitable over existing cotton – wheat copping pattern.

Table 13: Cropping pattern profitability of cotton-wheat vis-à-vis alternative wheat- vegetable crops: 2017-18

(Rs. /ha)

	Existing cropping pattern	**Alternate cropping patterns**		
Particulars	**Cotton – Wheat**	**Cauliflower (early) - Wheat - Cauliflower (Mid)**	**Cauliflower (early) - Wheat - Cucumber**	**Okra - Wheat - Cucumber**
Variable cost	96867	283269	224967	281984

Total cost	168717	411384	337972	412017
Gross returns	189022	505895	425205	512705
Returns over variable cost	92155	222626	200238	230721
Net Returns	20305	94511	87233	100688
B: C Ratio	1.12	1.23	1.26	1.24

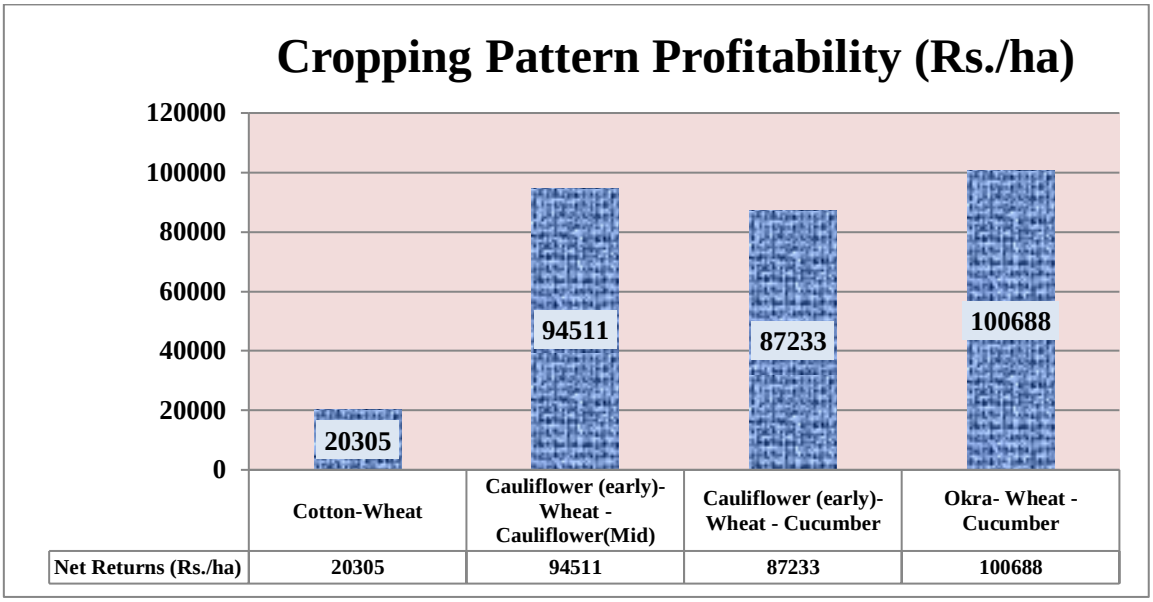

Fig. 4: Comparative analysis of profitability of paddy – wheat with wheat - vegetable cropping systems

Constraints faced by the farmers in cultivation of crop

Constraints faced by the farmers in cultivation of crops both in *Kharif* and *Rabi* season in the study area are presented in table14.

Table 14: Constraints faced by the farmers in selected villages: 2017-18 (N=80)

S. No.	Particulars	Overall (Per cent response)
Diseases		
1	Bacterial leaf blight of cluster bean	40.00
2	Flag smut in wheat	15.00
Insects/pests		
1	Leaf Hopper and white fly in cotton	65.00
2	Sucking pest and fruit borer in vegetables	42.50
3	Grey weevil in pearl millet	10.00
Weeds		
1	Mandusi(*Phalaris minor*), Hirankhuri and Bathu in wheat	67.50
2	Cholayi, Satti in bajra and cotton	55.00
Non-availability of inputs		

1	Erratic supply of electricity for irrigation	93.75
2	Inadequate procurement of agriculture produce at minimum support price (MSP)	90.00
3	Depletion of water table	77.50
4	Variability in the prices of agricultural produce	75.00
5	lack of awareness about various crop developmen programmes	70.00
6	Poor accessibility of credit facilities	35.00
7	Non-availability of quality seeds and agro chemicals	32.50

- Forty per cent of the farmers responded that bacterial blight as major disease in cluster bean followed by flag smut of wheat (15 %).

- 65 %respondents stated that leaf hopper and white fly as major insect-pests in cotton followed by sucking pests and fruit borer in vegetables (42.50%) and Grey weevil in pearl millet (10 %).

- 67.50 % percent of the cultivators opined that mandusi, hirankhuri, bathua in wheat, and cholayi and satti in bajra and cotton crop as major weeds in the study area.

- 93.75 % of the cultivators opined that erratic supply of electricity for irrigation purpose, inadequate procurement of farm produce especially bajra and mustard by the govt. agencies (90 %), depletion of ground water (77.50%), variability in prices of agricultural produce (75 %), lack of awareness about various crop development programmes (70%), poor credit facilities (35 %) and non-availability of quality inputs (32.50 %).

Major findings of the study

- In *Kharif* season highest area accounted by cotton crop, i.e. 50.51 per cent followed by pearl millet (26.30 %), vegetables (12.80 %) cluster bean and fodder crops (5.20 %) at aggregate level. Whereas, during the *Rabi* season area allocated under wheat was 43.18 per cent followed by mustard (42.20 %), vegetables (8.77 %) and fodder crop (4.55 %).The least share area was devoted to barley (1.30 per cent) in the study area.

- Cotton – wheat cropping patterns was found profitable with net returns of Rs. 20305 per hectare as compared to cluster bean – wheat (Rs.15022/ha) and pearl millet – wheat(Rs. 6097/ha) in the study area.

- Among vegetable crops, highest net returns were observed from green onion i.e. Rs. 43950/ha followed by the other vegetables like cauliflower (Rs. 39448/ha), summer squash (Rs. 29375/ha), tomato (Rs. 28207/ha) and green pea (Rs. 27083) grown in the study area.

- Among the wheat – vegetables cropping pattern, okra – wheat – cucumber cropping pattern was found most profitable with net returns Rs. 1,00,688/ha.

- In suggestive cropping patterns, cauliflower (early) – green onion – cauliflower (mid) was found most profitable cropping pattern with net returns of Rs. 1, 22,846 per hectare.

- Inclusion of vegetable cropping patterns in existing cropping patterns may be feasible options to enhance the income of the marginal and small categories of farmers.

- The major constraints observed in the study are depletion of ground water, erratic supply of electricity, inadequate procurement of farm produce especially bajra and mustard by the govt. agencies, lack of awareness about various crop development programmes, cumbersome procedure in getting credit.

ix. Programme of work for 2018-19: Experiment concluded

Conclusion of the study:

The study was planned for three consecutive years (2016-2018) in different regions of the state. The tangible conclusions of the study are as under:

- In semi-arid zone of state, cotton-wheat was observed major cropping pattern in the study area (Hisar district) during 2015-16. Bacterial leaf blight in cluster bean, Leaf curl virus in cotton as major diseases, white fly, leafhopper and Jassid as major insect pest, Phalaris minor in wheat, and *Orobanche* and *Chenopodium album*in mustard as major weed were identified. Lack of irrigation facility and poor quality underground water, shortage of labour, small and fragmented land holding, lack of credit and non-availability of farm inputs were observed major constraints. In suggestive cropping patterns, vegetable crops like bottle gourd, okra, ridge gourd, onion and cauliflower were found to be feasible options for the marginal and small categories of farmers to switch over some area from cotton towards these vegetable crops for increase in farm income.

- In wet zone of state, paddy-wheat was the dominating cropping pattern in the study area (Karnal and Yamunanagar districts) during 2016-17. In suggested cropping patterns, maize–wheat–moong bean, and vegetable cropping patterns, cauliflower (early)–green pea–cucumber cropping patterns were observed profitable over paddy – wheat cropping pattern. Foot rot and neck blast as disease, shoot borer, stem borer and sucking pests, mandusi, makra and motha as weeds were identified as major constraints faced by the farmers in the study area.

- In arid zone of state, cotton-wheat cropping pattern was found profitable as compared to cluster bean-wheat and pearl millet-wheat in the study area (Bhiwani and Mahendergarh districts) during 2017-18. Depletion of ground water, erratic supply of electricity, inadequate procurement of farm produce especially bajra and mustard by the govt. agencies, lack of awareness about various crop development programmes, cumbersome procedure in getting credit were observed major constraints. In suggestive cropping patterns, cauliflower (early) – green onion – cauliflower (mid) were found most profitable over cotton – wheat-cropping pattern. Among the wheat – vegetables cropping patterns, okra – wheat – cucumber cropping pattern was found profitable in the study area.

i	**Experiment No. 2: " Economic Analysis of Crop Cultivation in Haryana"**	
ii	**Objectives of the experiment**	• To examine the costs, returns and profitability of selected crops over the period • To analyse the resource use efficiency in the production of principal crops • To examine the trends in farm harvest price (FHP) and minimum support price (MSP)
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Planning, Execution and finalization of Report • Dr. Jitender Kumar Bhatia Collection of data and report writing. • Dr. Dalip Kumar Bishnoi Data Compilation and report writing. • Dr. Nitin Bhardwaj Tabulation and Analysis of data.
iv	**Name(s) of the collaborator(s) with activity profile**	• Nil
v	**Year of start**	**2017-18**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :**Whole Haryana • **Statistical design/methods :** The statistical tools like mean, percentage, averages etc. were used to draw the inferences of the study
vii	**Observation recorded**	• Data for wheat, paddy, gram, bajra, mustard, cotton and sugarcane were collected for the period 2004-2015. • Secondary data on cost of cultivation, human labour, animal labour, machine labour, and material cost (includes seed, fertilizer, plant protection chemicals) of all seven crops was extracted from various published sources and records of Ministry of agriculture & Farmer's Welfare GOI, state government and CCS HAU, Hisar. • To estimate resource use efficiency, Cobb-Douglas Production function was employed.

Results achieved 2017-18

The information pertaining to the cost of cultivation, cost of production of selected crops were collected, compiled and analyzed to draw the various cost components.

Costs, returns and profitability of crops

Cost A1	All variable cost including • Value of hired human labour • Value of hired and owned bullock labour • Value of hired and owned machine labour • Value of seed (both farm seed and purchased) • Value of manures (owned and purchased) and fertilizers • Depreciation • Irrigation charges • Land Revenue, cesses and taxes • Interest on Working Capital • Miscellaneous Expenses
Cost A2	Cost A1 + Rent paid for the leased in land.
Cost B1	Cost A1 + Interest on value of owned capital assets (excluding Land).
Cost B2	Cost B1 + imputed rental value of owned land, (net of land revenue) + Rent paid for leased in land.
Cost C1	Cost B1 + Imputed value of family labour.
Cost C2	Cost B2 + Imputed value of family labour.
Cost C2 *	Cost C2* estimated by taking into account the statutory minimum wage rate or the actual wage rate whichever is higher.
Cost C3	Cost C2*+ Managerial cost @10 per cent of total cost C2

Cost C2 *= C2 Revised

Cost of Production: Cost of production was calculated by estimating all the costs that are incurred in producing one quintal of produce or output.

Cost of cultivation: It includes all expenses incurred in raising the crop per unit of area. In **operational costs,** the cost of hiring human labour, machine power, bullock charges have been estimated by prevailing rate at particular period in the study area. Hired labour charge at the actual wage paid in cash and other kind of payments were also converted into monetary terms at the prevailing price. Imputed value of the family labour was also calculated using the prevailing wage rate in the study area. In case of bullock, tractor and other machinery and hiring charges were applied to these as the cost

for those who do not own them, whereas the cost of fuel, repairing and maintenance cost were calculated for those who own them. **In case of material costs;** cost of seeds, manure, chemicals, fertilizers irrigation charges were included. Other costs includes land revenue, interests on fixed assets, interest on working capital, depreciation and rental value of the land. Simple interest was calculated on the working capital at a flat rate of 7% per annum. Rental value of the land prevailed in the study area during study period was taken.

Minimum Support Price (MSP): It is the price announced by Govt. of India on the recommendation of CACP to safeguard the interest of farmers against the steep fall in price of particular crop during glut/harvesting season. It is announced almost pre sowing of both *Kharif* and *Rabi* season so that farmers can make rational decision of area and other resource allocation accordingly.

The above data were compiled for all the seven principal crops (Wheat, Paddy, Gram, Bajra, Rapeseed & Mustard, Cotton as well as Sugarcane) for the study period i.e.2004-05 to 2014-15.

Table 15: Cost of cultivation and returns of various crops: 2004-2015

(Rs. /ha)

Particulars	**Wheat**			**Paddy**		
A. Costs	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
i) A1	11702.74	16615.28	24868.36	16677.60	21551.10	35182.92
ii) A2	12509.45	16644.26	24868.36	17967.36	21591.41	35182.92
iii) A2 + FL	15285.93	22382.77	33648.96	21540.01	28161.98	46032.95
iv) C2*	24525.79	43006.76	61533.43	32038.25	50717.64	78947.58
B. Returns						
i) Main Product	25298.03 (39.48)	44790.31 (45.66)	57935.98 (39.96)	36123.33 (44.70)	70844.67 (43.61)	117530.80 (50.53)
ii) By- Product	4354.95	10047.29	13617.98	619.31	839.32	2446.60
Gross Return	**29652.98**	**54837.60**	**71553.96**	**36742.64**	**71683.99**	**119977.40**
C. Return Over						
i) Return over A2	17143.53	38193.34	46685.6	18775.28	50092.58	84794.48
ii) Return over C2*	5127.19	11830.84	10020.53	4704.39	20966.35	41029.82
B:C Ratio	**1.21**	**1.27**	**1.16**	**1.15**	**1.41**	**1.52**
Particulars	**Gram**			**Bajra**		
A. Costs	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
i) A1	3316.57	4528.29	11467.73	3345.59	6989.17	13943.54
ii) A2	3316.57	4528.29	11467.73	3484.55	6989.17	13943.54
iii) A2 + FL	5157.69	7530.18	17993.23	6414.81	13131.37	26208.19
iv) C2*	9025.90	13386.15	32706.69	9325.70	21735.51	37615.55
B. Returns						
i) Main Product	9336.69 (6.09)	11807.59 (4.22)	38159.07 (9.17)	5770.43 (10.88)	14914.24 (16.95)	20109.02 (17.71)
ii) By- Product	968.18	1830.85	2853.14	1528.96	5843.41	8751.52
Gross Return	**10304.87**	**13638.44**	**41012.21**	**7299.39**	**20757.65**	**28860.54**
C. Return Over						

i) Return over A2	6988.3	9110.15	29544.48	3814.84	13768.48	14917
ii) Return over C2*	1278.97	252.29	8305.52	-2026.31	-977.86	-8755.01
B:C Ratio	**1.14**	**1.02**	**1.25**	**0.78**	**0.96**	**0.77**
Particulars	**Rapeseed & Mustard**			**Cotton**		
A. Costs	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
i) A1	6858.59	10800.14	17763.73	11060.09	20879.78	29842.78
ii) A2	6858.59	10800.14	17763.73	11060.09	20879.78	29842.78
iii) A2 + FL	9393.36	16573.39	24941.42	17571.13	31895.29	45095.36
iv) C2*	15943.08	31449.78	48054.79	27288.54	48920.33	64904.91
B. Returns						
i) Main Product	18476.18 (11.52)	38762.70 (17.69)	46106.38 (14.79)	32923.17 (18.04)	57762.04 (19.65)	43982.54 (10.65)
ii) By- Product	804.67	4576.21	4667.88	752.00	1810.28	3295.50
Gross Return	**19280.85**	**43338.91**	**50774.26**	**33675.17**	**59572.32**	**47278.04**
C. Return Over						
i) Return over A2	12422.26	32538.77	33010.53	22615.08	38692.54	17435.26
ii) Return over C2*	3337.77	11889.13	2719.47	6386.63	10651.99	-17626.9
B:C Ratio	**1.21**	**1.38**	**1.06**	**1.23**	**1.22**	**0.73**

Figures in parenthesis are quantity of main product in qtls. Contd.....

Table 16: Cost of cultivation and returns of various crops: 2004-2015

(Rs. /h)

Particulars	**Sugarcane**		
A. Costs	**2004-05**	**2009-10**	**2013-14**
i) A1	16539.97	29765.88	50877.09
ii) A2	16539.97	29765.88	50877.09
iii) A2 + FL	20506.02	36366.67	55447.05
iv) C2*	47566.20	88414.25	113004.60
B. Returns			
i) Main Production	72697.12 (649.33)	174454.60 (644.49)	162946.80 (549.09)
ii) By- Product	3465.36	3459.18	6214.22
Gross Return	**76162.48**	**177913.78**	**169161.02**
C. Return Over			
i) Return over A2	59622.51	148147.9	118283.9
ii) Return over C2*	28596.28	89499.53	56156.42
B:C Ratio	**1.60**	**2.01**	**1.50**

Figures in parenthesis are quantity of main product in qtls.

It is clearly evident from the table 15 & 16 that cost of cultivation of all the seven selected crops i.e. Wheat, Paddy, Gram, Bajra, Rapeseed & Mustard, Cotton as well as Sugarcane has showed increasing trend over the years. The cost of cultivation is defined in terms of A1, A2, A2 + FL (family labour) and C2*.

A1: indicates all actual expenses in cash and kind.

A2: indicates all actual expenses in cash and kind+ Rent paid for leased in land

A2+FL: includes all actual expenses in cash and kind+ Rent paid for leased in land+ imputed value of family labour

C2*: includes A2+ FL along with interest on owned capital assets and rental value of owned land.

The costs A2, A2+ FL and C2* are higher than cost A1 due to inclusion of various other costs. The yield pattern of main product of all selected crops showed fluctuating trend over the years due to biotic and abiotic stresses.

However, the increase in gross returns was higher during the period 2004-05 to 2009-10 as compared to increase in period 2009-10 to 2014-15. This was due to gradual changes in costs of human labour, machine labour, material cost as well as irrigation charges got almost doubled during the study period. The gross returns in case of wheat increased from Rs. 29000 to 71000, paddy from Rs. 36000 to 120000, gram from Rs. 10000 to 41000, bajra from Rs. 7000 to 28000, rapeseed & mustard from Rs. 19000 to 50000 and sugarcane from Rs. 76000 to 169000.

The gross returns of the entire crops showed increasing trend except cotton. The gross returns in case of cotton declined in year 2014-15 from Rs. 59000 to Rs. 47000 due to severe infestation of insect-pests as well as increased use of plant protection chemicals. The gross return over cost A2+ FL ranged between Rs. 14000-37900 for wheat, Rs. 15200-73900 for paddy, Rs. 5100-23200 for gram, Rs. 800-7600 for bajra, Rs. 9800-25800 for mustard, Rs. 16100-27600 for cotton and Rs. 45000-113000 for sugarcane during the study period.

The return over cost C2 was computed by taking in to account all expenses incurred by the farmer in raising the crops. The net returns (gross returns-cost C2) also indicated the increasing trend except bajra. Return over cost C2 was found negative in 2014-15.

Similar trend was noticed in case of return over cost A2 and costA2+ FL during the study period. However B: C ratio of all crops except bajra showed fluctuating trend over the years due to gradual changes occurred in returns of the selected crops, while, it was negative in bajra crop.

Table 17: Cost of production and MSP of various crops: 2004-2015

(Rs. /quintal)

Particulars	**Wheat**			**Paddy**		
Cost of Production	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
A2	269.83	332.45	503.37	399.17	488.95	677.44
A2 + FL	340.15	472.72	723.11	479.09	639.78	892.16
C2	529.99	858.73	1245.42	704.69	1149.75	1531.08
MSP	**640**	**1100**	**1450**	**590**	**1030**	**1400**
% age of A2 to MSP	42.16	30.22	34.72	67.66	47.47	48.39
% age of A2+FL to MSP	53.15	42.97	49.87	81.20	62.11	63.73
% age of C2 to MSP	82.81	78.07	85.89	119.44	111.63	109.36
Particulars	**Gram**			**Bajra**		
Cost of Production	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
A2	496.90	1100.59	1184.61	248.13	298.44	533.06
A2 + FL	799.22	1811.94	1896.22	517.46	660.81	1225.59
C2	1342.75	2738.17	3313.40	675.02	921.17	1487.42
MSP	**1425**	**1760**	**3175**	**515**	**840**	**1250**
% age of A2 to MSP	34.87	62.53	37.31	48.18	35.53	42.64
% age of A2+FL to MSP	56.09	102.95	59.72	100.48	78.67	98.05
% age of C2 to MSP	94.23	155.58	104.36	131.07	109.66	118.99
Particulars	**Rapeseed & Mustard**			**Cotton**		
Cost of Production	**2004-05**	**2009-10**	**2014-15**	**2004-05**	**2009-10**	**2014-15**
A2	572.97	536.64	1104.32	599.39	1030.31	2572.71
A2 + FL	993.00	863.00	1589.62	960.31	1582.46	3978.48
C2	1326.11	1590.79	2953.06	1478.86	2413.61	5573.05
MSP	**1700**	**1830**	**3100**	**1760**	**2500**	**3750**
% age of A2 to MSP	33.70	29.32	35.62	34.06	41.21	68.61
% age of A2+FL to MSP	58.41	47.16	51.28	54.56	63.30	106.09
% age of C2 to MSP	78.01	86.93	95.26	84.03	96.54	148.61

Particulars	**Sugarcane**		
Cost of Production	**2004-05**	**2009-10**	**2013-14**
A2	24.34	44.89	89.27
A2 + FL	30.47	55.13	97.59
C2	69.91	134.49	198.23
MSP *	**74.50**	**139.12**	**220.00**
% age of A2 to MSP	32.67	32.27	40.58
% age of A2+FL to MSP	40.90	39.63	44.36
% age of C2 to MSP	93.84	96.67	90.10

*Price announced by State Govt.

- MSP (Minimum Support Price) announced by the government in different year showed increasing trend in study period (2004-05 to 2014-15). The increase in MSP worked out was (126, 137, 122, 142, 82, 113 and 195) per cent for wheat, paddy, gram, bajra, rapeseed &mustard, cotton and sugarcane, respectively.

- Cost of production per quintal of all the crops also increased throughout the study period. Cost of production of all selected crops was increased by (135, 117, 146, 120, 122, 277 and 183) percent in wheat, paddy, gram, bajra, rapeseed &mustard, cotton and sugarcane respectively.

- Highest increase in cost of production was in case of cotton was recorded due to use of Bt. cotton seed, picking charges increased in the recent years. Highest increase in MSP was in case of Sugarcane over the years in the study period.

Resource use efficiency in crops

Table 18: Resource use efficiency in various crops (2004-05 to2014-15)

Crops		Human labour	Animal labour	Machine labour	Material cost	Irrigation	R2
Wheat	Coefficient	0.748	0.021	0.283	-0.502	0.084	0.91
	t-value	1.757	0.402	0.338	-0.707	0.170	
	D-value	21.32	16.92	42.37	-23.31	68.03	
	Efficiency	under utilized	under utilized	under utilized	Over utilized	under utilized	
	MVP	4.69	5.91	2.36	-4.29	1.47	
Cotton	Coefficient	1.105	-0.045	-0.610	0.352	-0.275	0.87
	t-value	1.496	-0.192	-1.326	0.377	-0.736	
	D-value	83.33	-123.46	-26.11	111.11	-50.76	
	Efficiency	under utilized	Over utilized	Over utilized	under utilized	Over utilized	
	MVP	1.20	-0.81	-3.83	0.90	-1.97	
Gram	Coefficient	0.282	-0.080	0.181	0.514	0.016	0.93
	t-value	1.420	-0.545	0.198	1.283	0.375	
	D-value	90.91	-9.74	70.92	15.02	23.36	
	Efficiency	under utilized	Over utilized	under utilized	under utilized	under utilized	
	MVP	1.10	-10.27	1.41	6.66	4.28	
Mustard	Coefficient	1.600	-0.169	-1.981	0.676	-0.362	0.79
	t-value	1.783	-0.622	-1.269	0.898	-0.666	
	D-value	10.42	-2.92	-5.16	10.08	-13.42	
	Efficiency	under utilized	Over utilized	Over utilized	under utilized	Over utilized	
	MVP	9.60	-34.23	-19.37	9.92	-7.45	
Bajra	Coefficient	1.118	0.081	-0.425	0.200	0.019	0.92
	t-value	1.254	0.580	-0.413	0.301	0.159	
	D-value	48.54	31.35	-49.50	48.31	158.73	

	Efficiency	under utilized	under utilized	Over utilized	under utilized	under utilized	
	MVP	2.06	3.19	-2.02	2.07	0.63	
Sugarcane	**Coefficient**	0.783	-0.031	-0.163	0.172	0.371	0.92
	t-value	1.820	-0.705	-0.642	0.445	0.670	
	D-value	22.42	-0.90	-9.12	38.31	5.39	
	Efficiency	under utilized	Over utilized	Over utilized	under utilized	under utilized	
	MVP	4.46	-110.99	-10.96	2.61	18.57	
Paddy	**Coefficient**	0.874	-0.068	-0.296	1.093	-0.564	0.87
	t-value	2.254	-0.524	-0.290	1.023	-0.831	
	D-value	21.55	-1.90	-18.28	7.67	-4.40	
	Efficiency	under utilized	Over utilized	Over utilized	under utilized	Over utilized	
	MVP	4.64	-52.51	-5.47	13.03	-22.71	

D= Absolute value of percentage change in MVP of each resource

Material cost = Value of seed, Fertilizer & manures and Plant protection chemicals

The Coefficient of Multiple Determination (R^2) indicates the contribution in dependant variable explained jointly by the independent variables. The results were of paramount importance as they provide readily the information relating to probable effects of resource use on the crop output /gross return. The results in table 18 clearly indicate that all given resource variables are highly responsive which ranged from 87 to 93 per cent in all the crops. However, machine labour and material costs contributed largely and found significant for gross returns of all the selected crops.

Farm Harvest Price and Minimum Support Price

Farm Harvest Price (FHP) and MSP of all crops showed increasing trends over the years. It is clear from the table 19 and 19Athat FHP of all the crops was either equal or on higher side from the MSP as announced by the government during study period. In exceptional years, the FHP of some crops like paddy, bajra, rapeseed and mustard was lower than the MSP.

Table 19: Trends in farm harvest price and minimum support price of crops: 2004-2015 **(Rs. /quintal)**

Years	FHP of Wheat	MSP of Wheat	FHP of Paddy	MSP of Paddy	FHP of Bajra	MSP of Bajra
2004-05	640.00 (100.00)	640	584.71 (99.10)	590	529.23 (102.76)	515
2005-06	756.91 (116.45)	650	613.19 (102.20)	600	604.94 (115.23)	525
2006-07	856.07 (114.14)	750	644.65 (105.68)	610	667.31 (123.58)	540
2007-08	1000.00 (100.00)	1000	716.14 (106.09)	675	689.62 (114.94)	600
2008-09	1081.89 (100.18)	1080	907.56 (103.13)	880	802.92 (95.59)	840
2009-10	1100.00 (100.00)	1100	963.67 (93.56)	1030	860.80 (102.48)	840
2010-11	1173.76 (104.80)	1120	1056.57 (102.58)	1030	891.79 (101.34)	880
2011-12	1289.50 (100.35)	1285	1280.00 (115.32)	1110	986.88 (100.70)	980
2012-13	1436.00 (112.19)	1280	1350.00 (100.00)	1350	1220.15 (103.84)	1175
2013-14	1533.06 (113.98)	1345	1430.00 (102.14)	1400	1305.00 (104.40)	1250
2014-15	1565.00 (111.79)	1400	1486.49 (102.52)	1450	1352.78 (108.22)	1250
2015-16	1570.00 (108.28)	1450	1533.94 (100.59)	1525	1354.09 (106.20)	1275
2016-17	1620.13 (107.29)	1510	1626.39 (100.09)	1625	1365.56 (102.67)	1330

Figures in parenthesis indicates the percentage of FHP to MSP

The government should ensure the procurement of the crops at MSP in such situation. Highest difference in MSP and FHP was recorded in case of cotton due to the commercial crop and its industrial demand.

In case of gram & mustard, FHP remained higher due to shortage occurred due to mismatch of demand & supply.

Table 19 A: Trends in farm harvest price and minimum support price of crops: 2004-2015 **(Rs. /quintal)**

Years	FHP of Gram	MSP of Gram	FHP of Rapeseed & Mustard	MSP of Rapeseed & Mustard	FHP of Cotton	MSP of Cotton
2004-05	1533.38 (107.61)	1425	1601.62 (94.21)	1700	1697.73 (96.46)	1760
2005-06	2191.68 (152.73)	1435	1634.53 (95.31)	1715	1873.96 (106.48)	1760
2006-07	2186.79 (151.33)	1445	1771.72 (103.31)	1715	1915.27 (108.21)	1770
2007-08	2645.65 (165.35)	1600	2380.58 (132.25)	1800	2327.68 (129.32)	1800
2008-09	2310.83 (133.57)	1730	2365.80 (129.28)	1830	3155.50 (126.22)	2500
2009-10	2321.63 (131.91)	1760	2341.00 (127.92)	1830	3188.57 (127.54)	2500
2010-11	2940.00 (140.00)	2100	2463.71 (133.17)	1850	5022.50 (200.90)	2500
2011-12	3915.50 (139.84)	2800	3489.43 (139.58)	2500	5311.90 (189.71)	2800
2012-13	3739.02 (124.63)	3000	3416.19 (113.87)	3000	5337.50 (148.26)	3600
2013-14	3506.15 (113.10)	3100	3437.50 (112.70)	3050	5229.17 (141.33)	3700
2014-15	4069.44 (128.17)	3175	3511.21 (113.26)	3100	4546.22 (121.23)	3750
2015-16	4072.83 (118.91)	3425	3523.72 (105.19)	3350	4557.58 (119.94)	3800
2016-17	4807.87 (120.20)	4000	3501.25 (94.63)	3700	4092.01 (106.01)	3860

Figures in parenthesis Shows the percentage of FHP to MSP

Tangible conclusions:

It was concluded from the study that cost of cultivation as well as cost of production of all principal crops in the state increased considerably. Major factors contributing to gross returns are human labour, animal labour, machine labour, material cost and irrigation. Minimum support price remain closer to farm harvest price (FHP) of all crops except cotton in some years was due to change in demand of cotton leading changes in prices. Whereas, bajra showed negative trend in return over cost C2 throughout the study period indicting all expenses incurred by farmers in raising the crops were not recovered. The continuous increase in cost of cultivation of gram exhibited as results of increased use of improved seeds, chemical fertilizers and higher prices of inputs over the period even with slight increase in productivity. The gram is cultivated mainly on rain fed area and its productivity is fluctuated due to erratic rainfall.

ICAR funded

i	**Experiment No. 3: 3615/ C(b) Ag. Econ-1-ICAR–NIAP Resource-Use Planning for Sustainable Agriculture**	
ii	**Year of start**	**2017-18 and continue up to 2019-20**
Iii	**Objectives of the experiment**	• To assess resource endowment and crop suitability matrix for different agro-climatic conditions • To identify zone specific constraints, potentials and interventions to optimize resource use and income enhancement • To develop optimum crop plans under various agro-climatic conditions • To identify technological, institutional and policy interventions for sustainable improvement in farm income and resource use
iv	**Name(s) of the investigators**	• Dr. D.P. Malik Principal Investigator Planning , monitoring and execution • Dr. D.K. Bishnoi, Co-PI Preparation of schedule, compilation of data preparation of progress report. Dr. J.K. Bhatia, compilation of data and preparation of progress report. • Dr. Neeraj Pawar, CCPI for eastern zone, Dr. Ashok Dhillon, Dr. Nirmal Kumar CCPIs for western zones Collection, compilation and analysis of data • Dr. Nitin Bhardwaj CCPI Tabulation and analysis of data
v	**Name(s) of the collaborator(s) with activity profile**	• Nil
vi	**Treatment details**	• **Locale of experiment:** Haryana • Data will be collected for districts of each i.e. eastern and western zone. • **Statistical design/methods**: The statistics, input-output matrix, Linear programming etc. will be used.
vii	**Observation recorded**	• Data related to resource endowment and status of infrastructure created for agriculture sector were collected • Data on various economic aspects of prevalent cropping patterns as well as new interventions for crop productivity enhancement will be collected at different time intervals.

Budget for the year 2017-18 (head wise sanction and expenditure details)

(in Rs.)

Sr. No.	SOE	Allotment	Expenditure	Balance
1	Pay	2,20,000	0	2,20,000
2	M&S	1,00,000	99,522	478
3	T.A.	1,00,000	37,609	62,391
4	OE (others)	50,000	49,570	430
5	POL	50,000	5402	44,598
6	Institutional charges	42,000	42,000	0
Total		**5,62,000**	**2,34,103**	**3,27,897**

viii. Results achieved during 2017-18

The work of project was initiated in January 2018 and the progress of the project is as follows:

- Appointment of senior research fellows in month of February ,2018
- Secondary data related to resource endowment was submitted to funding agency
- Collection of data related to various economic parameters as communicated by funding agency is in progress
- Primary data related to technological intervention i.e. micro-irrigation (Sprinkler irrigation) is in progress from Mahendergarh district.

ix. Programme of work for 2018-19: Continued

11. New Experiments planned for the 2018-19

i	**Experiment No. 1: Prospects of summer mung bean cultivation in Haryana**	
ii	**Objectives of the experiment**	• To examine the status and potential of summer mungbean cultivation • To work out profitability of summer moongbean cultivation • To examine resource use efficiency in summer mungbean cultivation • To ascertain the perception of farmers regarding cultivation of summer mungbean
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring planning and finalization of interview schedule • Dr. Dalip Kumar Bishnoi, Report writing • Dr. Neeraj Pawar, Collection, compilation and analysis of data of Panipat and Kurukshetra district • Dr. Nirmal Kumar Collection, compilation and analysis of data of Hisar and Fatehabad districts
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :**Panipat and Kurukshetra from eastern zone and Hisar and Fatehabad from western zone of the state. • **Number and type of respondents** : Twenty farmers from each selected district • **Statistical design/methods:** The statistics like mean, percentage will be used
vii	**Observation to be recorded**	• Information related to area, production and productivity from state department of agriculture will be collected • 20 farmers of each selected district will be surveyed. • Information related resources use and output and their prices will be collected from selected farmers • Perception of farmers about cultivation of summer mungbean cultivation will be recorded.

i	**Experiment No. 2: Economic analysis of castor cultivation in semi-arid zone of Haryana**	
ii	**Objectives of the experiment**	• To work out the profitability of castor cultivation • To analyze the contribution of various resources in castor cultivation • To study the constraints in cultivation of castor
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring planning and finalization of interview schedule • Dr. K. K. Kundu, Report writing • Dr. Neeraj Pawar, Collection, compilation and analysis of data of Rewari district • Dr. Nirmal Kumar Collection, compilation and analysis of data of Hisar and Sirsa districts
iv	**Name(s) of the collaborator(s) with activity profile**	**Nil**
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :** Sirsa, Hisar and Rewari • **Statistical design/methods:** The statistics like mean, percentage etc. will be used
vii	**Observation to be recorded**	• Information related to area, production and productivity from published sources • Fifteen (15) farmers from each selected district will be surveyed. • Information related resources use and output and their prices will be collected from selected farmers • Farmers will be interacted to record constraints in cultivation of castor.

i	**Experiment No. 3: Climate change vis-à-vis crop productivity in western zone of Haryana**	
ii	**Objectives of the experiment**	• To examine the trends of temperature and rainfall • To work out the impact of climate factors on productivity of major *Kharif* and *Rabi* crops • To identify the implications of climate change on food security
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring planning and finalization of interview schedule • Dr. Dalip Kumar Bishnoi, Report writing • Dr. Nirmal Kumar Collection and Compilation of data form published sources
iv	**Name(s) of the collaborator(s) with activity profile**	Dr. Raj Singh, Professor and Head , deptt. of Agro-meteorology
v	**Year of start**	**2018-19 to 2019-20**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :**Sirsa, Hisar and Rewari from western zone of state • **Statistical design/methods:** The statistics like mean, percentage etc. will be used.
vii	**Observation to be recorded**	• Data related to rainfall, temperature etc will be collected from department of agro-meteorology and other institutions • Data on area, production and productivity crops will be recorded from published sources. • Crops like paddy, wheat, mustard, pearl millet etc. will be covered under proposed study

i	**Experiment No. 4: Structural changes and growth in agriculture in Haryana**	
ii	**Objectives of the experiment**	• To analyze the structural changes in the economy of Haryana • To examine the diversion in cropping pattern over the years • To examine the growth in production and productivity of crops • To identify the major factors contributing for growth of agriculture
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring planning and finalization of Data • Dr. Jitender Kumar Bhatia, Report writing • Dr. Nitin Bhardwaj, Compilation and Analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	**Nil**
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
vii	**Observation to be recorded**	• Sectoral contribution in GDP, No. of farm holdings, land use pattern, crop wise, area coverage, productivity & production of various crops • Information related to fertilizer/nutrient use, farm machinery & implements, irrigation sources, status of marketing facilities, credit availability

i	**Experiment 5**: Impact assessment of sprinkler irrigation on crop productivity in southern zone of Haryana	
ii	Objectives of the experiment	• To work out the economics of sprinkler irrigation system. • To examine the resource use efficiency of sprinkler irrigation system. • To identify the constraints in adoption of sprinkler irrigation system.
iii	Name(s) of the investigators	• **Investigator:** Vinay Mehala – Planning, Preparation of Schedule and Report writing • **Investigator:** Neeraj Panwar - Data Collection and Report writing • **Investigator:** Monika Devi – Tabulation and Analysis of Data
iv	Name(s) of the collaborator(s) with activity profile	Nill
v	Year of start	2018-19
vi	Treatment details	• Locale of experiment: Haryana • District covered: Bhiwani and Mahendergarh from southern zone of the state • Blocks and Villages: Two blocks will be randomly selected from each district and from each selected block one village will be selected randomly • Number and type of respondents: Thirty farmers from each selected district • Statistical design/ methods: The statistical tools like mean, percentage will be used
vii	Observation to be recorded	• Sixty farmers will be interviewed to work out the economics of sprinkler irrigation. • Information related to input use i.e. irrigation, frequency of fertilizers, agro-chemicals from 60 farmers of both district. • Farmers will be interviewed to collect information for identifying the constraints in adoption of sprinkler irrigation system.

i	**Experiment 6**: Gap analysis of MSP and harvest price of principal crops in Hisar district of Haryana state	
ii	Objectives of the experiment	• To examine the trends in harvest prices of major agricultural commodities • To analyze the gap in market price and MSP • To identify the constraints faced in getting MSP.
iii	Name(s) of the investigators	• **Investigator:** Vinay Mehala - Preparation of Schedule, Data collection and Report writing • **Investigator:** V. P. Mehta - Planning, Report writing • **Investigator:** Monika Devi – Tabulation and Analysis of Data
iv	Name(s) of the collaborator(s) with activity profile	Nill
v	Year of start	2018-19
vi	Treatment details	• Locale of experiment: Haryana • Crops: Paddy, Bajra, Wheat, Mustard, Cotton and Gram • Area covered: Grain Market of Hisar district. • Number and type of respondents: Thirty farmers and Thirty market intermediaries. • Statistical design/ methods: The statistical tools like mean, percentage will be used.
vii	Observation to be recorded	• Identification of gap in harvest prices and MSP of principal crops will be collect for the period of 1997 to 2017. • Farmers and market intermediaries will be interviewed to collect information for identifying the constraints in getting MSP.

i	**Experiment 7**: Measurement of Variability and Factors affecting Agricultural Production of Principal Crops of Haryana.	
ii	Objectives of the experiment	• To examine the trends in area, production and productivity of principal crops of Haryana. • To study the variability in area, production and productivity of principal crops. • To analyze the factors affecting agricultural production of Principal crops.
iii	Name(s) of the Investigator	• **Investigator:** Monika Devi – Compilation and Analysis of Data • **Investigator:** V. P. Mehta – Planning and Report writing • **Investigator:** Vinay Mehala - Data collection and Report writing
iv	Name(s) of the collaborator(s) with activity profile	Nil
v	Year of start	2018-19
vi	Treatment details	• Locale of experiment: Haryana • Crops: Wheat, Gram, Paddy and Cotton • Period: 1980-2017
vii	Observations to be recorded	• The present study will be based on secondary data. • Data of area, production and productivity for the selected crops will be collected. • Further, the data of total cropped area, fertilizer consumption, gross irrigated area, average rainfall and other major factors as per the availability of related data will also be collected.
viii	Statistical Design/Methods	• To achieve the above objectives, Descriptive statistics, Coefficient of Variation, Coefficient of Determination and Multiple Linear Regression and some other suitable statistical techniques subject to need of study will be used.

i	**Experiment 8**: An Application of Principal Component Analysis to Measure the Effect of Weather Variables on Cotton Yield.	
ii	Objectives of the experiment	• To examine the yield trends of Cotton crop over the years in Hisar District. • To study the variability in area, production and productivity of Cotton. • Selection of weather variables based on principal component analysis.
iii	Name(s) of the Investigator	• **Investigator:** Monika Devi - Planning, Analysis of Data and Report writing • **Investigator:** Vinay Mehala - Monitoring, Data collection and Report writing
iv	Name(s) of the collaborator(s) with activity profile	Nil
v	Year of start	2018-19
vi	Treatment details	• Locale of experiment: Hisar • Crops: Cotton • Period: 1980-2017
vi	Observations to be recorded	• The present study will be based on secondary data. • Time series data of crop yield will be collected. • Further, weather data for same period on five weather variables, viz., Minimum temperature, Maximum Temperature, Rainfall, Relative Humidity, Sun-shine hours will be collected.
vii	Statistical Design/Methods	• To achieve the above objectives, Descriptive statistics, Coefficient of Determination, Principal component analysis and some other suitable statistical techniques subject to need of study will be used.

Other Agencies

1. **Scheme No:** 3066-C(c) Econ.-I.(CS)

Title -: "Comprehensive Scheme studying the Cost of Cultivation of Principal Crops in India-Haryana**"** (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, Govt. of India)

2. **Year of start**: :1970

3. **Location** : Haryana

4. **Objectives of scheme**: To provide representative and quality data on cost of Cultivation of principal crops in Haryana. The detailed objectives are as under:

- To facilitate data entry at Tehsil / Village level, making the process of data collection, validation and compilation efficient through ICT enabled Web based System.

- To facilitate processing of data and generation of query based report at Central level.

- To monitor the functioning of field–men, field supervisors and Field Officers at different levels through workflow based system

- To scrutinize and validate the data entered by Field-men at the level of field supervisor and field officer through the envisaged workflow based system.

- To reduce the time lag in reporting of data

5. **Any need to modify the objective as per need of the state**: Nil

6. Budget for the year 2017-18 (head wise sanction and expenditure details)

(Rs.)

Sr. No.	SOE	Allotment	Expenditure	Balance
1	PAY	13380000	13165374	214626
2	ADA	7023000	6952300	70700
3	GPF	1900000	1893397	6603
4	TA	800000	472411	327589
5	Gratuity	1949000	1948434	566
6	Medical	200000	194829	5171
7	LTC	403000	402667	333
8	O.E. (NR)	300000	0	300000
9	PSS	752000	750526	1474
10	Other charges	148000	147084	916
	TOTAL	**26855000**	**25927022**	**927978**

7. Salient Achievements during 2017-18

- The cost of cultivation data of nine important crops of Haryana state namely, Paddy, Cotton, Pearl millet, Sugarcane, Wheat, Gram and Rapeseed & Mustard, Summer moong and Onion was collected from 30 Centres /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method.

- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

- The data entries in old and new FARMAP2.0 software for the Rabi and Kharif seasons for the year 2016-17 have been submitted in December 2017 to the Ministry of Agriculture and Farmer's Welfare. The data will be used for further analysis and result of which will be used by the Commission for Agricultural Costs and Prices (CACP) for fixing the minimum support prices of *Kharif* and *Rabi* crops at national level.

- The online data entries in new software (FARMAP 2.0) as per instruction of funding agency for the *Rabi* and *Kharif* seasons for the year 2016-17 has been submitted in June 2018.

- The online data entries in new software (FARMAP2.0) for Kharif season of year 2017-18 have been completed at the level of field men and field supervisors.

- Three-computer training about online data entries in new software was imparted Agriculture inspectors/field men at Regional Research Centre, Uchani. RRS, Bawal and Department of Agricultural Economics, COA, CCSHAU, Hisar during 2017-18.

- One computer training about FARMAP2.0 software was organised for field men/ AIs in December 2017 for the orientation of new software at Directorate of Human Resource Management CCSHAU Hisar.

- The work of data entry operators, progress of online data etc. in computer lab of cost of cultivation scheme was closely monitored to ensure timely submission of data to funding agency.

- Meetings of AIs/ field men were organized by supervisors during 2017-18 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items, keeping daily operation record etc.

- For *Rabi* season 2017-18 the online data entries is in progress by field men and will be completed 15thJuly, 2018.

- The scientists/supervisors supervised the work of AIs/ field men, cross checked the information by visiting clusters and interaction with farmers.

- The discrepancies in data as reported by funding agency were rechecked, corrected and re-submitted again well in time.

8. **Justification for continuation of scheme**:

The scheme was started in 1970 with an objective to collect quality data from farmers for various kharif and rabi crops in each season of every year to provide basis for fixation of MSP at national Level. The scheme is to be continued taking into consideration-increased use of purchased inputs, mechanisation of farm operations etc. to work out cost of cultivation to provide remunerative price to farmers for sustainability of agriculture in country.

9. **Constraints, if any** **:** Shortage of Agriculture Inspectors

10. **Cluster allocation:**

Name of Scientist	Name of cluster allotted
Dr. V. P. Luhach	All 30 cluster selected under scheme
Dr. R. S. Pannu	Bana Barahman, Kurali, Jalbera, Samani, Babarpur, Saraisukhi, Majri, Rattangarh, Teek, &Teontha
Dr. NeerajPawar	Kasoli, Raipur, Surana, Sasroli, Godhri, Gwalison, Sidhrawali, Madnaka, Khubru&Kulta.
Dr. Nirmal Kumar	Dang Kalan, Sampal, Dahima, Bajeka, Petwar, Dariyapur, Sultanpur, Jamalpur, Bibipur & Bilawal

11. New experiment planned for the year 2018-19

i	**Experiment No:1**	Studying the Cost of Cultivation of kharif crops in Haryana
ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Dr. V.P. Luhach** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nitin Bhardwaj** Validation, rectification, RT wise check list, correction in online data
iv	**Name s of Collaborators with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	**Locale of experiment: Haryana**
vii	**Observation to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/filed officer

i	**Experiment No: 2**	Studying the Cost of Cultivation of rabi crops in Haryana
ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Dr. V.P. Luhach** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nitin Bhardwaj** Validation, rectification, RT wise check list, correction in online data
iv	**Name s of Collaborators with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	**Locale of experiment: Haryana**
vii	**Observation to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/filed officer

LIST OF PG STUDENTS OF DEPARTMENT

S. No.	Name of student	Adm. No.	Research Title	Major advisor
Ph.D. students				
1.	Veer Sain	2013A1D	Market Information System and its application for agricultural commodities in Haryana	Dr. K.K.Kundu
2.	Sumit	2014A1D	An Economic analysis of Bee-keeping: Production and Marketing of Honey in Haryana	Dr.R.S.Chauhan
3.	Sadhanala	2015A2D	Dynamics of major oil seeds and pulses in India under future aspects	Dr. V.P.Mehta
4.	Kavita	2015A3D	An analytical study on Impact of WTO on Agricultural Trade in India	Dr. V.P.Mehta
5.	Raj Kumar	2015A4D	Estimation of Effective Demand and Economic analysis of fruit and vegetable crops in Haryana	Dr. A.K. Rathee
6.	Parveen Kumar	2015A5D	Economic analysis of vegetable cultivation under protected structures in Haryana	Dr.R.S.Chauhan
7.	Meenu Punia	2015A6D	Agricultural Insurance in India vis-à-vis in Haryana Problems and Prospects	Dr. K.K.Kundu
8.	Swamy, H.	2016A1D	Spatial and Temporal Crop Diversification in India and their consequences on Agriculture	Dr. U.K.Sharma
9.	Sunita	2016A2D	A study to develop optimum combination of farm enterprises in Haryana	Dr. V.P.Mehta
10.	Sanjay	2016A3D	An empirical analysis of agriculture credit system in Haryana.	Dr.R.S.Pannu
11.	Heena	2016A4D	An economic analysis of organic farming vis-à-vis inorganic farming in Haryana.	Dr.D.P.Malik
12.	Manohar,V.	2017A4D	Yet to be finalized	Dr. D.P.Malik
13.	Navneet Singh	2017A5D	Yet to be finalized	Dr. V.P.Mehta
14.	D. Pal Singh	2017A6D	Yet to be finalized	Dr.K.K.Kundu
M.Sc. students				
1.	Mrityunjay Pandey	2014A1M	Estimation of demand for NPK use in Haryana	Dr. U.K.Sharma
2.	Neelam Kumari	2016A2M	Role of Haryana State in food security of India	Dr. V.P.Mehta
3.	Sonu Ram	2016A04M	Economic analysis of production and marketing of Baby corn in Sonipat district of Haryana	Dr. Parminder Singh
4.	K. Archana	2015A1M	Dynamics of Production and Marketing of BT Cotton in Haryana vis-à-vis T. Nadu	Dr. K.K.Kundu
5.	BidyutKalita	2015A2M	An Economic analysis of Production and Marketing of Straw berry in Hisar district of Haryana.	Dr. R K Grover
6.	Abhijeet	2015A3M	An Economic Analysis of Prevailing Vegetable crop rotation in Haryana	Dr.R S.Chouhan
7.	Mohit	2015A4M	Performance and Prospects of Primary Agricultural Credit Societies in Haryana	Dr. V.P.Mehta
8.	Usha	2015A5M	Comparative Economic Analysis of Marketing	Dr. V.P.Luhach

			and Storage of Onion in Haryana	
9.	Kamal	2015A7M	An Economic analysis of Production and Marketing of Pulses in Haryana.	Dr. J.K. Bhatia
10.	Ashu	2015A8M	An Economic analysis of Potato Seed Production under Contract Farming in Haryana	Dr. Dalip Kumar Bishnoi
11.	Mahesh, V.	2016A1M	Market integration and price volatility of cotton in Haryana	Dr. R.K.Grover
12.	Sachin Kumar	2016A5M	Economic analysis of production and marketing of spices in Haryana	Dr. Gurnam Singh
13.	MousumiPriyadarshini	2017A01M	Impact study of mission for integrated development of horticulture in Haryana vis-à-vis Odisha	Dr. K.K. Kundu
14.	Ali Rezaei	2017A02M	Planting Methods of Paddy Cultivation in Haryana – A comparative economic analysis.	Dr.D.K.Bishnoi
15.	Abdul Qasim	2017A03M	Dynamics of export and import of major agricultural commodities in India.	Dr. V.P. Mehta
16.	Vivek Garg	2017A04M	Economics of Production and Marketing of Castor in Haryana	Dr. K.K. Kundu
17.	Pardeep Kamboj	2017A05M	Economics analysis of Production and export of basmati rice in Haryana	Dr. Gurnam Singh
18.	Ritu	2017A06M	Impact of Agricultural Price Policy on Major Food Crops in Haryana	Dr. V.P. Mehta
19.	Ajay Singh	2017A07M	Economic analysis of establishment techniques of wheat in Haryana	Dr. A.K. Rathee
20.	Sandeep Kumar	2017A08M	Impact of Agricultural Price Policy on Oilseed and Pulse crop in Haryana.	Dr. V.P. Luhach
21.	Nisha	2017A09M	An economic analysis of sugarcane cultivation in Haryana	Dr. D.P. Malik
22.	Naveen	2017A10M	Economic analysis of Maize cultivation in Haryana	Dr. R.S. Pannu

D List of Publications: 2017-18

Sr. No.	Details of Research Paper	NAAS Rating
1	Sain, V., Kundu, K.K. and Mehta, V.P. (2017). Dissemination and Utilization of Market Information System by Farmers for Gram Crop in Bhiwani District of Haryana, India. *International Journal of Current Microbiology and Applied Science* 6(4): 58-65.	**5.38**
2	Sain, V., Kundu, K.K., Mehta, V.P. and Bishnoi, D. (2017). Role of Information System in Regulated Markets in Mohindergarh District of Haryana. *Annals of Biology* 8 (33): 145-151.	**4.08**
3	Sain, V., Kundu, K.K., Mehta, V.P. and Bhyan, S. (2017). Market Information System for Basmati Rice in Karnal District of Haryana. *International Journal of Agricultural Sciences* 9(6): 3782-3787.	**4.82**
4	Kumar, N., Duhan, A., Bhatia, J.K. and Malik, V. (2017). "Economic Appraisal of Kinnow Production and its Marketing in Sirsa District of Haryana, India" *International Journal of Current Microbiology and Applied Sci*ences 6(11): 4045-4053.	**5.38**
5	Kavita, Grover, R.K., Kumar, R., and Sumit (2017). Temporal Changes in Prices of Sugar in India, *International Journal of Current Microbiology and Applied Sciences* 6(6): xx-xx.	**5.38**
6	Ashu, Bishnoi, D.K., Bhatia, J.K. and Sheoran, O.P. (2018). An Economic Analysis of Potato Seed Production in Haryana, India. *Indian Journal of Economics and Development* 14(1a): 113-119.	**4.82**
7	Ashu, Bishnoi, D.K., Bhatia, J.K., Baskaur and Sheoran, O.P. (2018). Production and Marketing Challenges of Potato Cultivation in Haryana, India. *International Journal of Current Microbiology and Applied Sciences* 7(3):1349-1355	**5.38**
8	Jakhar, D.S., Kumar, N. and Kumar, S. (2018). Performance of Salt Tolerant Wheat Varieties in Salt affected Soils. *Journal of KrishiVigyan*6(2): 184-186.	**4.41**
9	Choudhary, K.M., Jat, H.S., Nandal, D.P., Bishnoi, D.K., Sutaliya, J.M., Choudhary, M., Singh, Y., Sharma, P.C. and Jat, M.L. (2018). Evaluating Alternatives to Rice-Wheat System in Western Indo-Gangetic Plains: Crop Yields Water, Productivity and Economic Profitability. *Field Crops Research* 218: 1-10	**9.05**
10	Kamal, Bhatia, J.K., Bishnoi, D.K. and Bhardwaj, N. (2018). An Economic Analysis of Pulses Production in Haryana. *Indian Journal of Economics and Development* 14(1a): 120-126.	**4.82**
11	MuhammedJaslam P.K., Deepankar and luhach V.P. (2018). Growth rate analysis of legumes in Haryana state. *International Journal of Agriculture Sciences* 10(10): 6113-6115.	**4.20**
12	Prakash, S., Sarkar, D., Bishnoi, D.K. and Singh, R. (2018). Production and Marketing Challenges of Strawberry Cultivation in Haryana. *Indian Journal of Economics and Development* 14(1a): 223-226.	**4.82**
13	Singh, M., Kumar, R., Luhach, V.P. and Singh V. (2018). Economic Analysis of Guar [Cyamopsistetragonoloba (L.) Taub.] Production and Constraints Involved in Guar Production in Hisar. *Annals of Biology* 34 (1): 103-106.	**4.08**
14	Singh, M., Kumar, R., Luhach, V.P. and Singh, V. (2018). Economic Analysis of Marketing Cost, Margin and Price Spread of Guar [Cyamopsistetragonoloba (L.) Taub.] through Different Marketing Channels in Bhiwani District. *Annals of Agri Bio Research* 23 (1): 44-48.	**3.97**
15	Kumar, S., Satyavan, Bishnoi. D.K., Kumar, N. and Dhillion. A. (2018). Effect of Integrated Nutrient Management on Yield and Yield Attributes and Economics of Wheat (Triticumaestivum L.) under Saline and Non-Saline Irrigation Water. *International Journal of Current Microbiology and Applied Sciences* 7(5):618-628.	**5.38**
16	Kumar, P., Chauhan, R.S., Tanwar, N. and Grover, R.K. (2018).Status and Constraints in Vegetable Cultivation under Polyhouse in Haryana, *Advances in Bioresearch* 9(2): 61-66.	**4.77**
17	Jakhar, D.S., Kumar, N. and Kumar, S. (2018). Performance of Salt Tolerant Wheat Varieties in Salt affected Soils. *Journal of KrishiVigyan*6(2): 184-186.	**4.41**

Book Chapters

- Ashu, Bishnoi, D.K., Sheoran, O.P., Bhatia, J.K., Kumar, R. and Sumit. **(**2018**)**. Contract Farming: A way Forward towards Price Stability in Potato Seed Production. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 279-288.

- Kalita, B., Grover, R.K. and Goyal, S.K. **(**2018**)**. Economic Analysis of Strawberry Production in Hisar District of Haryana. *Agricultural Development Technical and Policy Option.* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 109-118.

- Kumar, A., Pannu, R.S., Singh, H., and Verma, D.K. **(**2018**)**. Potato and Tomato Cultivation in Yamunanangar and Karnal District of Haryana: An Economic Analysis. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 51-62.

- Kumar, K., Bhatia, J.K. and Bishnoi, D.K. **(**2018**)**. Growth and Trend in Area, Production and Productivity of Pulses in Haryana. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 181-186.

- Kumar, R., Bishnoi, D.K., Sumit, Rathee, A.K., Luhach, V.P., Bhatia, J.K. **(**2018**)**. Trends in Area, Production and Productivity of Fruit and Vegetable Crops in Haryana. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 193-198.

- Punia, M., Mehta, V.P., Kumar, P. and Bhatia, J.K. **(**2018**)**. Production and trade performance of tomato export from India. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 1-9.

- Sanjay, Kumar, S., Seidu, M. and Ghiyal, V. **(**2018**)**. Infrastructure and Problems faced by Market Functionaries in Regulated Markets of Haryana. *Agricultural Development Technical and Policy Option* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 397-412.

- Sumit, Chauhan, R.S., Kumar, R. and Bishnoi, D.K. **(**2018**)**. Import and Export Trends of Honey in India. *Agricultural Development Technical and Policy Option.* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 187-192.

- Sunita, Bhatia, J.K. Mehta, V.P. and Bishnoi, D.K. (2018). Crop Diversification in Haryana and Factors affecting it. *Agricultural Development Technical and Policy Option.* (Singh, R., Roy, A.Y.A. and Choudhury, A.). Biotech Books, New Delhi: 99-108.

- D.P.Malik, K.K.Kundu, S.K.Dhanda And Parveen Kumar.(2018)**.**Adoption, Returns and Initiatives for Bt-Cotton Cultivation**.** *Cotton and Other Fibre Crops* (Eds. M. S. Chauhan and R. S.Sangwan), Cotton Research and Development Association, CCS HAU, Hisar:184-193

Papers abstracted/presented in Conferences/Seminars/Symposia/Workshops

- Pawar, N., Mann, S., Sharma, M., Siwach, M.,Kumar. And Kumar, R. (2017). Journey Towards Organic Farming-A Case Study. *Golden Jubilee International Conference on "Gender Issues and Socio Economic Perspective for Sustainable Rural Development",* Oct. 23-25, 2017, CCSHAU, Hisar: 149.

- Malik, DharmPal (2017) Focused approaches for strengthening seed production system to enhance pulses productivity in India. *International Conference on " Advances in grain legume Cultivation and Use" ,* Sept. 27-28 Novi Sad, Serbia,: 76.

- Malik, V.K., Yadav N. K., Jakhar, D., Kumar, D. and Kumar, N. (2018).Efficacy of Cobalt Chloride AgainstParawilt of Bt Cotton. *International congress on "Cotton and Other Fibre Crops",* Feb. 20-23, 2018, ICAR Research Complex for NEH Region, Umiam (Barapani), Megahalaya: 64-65.

- Nimbrayan, P.K., Chauhan, R.S. and Mehta, V.P. (2018). Current Scenario of Polyhouses in Haryana. *International Conference on "Sustainable Agriculture, Energy, Environment and Technology",* Feb. 24-25, 2018, Maharshi Dayanand University, Rohtak, Haryana: A-623.

- Sharma, M., Siwach, M., Pawar, N. and Sharma, U.K. (2018). Declining Sex Ratio-A Battle to be Won. *Golden Jubilee International Conference on "Gender Issues and Socio Economic Perspective for Sustainable Rural Development",* Oct., 23-25, 2017, CCSHAU, Hisar: 26.

Popular Articles

- Jakhar, D.S., Kumar, N. and Kumar, S. (2017). Karbnic (Jaivik) Khado Ki Upyagita. *Haryana Kheti*, 50(9): 2-3.

- Kumar, N., Jakhar, D.S., Malik, V.K. and Dhillon, A.K. (2017). "Kese Kare Kisan Apni Aay Mai Ijafa" *MSC Krishi Jagran,* 22(9): 62-64.

- Jakhar, D.S., Kumar, N. and Kumar, S. (2017). Usar / Banjar Bhumi Ka Sudar. *Kheti Dunia*1(8): 13.

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- Kumar, P., Mehta, V.P. and Bhatia, J.K. (2018). Krishi mai vstu aivm e seva kar ka prabhav. *Haryana Kheti*, 50(1): 21.

- Solanki, Y.S. Pawar, N. and Kumar, R. (2018). Kam lagat mai genhu ka sudh beej kaise tayar kare. *Haryana Kheti,* 51(3): 19.

- Pawar, N., Malik, D.P and Dhillon, A. (2018). Doguni aaye ke liye karishak-samniwant krishi pranali apnaye. *Haryana Kheti*, 51(4): 20.

Radio/TV Talk- Kumar, N. (2017). Kheti mai badta kharch kaise kam ho: 24.05.2017, AIR Rohtak.

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(REVISED)

REVIEW OF RESEARCH SCHEMES (2018-19)

AND

FINALIZATION OF TECHNICAL PROGRAMME (2019-20)

DEPARTMENT OF AGRICULTURAL ECONOMICS

COLLEGE OF AGRICULTURE
CCS HARYANA AGRICULTURAL UNIVERSITY
HISAR - 125 004 (HARYANA)

INDEX

B. Details of Each Research Scheme(s) for Review:

1. Scheme No. : 1202-Dte-R-1-Agri (A)

Title: Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

2. Year of Start : 2002-2003

3. Location : Haryana

4. Objectives of the scheme:

- To analyse the resource use efficiency in Haryana farming.
- To carry out studies into different marketing aspects of major farm inputs and products.
- To study the possible agricultural diversification in different zones of Haryana.

5. Any need to modify the objectives as per the need of the state

- No-

6. Budget for the year 2018-19 (head-wise sanction and expenditure details) (in Rs.)

Sr. No.	Particulars	Allotment	Expenditure	Balance
1	O.E. (NR)	0	0	0
2	LTC	0	0	0
3	TA*	16110	16110	0
4	O.E. (Others)	22320	20855	1465
5	Other Charges*	6750	6750	0
6	M & S*	5850	5850	0
	Total	**51030**	**49565**	**1465**

*Funds surrendered in month of February, 2019

7. Salient Research Findings of the Scheme during 2018-19

Experiment No. 1: Prospects of summer mungbean cultivation in Haryana

- The per hectare net returns from summer mungbean crop in Kurukshetra, Hisar, Panipat and Haryana were estimated to be ₹ 3859.00, ₹ 3073.00, ₹ 4764.00 and ₹ 4071.00 respectively and B:C ratios were found to be 1.09, 1.07, 1.11 and 1.09 respectively.

- MVP of human labour and irrigation to its unit price was found to be positive and significant in Kurukshetra and Hisar districts. Similarly, MVP of human labour and machine labour and its unit price was found to be positive and significant in Panipat and overall basis in Haryana.

- Non-availability of suitable machine for threshing ranked first in Panipat, Kurukshetra, Hisar districts and overall basis with a total score 264, 264, 262 and 790 followed by non-procurement of produce by Govt. agencies with a total score of 242, 242, 244 and 728, respectively. Harvest price less than MSP ranked third on overall basis with a total score of

662 while in Panipat, Kurukshetra and Hisar districts it ranked third, sixth and fourth with a total score 222, 150 and 218, respectively.

Experiment No. 2: Economic analysis of castor cultivation in semi-arid zone of Haryana

- The per hectare net returns from castor crop in Rewari, Sirsa, Hisar and Haryana were estimated to be ₹61324, ₹ 41200, ₹ 44200 and ₹ 46331 respectively and the B:C ratio were found to be 1.64, 1.43, 1.45 and 1.48 respectively.

- The difference between MVP of machine labour, seed, fertilizer, irrigation and its unit price was found to be positive and significant in Rewari district. Similarly in case of Sirsa district machine labour, seed, plant protection and irrigation in Hisar district human labour, seed, fertilizer and irrigation was found to be positive and significant which indicates that these inputs were underutilized in respective districts.

- Most serious production problem *i.e*. F2 seed in the same field over the year was indicated by 93.33, 98.33 and 93.33 per cent of the respondents in Rewari, Sirsa and Hisar respectively and grain scattering during maturity was reported by more than 86 per cent of castor growers in the study area.

- Most serious marketing problem *i.e.* absence of minimum support prices was recorded from 96.67, 93.33 and 93.33 per cent of the respondents in Rewari, Sirsa and Hisar respectively, while low price of produce in open auction sale was shared by more than 88 per cent of castor growers in the state.

Experiment No. 3: Effect of climate change on productivity of major crops in western zone of Haryana

- Average mean temperature were ranged between 30.02 to 30.13 °C with a minimum of (23.69 - 23.72 °C) and maximum of (36.32 to 36.57 °C) during the *Kharif* season in western zone of the state.

- In *Rabi* season, the mean temperature were ranged between 17.78 to 18.68 °C lower than the *Kharif* season mean temperature.

- On average, the western zone of the Haryana state received nearly 320 mm annual rainfall, but mostly during the *Kharif* season in study period of 2006-07 to 2015-16.

- The rise in maximum temperature has positive and significant effect on paddy crop yield whereas, it has significantly negative impact on pearl millet yield but in case of cotton it has negative but non-significant effect on cotton yield.

- In *Rabi* season, rise in maximum temperature has significantly negative effect on wheat crop yield whereas, it has negative but non-significant impact on mustard yield.

- Rainfall coefficient was observed significantly positive impact on productivity of wheat mustard and pearl millet crops. Whereas, it has negative but non-significant effect on the productivity of paddy and cotton crop in the study area.

Experiment No. 4: Structural changes and growth in agriculture in Haryana

- Haryana is self-sufficient in food production and contributing more than 15 per cent to the Central pool and has achieved 180.32 lakh MTs food grain production during 2017-18 registering an increase of more than seven times as compared to 25.92 lakh MTs in 1966-67.

- More than 3/4th of the State has assured irrigation, most suited for rice-wheat production system, whereas, rain fed lands (around 1/5th) are most suited for rapeseed & mustard, pearl millet, cluster bean cultivation, agro-forestry and arid-horticulture.

- The share of Agriculture fell from 60.7 per cent in 1969-70 to 42.5 per cent in 1993-94 in a span of 24 years while that of secondary rose from 17.6 per cent to 26.2 per cent and the share of services sector rose from 21.7 per cent to 31.3 per cent during the same period. It means primary sector showed a fall of 18 per cent in 24 -25 years during the pre-reforms period.

- The total production of pulses was 5.63 lakh tones in 1966-67 which drastically decline due to decline area and production with a negative growth rate that is -4.75 per cent under the pulse crops.

- The number of tractors increased from 5000 in 1966-67 to 2.78 lakh in 2016-17 indicating that most of farm operations in cultivation of various crops are fully mechanized.

- 54 Mandis in the state have been connected with the e-NAM (National Agricultural Market) scheme for efficient marketing of agricultural produce for better price realisation to the farmers.

Experiment 5: Impact assessment of sprinkler irrigation on crop productivity in southern zone of Haryana

- Per hectare net returns from wheat in Mahendergarh, Bhiwani and overall were estimated to be ₹ 26025, ₹ 33011 and ₹ 29518, respectively. The B:C ratio were found to be 1.42, 1.53 and 1.47 respectively.

- Per hectare net returns from mustard in Mahendergarh, Bhiwani and overall were estimated to be ₹ 19631, ₹ 26844 and ₹ 23238 respectively. The B:C ratio were found to be 1.37, 1.50 and 1.44 respectively.

- The difference between MVP of machine labour, fertilizer, plant protection, irrigation and its unit price was found to be positive and significant in Mahendergarh district. Similarly in case of Bhiwani district, machine labour, fertilizer cost, plant protection and irrigation and overall basis machine labour, fertilizer cost, plant protection and irrigation was found to be positive and significant which indicates that these inputs were underutilized in respective districts.

- Heavy initial investment, less efficiency (irrigation) due to high temperature & high wind velocity, salty water and erratic supply of electricity were observed the main constraints in the study area.

Experiment 6: **Gap analysis of MSP and harvest price of principal crops in Hisar district of Haryana state**

Salient findings of the study

- MSP for all the crops was increasing linearly with a high value of R2 *i.e.* for paddy (0.93), wheat (0.94), gram (0.89), mustard (0.90), bajra (0.92) and cotton (0.90).
- Maximum positive deviation was observed in mustard *i.e.* 6 times.
- Problem of moisture contain in produce ranked 1st position among all the constraints faced by farmers.
- Direct payment in farmer's bank account ranked1st position among all the constraints faced by market intermediaries.
- The major constraints faced by farmers were problem of moisture content in produce, illiteracy, heavy glut in arrival low market prices even below MSP during peak season.
- The major constraints faced by market intermediaries were direct payment in farmers' bank account, low wage rate fix by government for labour work and delay in payment.

Experiment 7: **Measurement of Variability and Factors affecting Agricultural Production of Principal Crops of Haryana**

- It has been found that gram has a negative growth rate for area and production during the study period whereas all other selected crops are showing positive growth for area and production.
- Study reveals that area variability has been maximum in case of gram and minimum in case of wheat during the study period. It is because mean area under gram has been decreased almost ten times from base period to fourth period and it has been replaced by wheat and mustard mostly.
- Area under wheat and paddy is increasing because these crops are being considered as the least risky crops, fixed MSP, HYV and expansion of irrigation facilities. Increment in area under cotton is mainly due to evolution of hybrid varieties of cotton and Bt-cotton.
- Variability in production is found to be maximum in case of gram and minimum in case of wheat during the study period. It is because mean production of gram has been decreased almost six times from base period to fourth period and area substitution by other crops.
- Yield is showing an increasing trend for all the crops with an increment of about 1.7, 1.3, 1.6 and 1.5 times for wheat, paddy, gram and cotton respectively from base period to fourth period.
- The model selected may be considered satisfactory for explaining the fluctuations in agricultural production as it has the high value of adjusted R2.

- Gross area irrigated has been found major factors influencing the agricultural production followed by total cropped area.

Experiment 8: **An Application of Principal Component Analysis to Measure the Effect of Weather Variables on Cotton Yield**

- It has been observed that there is increasing trend in cotton yield during 1980-1994 and after that there is major decline in yield and it is due to incidence of insect pest and partial drought conditions.

- Yield gets increased after 2003 due to the evolution of Bt-cotton but again in 2014-2016 a fall has been observed in yield due to the attack of whitefly and partial drought conditions.

- Highest positive variation in cotton yield was observed during third period and it is due to the evolution of Bt-cotton, other high yielding varieties of cotton and expansion of irrigation facilities.

- Three models were fitted, model 1 was having trend yield and weather parameters as regressors, model 2 with trend yield and PC scores as regressors and third model was fitted by using trend yield and higher loading components from the component matrix as regressors.

- A perusal of the results indicates the preference of using prediction equations based on principal component scores (model 2) over the regression models using weather parameters as predictor variables and higher loading model as model 2 has highest Adj-R2 and low per cent deviation of the forecast from the observed yield followed by model 3.

- Model 3 shows that if minimum temperature is below the average minimum temperature during (30-45) days after planting or vegetative stage, it affects yield positively. Rise in average maximum temperature TMX1 shows negative effective during first fifteen days (germination) whereas an increment in average maximum temperature TMX5 (60-75 days) is showing positive effect on flowering stage.

- Increased relative humidity RH7, RH9 and bright sunshine hours BSH6, BSH7, BSH9 (75-120 days) above the average, have been found beneficial during flowering stage and reproductive stage (ball formation and maturation).

- This study has demonstrated the utility of understanding and quantifying the relationships between cotton yield and weather variables. Trend yield (Tr) is an important parameter appearing in all the models, which is an indication of technological advancement, improvement in fertilizer/insecticide/ pesticide / weedicide used and increased use of high yielding varieties

8. Justification for continuation of the scheme

Objectives of the schemes are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers, sustainable utilization of natural resources, diversification in agriculture; resource use is farm enterprise, marketing of agricultural produce and its value addition in Haryana.

9. Constraints, if any: Shortage of scientists in the scheme.

10. TECHNICAL PROGRRAME OF WORK DURING 2018-19

i	**Experiment No. 1: Prospects of summer mungbean cultivation in Haryana**	
ii	**Objectives of the experiment**	• To examine the status of summer mungbean cultivation • To work out profitability of summer mungbean cultivation • To examine resource use efficiency in summer mungbean cultivation • To ascertain the perception of farmers regarding cultivation of summer mungbean
iii	**Name(s) of the investigators**	• Dr. D.P. Malik: Monitoring planning and finalization of interview schedule • Dr. Dalip Kumar Bishnoi: Report writing • Dr. Neeraj Pawar: Collection, compilation and analysis of data of Panipat and Kurukshetra district • Dr. Nirmal Kumar: Collection, compilation and analysis of data of Hisar district
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :** Kurukshetra, Hisar and Panipat • **Village covered:** Jhimrehdi, Mirzapur and Lukhi(Kurukshetra), Chuli Bagrian and Parbhuwala (Hisar) and Goela Khurd, Bharampur, Ujha and Bapol (Panipat) • **Number and type of respondents**: Twenty (20) farmers from each selected district were interviewed. Thus total 60 farmers were surveyed. • **Statistical design/methods:** The statistical tools like mean, percentage, Cobb Douglas production function and Garret ranking technique were used.
vii	**Observation recorded**	• Information related to area, production and productivity of summer mungbean from state department of agriculture and framers' welfare was collected • 20 farmers from each selected district were surveyed and Information related resources use like seed, agro-chemicals, human labour, inputs and output prices were collected from selected farmers • Perceptions of 60 farmers for various constraints in cultivation of summer mungbean were recorded.

viii Results achieved during 2018-19

The share of summer mungbean to total pulses in the state in terms of area and production was 30.81 and 23.99 per cent respectively during 2013-14. After this, area and production of total pulses started decline and this trend continued till 2016-17. During 2017-18, contribution of area and production of summer mungbean was 83.12 and 84.99 per cent to the total pulses, respectively. The total acreage under pulses decreased during time period of 2013-14 to 2017-18. The growth rate for area and production of total pulses was negative i.e. -12.63 and -11.34 per cent, respectively while in case of summer mungbean, it showed positive sign (Table 1).

Table 1: Contribution of summer mungbean to total pulses in Haryana

Years	Summer mungbean	Total Pulses	% contribution in total area	Summer mungbean	Total Pulses	% contribution in total production
	Area	Area		Production	Production	
2013-14	47.00	152.55	30.81	30.00	125.05	23.99
2014-15	20.00	83.20	24.04	13.00	56.10	23.17
2015-16	34.00	96.60	35.20	25.00	65.68	38.06
2016-17	20.00	84.60	23.64	17.00	75.91	22.39
2017-18	64.00	77.00	83.12	50.00	58.90	84.89
CAGR (%)	**6.37**	**-12.63**		**13.77**	**-11.34**	

A=Area in '000' ha. P=Production in '000' tonnes

Cost and returns of summer mungbean cultivation in Haryana

The overall total cost of cultivation of summer mungbean were estimated to be Rs. 44089 and it was Rs. 44839 and Rs. 42399 and Rs 44686 in Kurukshetra, Hisar and Panipat districts, respectively (Table 2). The overall gross returns were computed Rs. 48160 whereas, in Kurukshetra, Hisar and Panipat districts it was found to be Rs. 48698, Rs. 45473 and Rs. 49450, respectively. Overall net returns were Rs. 4071 whereas, Rs. 3859, Rs. 3073 and Rs. 4764 were found to be in Kurukshetra, Hisar and Panipat districts respectively. The overall B-C ratio was calculated over variable costs was 3.00 and it was 3.01, 2.81 and 3.14 in Kurukshetra, Hisar and Panipat districts, respectively. B-C ratio was calculated over total cost in Kurukshetra, Hisar and Panipat districts were 1.09, 1.07 and 1.11, respectively and overall B-C ratio was 1.09.

Resource use efficiency

The predictor variables used in the model are human labour, machine labour, seed cost and irrigation. The estimated coefficient of multiple determinations (R^2) revealed that selected inputs were capable of explaining 47.90, 68.00, 94.00 and 100.00 per cent variation in Kurukshetra, Hisar, Panipat and Haryana, respectively (Table 3). It was seen that for Kurukshetra and Hisar districts, coefficient relating to variables like human labour and irrigation were found to be significant, while machine labour and seed cost showing negative significance, hence with more variables either being non or negative significance, elasticity of production was seen to be decreasing in both the districts. Similarly, in case of Panipat district as well as overall basis, human labour and machine labour were found to be significant, while seed cost and irrigation showed negative

significance, hence with more variables either being non or negative significance, elasticity of production was seen to be decreasing.

Table 2: Cost and returns of summer mungbean cultivation in Haryana (Rs/ha)

S. No.	Particulars	Kurukshetra		Hisar		Panipat		Overall average	
		Qty	Value	Qty	Value	Qty	Value	Qty	Value
1	Field preparation	2	3788 (8.45)	2	3981 (9.39)	2	3513 (7.86)	2	3760 (8.53)
2	Seed cost	10	2200 (4.91)	9	1763 (4.16)	10	1835 (4.11)	10	1933 (4.38)
3	Sowing		500 (1.12)		450 (1.06)		500 (1.12)		483 (1.10)
4	Irrigation	2	2500 (5.58)	2	3000 (7.08)	2	2875 (6.43)	2	2792 (6.33)
5	Plant protection	1	1158 (2.58)	1	1038 (2.45)	1	588 (1.31)	1	928 (2.10)
6	Harvesting and threshing		5420 (12.09)		5363 (12.65)		5863 (13.12)		5548 (12.58)
7	Interest on working capital		603 (1.34)		606 (1.43)		586 (1.31)		613 (1.39)
8	**Variable cost**		**16168 (36.06)**		**16200 (38.21)**		**15759 (35.27)**		**16057 (36.42)**
9	Management and risk charges		3134 (6.99)		3150 (7.43)		3052 (6.83)		3211 (7.28)
10	Rental value of land		25000 (55.76)		22500 (53.07)		25000 (55.95)		24167 (54.81)
11	Transportation		538 (1.20)		550 (1.30)		875 (1.96)		654 (1.48)
12	**Total cost**		**44839 (100.00)**		**42399 (100.00)**		**44686 (100.00)**		**44089 (100.00)**
13	Yield		11.33		10.58		11.50		11.20
14	**Gross return (Rs./ha)**		**48698**		**45473**		**49450**		**48160**
15	Cost of production (Rs./qtl)		3915		3967		3842		5265
16	Returns over variable cost		32530		29273		33691		32103
17	**Net return**		**3859**		**3073**		**4764**		**4071**
18	**B:C** ratio over variable cost		3.01		2.81		3.14		3.00
19	**B:C** ratio over total cost		**1.09**		**1.07**		**1.11**		**1.09**

***** Rental value of land for mungbean included one fifth of the total rental value of land for one year

** Figures in parenthesis are representing per cent of total cost

Table 3: Resource use efficiency of summer mungbean in Haryana

Particulars	Kurukshetra				
	GM	**Coefficients**	**MVP**	**MFC**	**r**
Constant	1093616				
Human labour	2365.373	0.362**	2.88	1	2.881925
Machine labour	3467.771	-0.646**	-3.51	1	-3.50797
Seed cost	996.6972	-0.236	-4.46	1	-4.45885
Irrigation	832.1184	0.004**	0.09	1	0.090521
R-square value :	0.479				
Return to scale = ∑bi = -0.52 = Decreasing return to scale, (Over-utilization of resources)					
	Hisar				
Constant	1339759				
Human labour	2246.31	0.02**	0.16	1	0.16
Machine labour	2097.30	-0.35	-2.65	1	-2.65
Seed cost	647.40	-0.34	-8.39	1	-8.39
Irrigation	1212.71	0.03**	0.42	1	0.42
R- square value	0.68				
Return to scale =∑bi = -0.63= Decreasing return to scale, (Over-utilization of resources)					
	Panipat				
Constant	815.66				
Human labour	2425.32	0.29**	1.99	1	1.99
Machine labour	2703.99	0.16**	0.97	1	0.97
Seed cost	880.27	-0.06	-1.23	1	-1.23
Irrigation	912.99	-0.005	-0.09	1	-0.09
R- square value	0.94				
Return to scale =∑bi = 0.38= Decreasing return to scale, (Over-utilization of resources)					
	Overall				
Constant	1716.43				
Human labour	2344.48	0.29**	2.08	1	2.08
Machine labour	2699.22	0.18**	1.16	1	1.16
Seed cost	828.17	-0.17	-3.58	1	-3.58
Irrigation	973.05	-0.03	-0.49	1	-0.49
R- square value	0.100				
∑bi = 0.27 = Decreasing return to scale, (Over-utilization of resources)					

**Significance at 5% level

Marginal value of productivities (MVPs)

In Kurukshetra district, human labour (2.88) was greater than unity. It indicated that the human labour was underutilized. Therefore, these inputs were to be maximized to get the optimum level of output and the ratios of MVP to MFC *i.e.* were less than unity for machine labour (-0.646), seed cost (-0.236) and irrigation (0.004). It was due to use of various costs above the recommended levels. So these inputs were to be minimized to get the optimum level of output. Similarly, in Hisar district, human labour (0.16), machine labour (-2.65), seed cost (-8.39) and irrigation (0.42) were less than unity. It indicated that all the inputs were over utilized. So

these inputs were to be minimized to get the optimum level of output. It was due to use of various costs above the recommended levels.

In Panipat district, human labour (1.99) was greater than unity. It indicated that the human labour was underutilized. So these inputs were to be maximized to get the optimum level of output and the ratios of MVP to MFC *i.e.* were less than unity for machine labour (0.97), seed cost (-0.23) and irrigation (-0.09). Hence, these inputs were to be minimized to get the optimum level of output. Similarly on overall basis, human labour (2.08) and machine labour (1.16) were greater than unity. It indicated that the human labour and machine labour were underutilized, so these inputs were to be maximized to get the optimum level of output and the ratio of MVP to MFC *i.e.* were less than unity for machine labour (0.97), seed cost (-0.23) and irrigation (-0.09, so these inputs were to be minimized to get the optimum level of output. There was ample scope of greater exploitation of these resources to maximize the production and to increase the gross returns. Whereas, the ratio of MVP to MFC for this indicated that at their average level, these resources were over utilized in the production process in all the selected districts (Table 3).

Constraints faced by summer mungbean growers in Haryana

The analysis reveals that non-availability of suitable machine for threshing ranked first in Panipat, Kurukshetra, Hisar districts and overall basis with a total score 264, 264, 262 and 790 followed by purchase of produce by Govt. agencies with a total score of 242, 242, 244 and 728, respectively. Harvest price less than MSP ranked third on overall basis with a total score of 662 while in Panipat, Kurukshetra and Hisar districts its position was third, sixth and fourth with a total score 222, 150 and 218, respectively.

Table 4: Constraints faced by the mungbean growers in Haryana

S. No.	Particulars	Panipat		Kurukshetra		Hisar		Overall	
		Total score	Rank	Total score	Rank	Total score	Rank	Total score	Rank
1	Non-availability of suitable machine for threshing	264	1	264	1	262	1	790	1
2	Absence of procurement of produce by Govt. agencies	242	2	242	2	244	2	728	2
3	Harvest price less than MSP	222	3	150	6	218	4	662	3
4	Non-availability of labour for harvesting of crop	220	4	220	3	219	3	659	4
5	Inadequate of quality seed	170	5	170	4	173	5	513	5
6	Lack of market information related to price.	154	6	154	5	156	6	464	6
7	Quality of seed purchased from different sources	150	7	96	11	147	8	447	7
8	Non-availability of seed of short duration varieties	148	8	148	7	143	9	439	8
9	Problem of stray animals	136	9	136	8	148	7	420	9
10	Demand of produce in market	126	10	126	9	121	10	373	10
11	Synchronous maturity of crop	98	11	98	10	102	11	298	11
12	High cost of seed	80	12	80	12	79	12	239	12

13	Shortage of irrigation water	53	13	53	13	50	13	156	13
14	Delay the sowing of next crop	34	14	34	14	35	14	103	14

On overall basis availability of labour for harvesting of crop, availability of quality seed, lack of market information, quality of seed purchased from different sources, non-availability of seed of short duration varieties, problem of stray animals, demand of produce in market, demand of produce in market and synchronous maturity of crop ranked at 4th, 5th, 6th, 7th, 8th, 9th, 10th and 11th position with total score 659, 513, 464, 447, 439, 420, 373 and 298, respectively. High cost of seed, shortage of irrigation water and cultivation of mungbean delay the sowing of next crop ranked twelfth, thirteen and fourteen in Panipat, Kurukshetra, Hisar districts and overall basis with a total score 239, 156, and 103, respectively (Table 4).

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

It is concluded from the aforesaid discussion that after the harvest of wheat and before the transplanting of rice, the land remains fallow for 65-70 days (April to early July). This period could be used to raise the pulses as a catch crop. The early emergence of even one day is highly beneficial for cultivation of mungbean in summer season. This means mechanization can enable us for timely sowing by which we can earn more through reducing cost of cultivation. It also fixes nitrogen in the soil, requires less irrigation and helps maintain soil fertility and texture. Adding mungbean to the cereal cropping system has the potential to increase farm income, improve human health and promote long-term sustainability of agriculture. Mungbean farmers received higher return on their investment. The B:C ratio worked out by dividing the gross return with total cost was found to be 1.09. The analysis reveals that there is scope for reorganization of resources to optimize their use to enhance returns in the study area. The constraints analysis on the sampled farmers suggest that there is a need of suitable machine for threshing, Purchase of produce by Govt. agencies, Harvest price less than MSP were the major constraints in the study area.

Salient findings of the study

- The per hectare net returns from summer mungbean crop in Kurukshetra, Hisar, Panipat and Haryana were estimated to be ₹ 3859.00, ₹ 3073.00, ₹ 4764.00 and ₹ 4071.00, respectively and B:C ratios were found to be 1.09, 1.07, 1.11 and 1.09, respectively.

- MVP of human labour and irrigation to its unit price was found to positive and significant in Kurukshetra and Hisar districts. Similarly, MVP of human labour and machine labour and its unit price was found to be positive and significant in Panipat and overall basis in Haryana.

- Non-availability of suitable machine for threshing ranked first in Panipat, Kurukshetra, Hisar districts and overall basis with a total score 264, 264, 262 and 790 followed by non-procurement of produce by Govt. agencies with a total score of 242, 242, 244 and 728, respectively. Harvest price less than MSP ranked third on overall basis with a total score of 662 while in Panipat, Kurukshetra and Hisar districts it ranked third, sixth and fourth with a total score 222, 150 and 218, respectively.

i	**Experiment No. 2: Economic analysis of castor cultivation in semi-arid zone of Haryana**	
ii	**Objectives of the experiment**	• To work out the profitability of castor cultivation • To analyze the contribution of various resources in castor cultivation • To study the constraints in cultivation of castor
iii	**Name(s) of the investigators**	• Dr. D.P. Malik: Monitoring planning and finalization of interview schedule • Dr. K. K. Kundu: Report writing • Dr. NeerajPawar: Data collection • Dr. Nirmal Kumar: Data collection, compilation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	**Nil**
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :**Sirsa, Hisar and Rewari • **Village covered:** Nathusari and Ludesar (Sirsa, Sadalpur and Chaudhariwali (Hisar) and Jathal and Sangwali (Rewari) • **Number and type of respondents: 60** farmers (20 farmers from each selected district). • **Statistical design/methods:** The statistical tools like mean, percentage, cobb Douglas production function and Spearman's Rank Correlation technique were used
vii	**Observations recorded**	• 20 farmers of each selected district were surveyed and Information related resources use like seed, agro-chemicals, human labour, inputs and output prices was collected from selected farmers • Perception of 60farmers for various constraints in castor cultivation was recorded.

Results achieved during 2018-19

Costs and returns of castor cultivation in Haryana

The per hectare gross returns from castor crop in Rewari, Sirsa, Hisar and Haryana were estimated to be ₹157811, ₹137913, ₹142371 and ₹143743, respectively (Table 1). The per hectare net returns from castor crop in Rewari, Sirsa, Hisar and Haryana were estimated to be ₹ 61324, ₹ 41200, ₹ 44200 and ₹ 46331, respectively and B:C ratio were found to be 1.64, 1.43, 1.45 and 1.48, respectively.

Resource use efficiency

The estimated coefficient of multiple determinations (R^2) revealed that selected inputs (human labour, machine labour, seed, fertilizers, plant protection and irrigation) were capable of explaining 55.61, 66.62 and

72.16 per cent variation in castor production in Rewari, Sirsa and Hisar districts, respectively (Table 2). It was seen that for Rewari district, coefficient relating to variables like machine, seed and irrigation were significant, while fertilizer and plant protection showing negative significance, hence with more variables either being non or negative significance, elasticity of production was seen to be decreasing. Similarly, in case of Sirsa district machine labour, seed, plant protection and irrigation were found significant, while human labour showed negative significance, hence with more variables either being non or negative significance, elasticity of production was seen to be increasing. Similarly, in case of Hisar district human labour, seed and irrigation were found significant, while machine labour showing negative significance, hence with more variables either being non or negative significance, elasticity of production was seen to be increasing.

Table: 1. Cost and returns of castor crop cultivation in Haryana **(Rs./ha)**

S. No.	Inputs/Districts	Rewari		Sirsa		Hisar		Haryana		
		Qty	Value	Qty	Value	Qty	Value	Qty	Value	(%)
1	Field Preparation	3.56	5646	3.60	5728	3.61	5526	3.60	5609	5.76
2	Seed (Kg.)	3.70	1170	3.13	950	3.05	1038		1034	1.06
3	Total Fertilizer Investment (Kg)	368.74	5873	402.93	4208	310.61	4813	322.54	4814	4.94
4	Irrigation	4.88	3385	3.35	7108	3.57	7763	3.74	6777	6.96
5	Hoeing/ Weeding Manual	1.95	4628	1.84	2973	2.22	4300		3946	4.05
6	Plant Protection		1788		5815		4988		4673	4.80
7	Picking + Threshing		16463		16454		15971	0	16208	16.64
8	**Total (1 to 7)**		**38953**		**43236**		**44399**		**43061**	**44.20**
9	Interest on working capital@7%		2727		3027		3108		3014	3.09
10	**(A) Total Variable Cost**		**41680**		**46263**		**47507**		**46075**	**47.30**
11	Management + Risk factor		8336		9253		9501		9215	9.46
12	Transportation		6443		2948		2468		3327	3.42
13	Rental value of land		40028		38250		38695		38795	39.83
14	**(B) Total Fixed Cost**		**54807**		**50451**		**50664**		**51337**	**52.70**
15	**Total Cost (A+B)**		**96487**		**96713**		**98171**		**97412**	**100.00**
16	Production									
17	Main Product (qtl./ha)	31.43	156638	28.00	135450	28.80	140078	29.02	141598	
18	By Product		1173		2463		2293		2145	
19	Gross returns		157811		137913		142371		143743	
20	ROVC		**116131**		**91650**		**94864**		**97668**	
21	Net returns		**61324**		**41200**		**44200**		**46331**	
22	**B:C ratio**		**1.64**		**1.43**		**1.45**		**1.48**	

ROVC means Returns over variable cost

Table: 2. Regression coefficient and standard error of castor production function in Haryana

S. No.	Parameters	Rewari (N=20)	Sirsa (N=20)	Hisar (N=20)
1	Constant	11.033 (4.700)	16.249 (9.659)	-3.396 (4.797)
2	Human labour	-0.014 (0.178)	-0.723 (0.790)	1.046** (0.449)
3	Machine Labour	0.268** (0.521)	1.076* (0.569)	-0.031 (0.251)
4	Seed	0.099*** (0.193)	0.143*** (0.384)	0.129* (0.100)
5	Fertilizers	-0.151 (0.180)	0.047 (0.171)	0.168 (0.089)
6	Plant protection	-0.032 (0.051)	0.335** (0.264)	0.037 (0.145)
7	Irrigation	0.184* (0.201)	0.440* (0.682)	0.404** (0.209)
8	Return to scale	0.355 Decreasing	1.319 Increasing	1.753 Increasing
9	R^2 (%)	55.61	66.62	72.16

Figures in parentheses indicate the standard error of estimated parameters
*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Marginal value of productivities (MVPs)

In order to examine the resource use efficiency in castor production, the marginal value productivity (MVP) of inputs whose regression coefficients found statistically significant in castor production function were compared with their respective unit price. To test the significance of deviation of MVP of an input from its unit price, t-statistics was employed. A significant higher MVP of an input from its unit price implies that more of that input can be used to increase the castor productivity, while a significant lower MVP of an input from its unit price implies that the input is used in excess and needs reduction in use of quantity of that particular input.

The present study revealed that the difference between MVP of machine labour, seed and irrigation and its unit was found to positive and significant in Rewari district (Table 3) . Similarly, in case of Sirsa district, machine labour, seed, plant protection and irrigation and in Hisar district human labour, seed, fertilizer and irrigation and its unit was found to be positive and significant which indicate that these inputs were underutilized in all districts.

Table: 3. Marginal value of productivity of different inputs used in castor production in Haryana

Inputs	Rewari district (N=20)					
	Human Labour	Machine Labour	Seed	Fertilizers	Plant protection	Irrigation
MVP	-0.125	3.285	2.680	-2.245	-2.805	4.994
Price	1.000	1.000	1.000	1.000	1.000	1.000
Difference	-1.125	2.285**	1.680***	-3.245	-3.805	3.994*

SE of MVP	0.178	0.522	0.193	0.180	0.051	0.200
	Sirsa district (N=20)					
MVP	-2.793	4.571	2.425	1.941	3.127	4.376
Price	1.000	1.000	1.000	1.000	1.000	1.000
Difference	-3.793	3.571*	1.425***	0.941	2.127**	3.376*
SE of MVP	0.790	0.569	0.384	0.171	0.264	0.682
	Hisar district (N=20)					
MVP	3.529	-0.443	3.938	2.676	1.018	3.340
Price	1.000	1.000	1.000	1.000	1.000	1.000
Difference	2.529**	-1.443	2.938*	1.676*	0.018	2.340**
SE of MVP	0.449	0.251	0.100	0.089	0.145	0.209

*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Production problems faced by castor growers

The problem of F2 seed in the same field over the year was reported by 93.33, 98.33 and 93.33 per cent of the castor growers in Rewari, Sirsa and Hisar, respectively and grain scattering problem during maturity was shared by 91.67, 91.67 per cent and 86.67 per cent of selected farmers, respectively (Table 4). More than 80 per cent of farmers in study area were of opinion that effect of frost on crop growth was also serious problem in cultivation of caster. The least problem in cultivation of castor was expressed by more than 60 per cent of castor growers were lack of technical knowledge about the control of for various insect-pests and diseases.

Marketing problems expressed by castor growers

The absence of minimum support prices (MSP) was reported by 96.67, 93.33 and 93.33 per cent of the respondents in Rewari, Sirsa and Hisar respectively while low price in open auction sale and heavy fluctuation in market prices was shared by more than 80 per cent of castor growers in the study area. The least problem in marketing of produce was expressed by the castor growers were lack of suitable packaging material.

Table: 4. Production constraints faced by castor crop growers in Haryana

Constraints / Districts	**Rewari**		**Sirsa**		**Hisar**		**Haryana**	
A) Production problems	MPS	RO	MPS	RO	MPS	RO	MPS	RO
a) Problem of F2 seed in the same field over the year	93.33	1	98.33	1	93.33	1	95.00	1
b) Grain scattering problem during maturity	91.67	2	91.67	2	86.67	4	90.00	2
c) Effect of frost on crop growth	83.33	3	88.33	4	91.67	2	87.78	3
d) Lack of knowledge of recommended fertilizer doses	76.67	6	91.67	2	88.33	3	85.56	4
e) Water shortage during crop season	81.67	4	78.33	8	83.33	5	81.11	5
f) Time consuming & labour intensive manual weeding	78.33	5	81.67	6	78.33	7	79.44	6
g) Lack of knowledge about package of practices	56.67	12	86.67	5	81.67	6	75.00	7
h) Lack of the knowledge about improved varieties, their seed / planting material	63.33	10	81.67	6	75.00	8	73.33	8
j) Non availability of seed and planting materials well in time	65.00	9	73.33	9	68.33	10	68.89	9
k) Poor quality of water (Tubewell)	73.33	7	63.33	10	70.00	9	68.89	9
l) Need of specialized labour/machinery for harvesting	70.00	8	63.33	10	68.33	10	67.22	11

m) Lack of technical knowledge for control of insect-pests and diseases	63.33	10	61.67	12	66.67	12	63.89	12

Table: 5. Marketing constraints faced by castor growers in Haryana

Constraints / Districts	**Rewari**		**Sirsa**		**Hisar**		**Haryana**	
B.) Marketing problems	MPS	RO	MPS	RO	MPS	RO	MPS	RO
a) Absence of minimum support prices	96.67	1	93.33	1	93.33	1	94.44	1
b) Low produce price in open auction sale	88.33	2	91.67	2	86.67	2	88.89	2
c) Heavy fluctuation in prices	86.67	3	83.33	3	76.67	3	82.22	3
d) High cost of transportation for sale in distant market	70.00	4	68.33	4	70.00	4	69.44	4
e) Lack of market information related to price	68.33	5	61.67	5	65.00	5	65.00	5
f) Less number of traders for procurement	61.67	6	51.67	6	56.67	6	56.67	6
g) Lack of processing unit	55.00	7	51.67	6	56.67	6	54.44	7
h) Lack of suitable packaging material	30.00	8	33.33	8	56.67	6	40.00	8

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

Castor seed production was found to be profitable in the study area. The cultivation of caster seed needs to be promoted for the limited irrigation and recourse poor areas. The resources like machine labour, seed, fertilizer, irrigation etc are underutilized in the study area. Hence there is need of use of all required input at optimum level to harvest potential yield of caster seed. The most serious hindrances in the cultivation of caster seed as observed by more than 90 per cent of the identified farmers were retention of F2 seed in the same field, grain scattering during maturity, absence of minimum support prices etc.

Salient findings of the study

- The per hectare net returns from castor crop in Rewari, Sirsa, Hisar and Haryana were estimated to be ₹61324, ₹41200, ₹44200 and ₹46331, respectively and the B:C ratio were found to be 1.64, 1.43, 1.45 and 1.48, respectively.

- The difference between MVP of machine labour, seed, fertilizer, irrigation and its unit price was found to positive and significant in Rewari district. Similarly in case of Sirsa district machine labour, seed, plant protection and irrigation and in Hisar district human labour, seed, fertilizer and irrigation was found to positive and significant which indicate that these inputs were underutilized in respective district.

- Most serious production problem *i.e.* F2 seed in the same field over the year was indicated by 93.33, 98.33 and 93.33 per cent of the respondents in Rewari, Sirsa and Hisar, respectively and grain scattering during maturity was reported by more than 86 per cent of castor growers in the study area.

- Most serious marketing problem *i.e.* absence of minimum support prices was recorded from 96.67, 93.33 and 93.33 per cent of the respondents in Rewari, Sirsa and Hisar , respectively while low price of produce in open auction sale was shared by more than 88 per cent of castor growers in the state.

i	**Experiment No. 3: Effect of climate change on productivity of major crops in western zone of Haryana**	
ii	**Objectives of the experiment**	• To analyze the trends of climate change • To work out the impact of climate change on productivity of major crops • To identify the implications of climate change on food security
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring and report writing • Dr. Dalip Kumar Bishnoi Preparation of schedule, data collection, analysis of data • Dr. Nirmal Kumar Data collection, compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Dr. Raj Singh Professor, Department of Agro-meteorology
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District covered :** Sirsa, Hisar and Rewari from western zone of the State • **Statistical design/methods:** The statistical tools like mean, percentage and panel data approach techniques were used
vii	**Observations recorded**	• Data related to rainfall, temperature were collected from department of agro-meteorology • Data on area, production and productivity of major food grain crops recorded form statistical abstract of Haryana. • Crops like paddy, wheat, mustard, pearl millet were covered.

viii. Results achieved during 2018-19

Decadal trend of weather variables for *Kharif* as well as *Rabi* season are presented in Table 1. The results of experiment revealed that, daily mean temperature was ranged between 30.02 to 30.13 °C with a minimum of (23.69 - 23.72 °C) and maximum of (36.32 to 36.57 °C) during the *Kharif* season in western zone of the state. Whereas, the mean temperature in *Rabi* season was ranged between 17.78 to 18.68 °C lower than the *Kharif* season mean temperature. On average, the western zone of the Haryana state received nearly 320 mm annual rainfall, but mostly during the *Kharif* season in study period of 2006-07 to 2015-16.

Figure 1 & 2 indicated the behaviour of climate variables, mean growing-period temperature and cumulative rainfall. It reveals that linear trend was observed in minimum and maximum temperature,

whereas, in case of annual rainfall, non-linear trend was found in both *Kharif* as well as *Rabi* seasons in the study area.

Table 1: Decadal trend of temperature and annual rainfall during in western zone: (2006-07 to 2015-16)

District	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Temperature (°C)	Rainfall (mm)
Kharif				
Hisar	36.32	23.72	30.02	248.41
Rewari	36.57	23.69	30.13	368.37
Sirsa	36.56	23.69	30.12	198.38
Rabi				
Hisar	26.07	9.49	17.78	46.05
Rewari	26.97	9.78	18.37	58.89
Sirsa	25.91	11.45	18.68	37.84

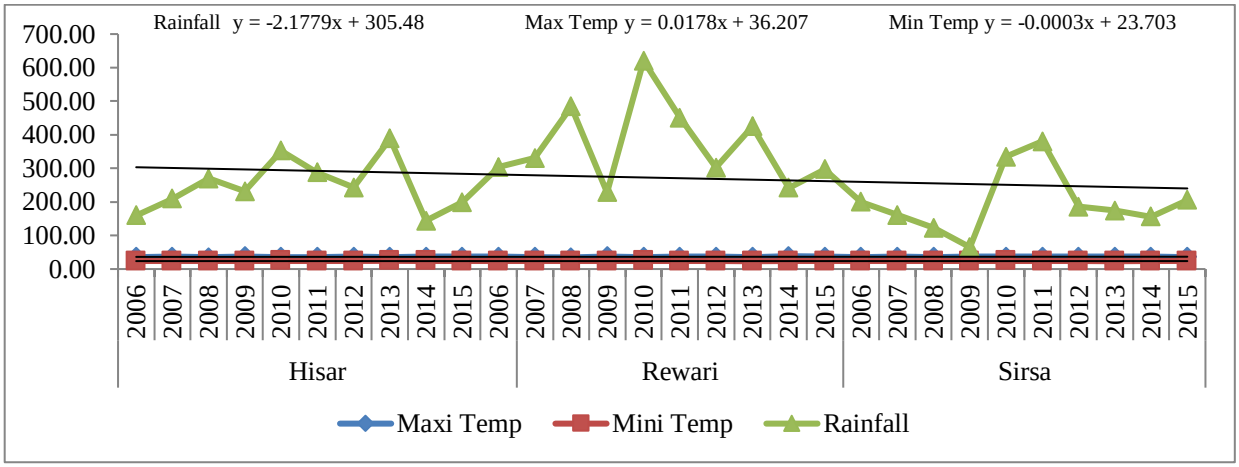


Figure 1: Annual trend in temperature and rainfall during the *Kharif* season in western zone of Haryana (2006-07 to 2015-16)

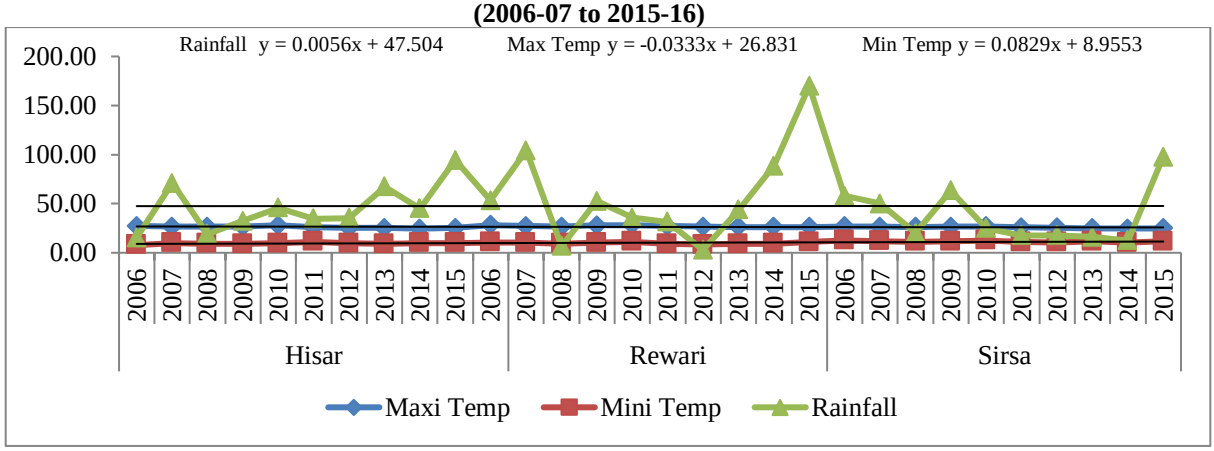


Figure 2: Annual trend in temperature and rainfall during the *Rabi* season in western zone of Haryana (2006-07 to 2015-16)

The weather variable effects on productivity of *Kharif* crops are presented in Table 2. The rise in maximum temperature has positive and significant effect on paddy crop yield whereas, it has significantly negative impact on pearl millet yield but in case of cotton it has negative but non-significant effect on cotton yield. On the other side, rise in minimum temperature has positive but

non-significant effect on productivity of paddy as well as pearl millet. Rainfall coefficient was observed significantly positive impact on pearl millet crop productivity whereas, it has negative but non-significant effect the productivity of paddy and cotton in the study area.

Table 2: Effect of weather variables on productivity of *Kharif* crops in western zone of Haryana

Kharif crops			
Variable	**Paddy**	**Cotton**	**Perl millet**
Maximum Temperature	0.0408** (0.019)	-0.0767 (0.086)	-0.021* (0.005)
Minimum Temperature	0.0085 (0.008)	-0.0230 (0.035)	0.0603 (0.0101)
Rainfall	-0.0001 (0.0002)	-0.00006 (0.001)	0.0004* (0.0023)

Figures within the parentheses are standard errors.
** and * denote significance at 5 per cent and 10 per cent levels, respectively.

The weather variable effects on productivity of *Rabi* crops are presented in Table 3. The rise in maximum temperature has significantly negative effect on wheat crop yield whereas, it has negative but non-significant impact on mustard yield. On the other side, rise in minimum temperature has negative but non-significant effect on productivity of wheat as well as mustard crops. Rainfall coefficient was observed significantly positive impact on productivity of wheat and mustard in the study area.

Table 3: Effect of weather variables on productivity of *Rabi* crops in western zone of Haryana

Rabi crops		
	Wheat	**Mustard**
Maximum Temperature	- 0.0386* (0.014)	-0.0247 (0.032)
Minimum Temperature	- 0.0177 (0.037)	-0.0178 (0.013)
Rainfall	0.0007 (0.015)	0.0002 (0.004)

Figures within the parentheses are standard errors.
** and * denote significance at 5 per cent and 10 per cent levels, respectively.

Implications of climate change on food security

Food security is dependent on food production process. The climate change affects food security by inducing the availability of food, stability of food supplies and volatility in food prices. Rice and wheat are the main staple foods for a majority of Indian population, and our findings of study that higher temperature and changing rainfall patterns may cause a considerable decline in crop yields especially in wheat yield.

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

The weather variable like rise in maximum temperature on productivity of kharif crops has positive and significant effect on yield of paddy crop while rise in minimum temperature has positive but non-significant effect on productivity of paddy and pearl millet. Rainfall coefficient was observed significantly positive impact on pearl millet productivity whereas, it has negative but non-significant effect on the productivity of paddy and cotton in Hisar, Sirsa and Rewari districts of western zone of the state.

The rise in maximum temperature has significantly negative effect on wheat crop yield whereas, it has negative but non-significant impact on mustard yield. On the other side, rise in minimum temperature has negative but non-significant effect on productivity of wheat as well as mustard. Rainfall coefficient was observed significantly positive impact on productivity of wheat and mustard in western zone of the state.

Salient findings of the study

- Average mean temperature were ranged between 30.02 to 30.13 °C with a minimum of (23.69 - 23.72 °C) and maximum of (36.32 to 36.57 °C) during the *Kharif* season in western zone of the state.

- In *Rabi* season the mean temperature were ranged between 17.78 to 18.68 °C lower than the *Kharif* season mean temperature.

- On average, the western zone of the Haryana state received nearly 320 mm annual rainfall, but mostly during the *Kharif* season in study period of 2006-07 to 2015-16.

- The rise in maximum temperature has positive and significant effect on paddy crop yield whereas, it has significantly negative impact on pearl millet yield but in case of cotton it has negative but non-significant effect on cotton yield.

- In *Rabi* season, rise in maximum temperature has significantly negative effect on wheat crop yield whereas, it has negative but non-significant impact on mustard yield.

- Rainfall coefficient was observed significantly positive impact on productivity of wheat and mustard and pearl millet crops. Whereas, it has negative but non-significant effect the productivity of paddy and cotton in the study area.

i	**Experiment No. 4: Structural changes and growth in agriculture in Haryana**	
ii	**Objectives of the experiment**	• To analyze the structural changes in the economy of Haryana • To examine the diversion in cropping pattern over the years • To examine the growth in production and productivity of crops • To identify the major factors contributing for growth of agriculture
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Monitoring planning and finalization of data • Dr. Jitender Kumar Bhatia, Report writing • Dr. Nitin Bhardwaj, Compilation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	**Nil**
v	**Year of start**	**2018-19**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **Statistical design/methods:** The statistical tools like mean, per centage , growth rates etc. were used.
vii	**Observations recorded**	• Information related to sectoral contribution in GDP, No. of farm holdings, land use pattern, crop wise, area coverage, productivity & production of various crops were collected . • Information related to fertilizer/nutrient use, farm machinery & implements, irrigation sources, status of marketing facilities, credit availability etc. were scanned from published sources.

viii- Results of the study:

- The structural change is a process of combining economic growth with changing share of different sectors in gross domestic product (GDP) and labour force. It follows a sequence of shift from agriculture to industry and to services. The structural shift and changing sectoral shares happen not only in domestic product but also in the shares of employment.
- With structural change and economic development, the relative importance of agriculture sector falls, along with rising share of secondary and tertiary sectors. Such type of perceptions has led to the underestimation of the role of agriculture in the process of economic development.
- At present more than 60 per cent of Haryana's population lives in villages. Rural population in the state has come down by 5.87 per cent since 2001. Total population in Haryana has increased by 20 per cent in 2011 as compared to 2001. Gradual changes in urban and rural

population are recorded in the study period where urban population got doubled and rural decreased by 20.00 per cent in last four decades and Census survey. Secondly, the Literacy rate which was low in Haryana seems to be improving continuously since inception to till date and increase to 75.47 per cent in 2011 from 26.89 per cent in 1971 (Table 1).

Table 1: Population status in Haryana

Year	Population (Number)					
	Total	**Rural**	**Increase**	**Urban**	**Increase**	**Literacy rate**
1971	100.36	82.63 (82.34)	-	17.72 (17.66)	-	26.99 (26.89)
1981	129.22 **(28.75)**	100.95 (78.12)	**22.16**	28.27 (21.88)	**59.47**	46.69 (43.85)
1991	164.63 **(27.40)**	124.09 (75.37)	**22.92**	40.55 (24.63)	**43.41**	74.79 (55.85)
2001	210.83 **(21.91)**	149.69 (71.00)	**20.63**	61.14 (29.00)	**50.79**	120.94 (67.91)
2011	253.51 **(20.24)**	165.09 (65.12)	**10.29**	88.42 (34.88)	**44.62**	165.99 (75.47)

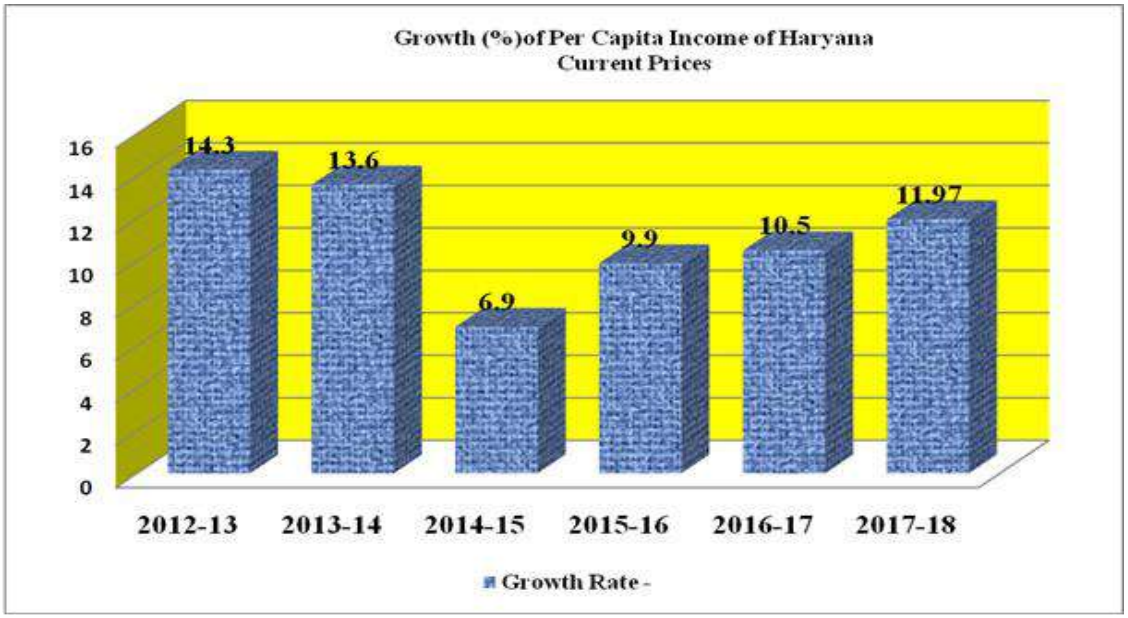
Note Figure in parenthesis indicate the percentage to the total

- The per capita income of the State at current prices was only Rs. 608 in 1966. Since then, the per capita income has increased multifold (Table 2).
- The per capita income at constant (2011-12) prices may reach the level of Rs. 1,45,000 during 2016-17 indicating an increase of 8.6 per cent as compared to the growth rate of 6.4 per cent recorded in 2016-17.
- At current prices, the State's per capita income is likely to reach the level of Rs. 1, 78,990 during 2016-17 with an increase of 10.5 per cent as compared to the growth rate of 9.9 per cent in 2015-16.
- The per capita income of the State, at both current and constant prices, is higher as compared to the National per capita income of Rs. 1, 03,780 and Rs. 82,229 respectively.

Table 2: Per Capita Income in Haryana (constant prices-2011-12)

Year	At Current Price			At Constant Price		
	Per Capita Income (Haryana)	**Growth Rate**	**Per Capita Income (India)**	**Per Capita Income (Haryana)**	**Growth**	**Per Capita Income (India)**
1966	**608**	**-**		**608**		
2011-12	106085	-	63462	106085	---	63462
2012-13	121269	14.3	70983	111780	5.04	65538
2013-14	137770	13.6	79118	119791	7.02	68572
2014-15	147313	6.9	86647	124986	4.3	72805
2015-16	161828	9.9	94731	136423	9.2	77826

2016-17	178990	10.5	103780	145163	6.4	82229



- The economic growth of Haryana has been exemplary since its creation as a separate State. Though Haryana is geographically a small state, the contribution of the state to the National Gross Domestic Product at constant (2011-12) prices has been estimated to be 3.7 per cent as per estimates of 2017-18.
- As per the Advance Estimates for the year 2018-19, the GSDP of the State at current prices has been estimated to be Rs. 7,07,126.33 crore, recording growth of 12.9 per cent in 2018-19 as against the growth rate of 12.5 per cent achieved in 2017-18.

Table 3: Gross State Domestic Product in Haryana **(Rs. in Crore)**

Year	Gross state domestic product at current prices	Gross state domestic product at constant prices 2011-12
2011-12	297538.52	297538.52
2012-13	347032.01	320911.91
2013-14	399268.08	347506.60
2014-15	437144.71	370534.51
2015-16	495249.01	413175.07
2016-17(P)	556324.58	450667.68
2017-18(Q)	626053.52	486238.67
2018-19(A)	707126.33	526055.24
CAGR (%)	**11.43**	**7.38**

- The GSDP at constant (2011-12) prices is expected to reach the level of Rs. 5, 26,055.24 crore with a growth of 8.2 per cent in 2018-19 as compared to the growth of 7.9 per cent recorded in 2017-18. The real growth of 8.2 per cent recorded in GSDP of the State in 2018-19 is higher than the All India GDP growth of 7.2 per cent (Table 3).

Figure: Growth of GSDP Haryana at constant (2011-12) prices

- The changing sectoral composition of the three main sectors confirms the structural change. The share of Agriculture fell from 60.7 per cent in 1969-70 to 42.5 per cent in 1993-94 in a span of 24 years while that of secondary rose from 17.6 per cent to 26.2 per cent and the share of services sector rose from 21.7 per cent to 31.3 per cent during the same period. It means primary sector showed a fall of 18 per cent in 24 -25 years during the pre-reforms period (Table 4).

Table 4: Contribution of various sectors in state economy over the period (per cent)

Year	Agriculture	Industry	Services
1969-70	60.7	17.6	21.7
1993-94	42.5	26.2	31.3
2003-04	29.5	27.5	43.0
2004-05	23.1	32.9	44.0
2014-15	14.1	27.0	58.9
2015-16	18.2	30.6	51.2
2016-17	17.8	30.5	51.7
2017-18	17.5	32.3	50.2
CAGR (1990-2017)	**-3.73**	**0.04**	**2.33**

- But the pace of structural change accelerated after the introduction of economic reforms and the share of agriculture fell by 13 per cent (from 42.5 to 29.5) during 1993-94 to 2003 -04 in the decade.
- In the next decade also, it fell by 9 per cent from 29.5 to 14.1 in 2014-15. In the post-reform period, the sectoral composition changed at a faster rate, the share of agriculture fell by 28.4 per cent, which of services sector by 27.6 per cent in a span of 20 years. (Table 4). This was the period of high growth in the state of Haryana.
- The secondary sector depicts somewhat different picture. Its share rose from 17.6 per cent in 1969-70 to 32.9 in year 2004-05 but after that its share fell to 27 per cent in 2014-15. In tune with the Indian economy, Haryana economy experienced structural change bypassing the required and expected high growth of secondary sector.

Gross fixed capital formation (GFCF) in Haryana

The sectoral distribution of gross fixed capital formation (GFCF) in Haryana indicates that agriculture has got lowest share in the GFCF.

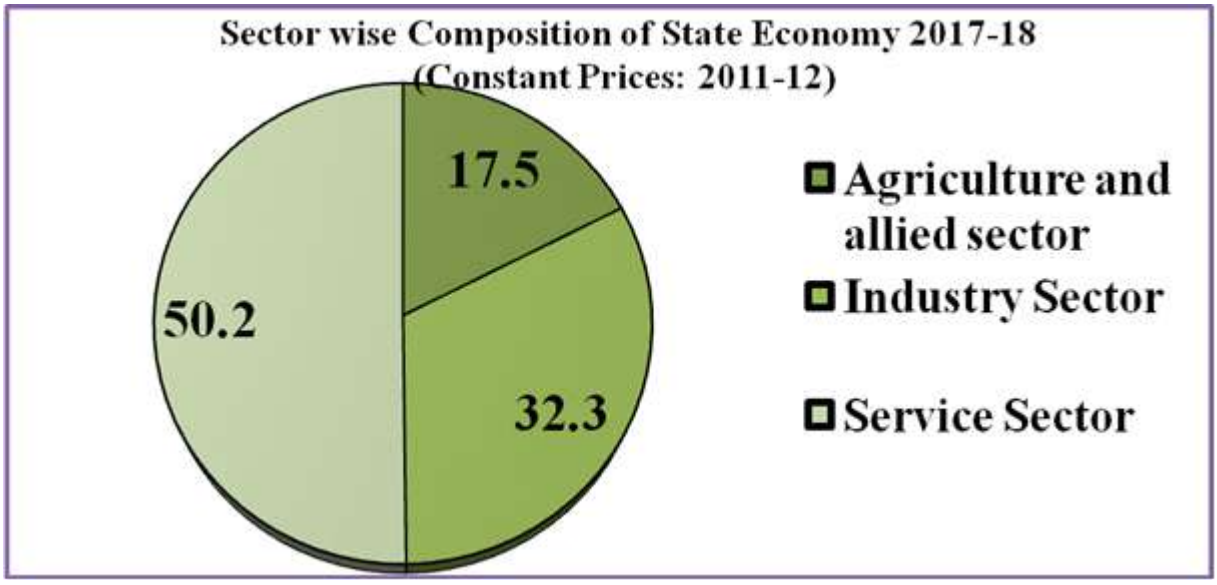
- The contribution of Gross Fixed Capital Formation in Agriculture and Allied Sectors at constant (2004-05) prices increased from 12.4 per cent in 2015-16 to 13.2 per cent in 2016-17. Over the years it showed increasing trend except two years and increased from 9.3 per cent in 2003-04 to 21.4 per cent in 2016-17 (Table 5).

- In the State, the contribution of Gross Fixed Capital Formation in Industry Sector was 43.7 per cent in 2015-16 and decreased to 43.4 per cent in 2016-17. Over the years it showed declining trend and decreased from 55.5 per cent in 2003-04 to 43.4 per cent in 2016-17.

- The contribution of Gross Fixed Capital Formation in Services Sector was 35.2 per cent in 2004-05. Thereafter, it increased to 35.9 per cent in 2015-16 and then showed a decrease to 35.2 per cent in 2016-17. Over the years it showed fluctuating trend and remained in stagnated position during 2016-17.

Table 5: Status of Gross Fixed Capital Formation in various sectors in Haryana (Per cent)

Year/Sector	Primary sector (Agriculture and Allied)	Secondary sector (Industry)	Tertiary Sector (Services)
2004-05	9.3	55.5	35.2
2005-06	8.6	56.5	34.9
2006-07	8.9	58.0	33.1
2007-08	9.8	57.2	33.0
2008-09	9.7	57.7	32.8
2009-10	10.4	55.1	38.1
2010-11	10.6	55.2	34.2
2011-12	13.0	54.2	33.7
2012-13	15.9	51.3	32.8
2013-14	18.0	47.9	34.1
2014-15	18.8	46.6	34.6
2015-16	20.4	43.7	35.9
2016-17	21.4	43.4	35.2



Land use pattern in Haryana

- The share of forest area, land not available for cultivation, permanent pastures and other grazing lands in total geographical area of Haryana has declined over the period. The share of forest land has dropped from 0.91 lakh ha in 1966-67 to 0.40 lakh ha in 2016-17. This is not appropriate for the sustainable development of agriculture in the state (Table 6).

- Rate of increase is the highest in case of area under non-agricultural uses. This is due to the changing structure of economy, which is increasing due to the expansion of industrialization, service sector and infrastructural activities. Further, an expansion of area under both urban and rural settlements has added to this increase. Thus, area under non-agricultural uses is increasing at the expense of wastelands and agricultural land.

- The decline in land under pastures and other grazing lands can be explained in terms of increase in net area sown (NAS) and use of land for non-agricultural purposes. In addition, Illegal encroachments due to expansion of cultivation on pasture lands are largely responsible for this decline in land under pastures.

- The cropping intensity has increased continuously from 134 per cent in 1966-67 to 184 per cent in 2016-17 due to expended irrigation, farm mechanization and use of improved production technologies.

Table 6: Land Use Pattern in Haryana **(000 ha)**

Year	Total Land acc. to village papers	For-ests	Land not availabl e for cultivati on	Other uncultiva ted land	Fallow Land	Net Area Sown	Cultur-able Area	Area sown more than once	Total cropped area	Cropping intensity (%)
1966-67	4,399	91	489	137	259	3423	3819	1176	4599	134
1970-71	4,402	99	490	98	150	3565	3813	1392	4957	139
1975-76	4,404	104	473	78	125	3624	3827	1827	5451	150
1980-81	4,405	132	434	60	177	3602	3839	1860	5462	152

1985-86	4,391	166	392	52	168	3613	3833	1988	5601	155
1990-91	4,378	169	417	48	169	3575	3792	2344	5919	166
1995-96	4,398	110	494	51	156	3586	3793	2388	5974	167
2000-01	4,402	115	470	59	232	3526	3817	2589	6115	173
2005-06	4,372	44	519	68	175	3566	3809	2943	6509	183
2010-11	4,370	39	624	65	125	3518	3681	2987	6505	185
2015-16	4,371	38	639	58	120	3519	3672	3059	6578	185
2016-17	4,371	40	564	68	201	3499	3744	2953	6452	184

Number and Area of Operational Holdings in Haryana

- Out of total 16.2 lakh operational holdings in Haryana, majority i.e. 67 per cent are small and marginal in size and only 3 per cent are large holdings (Table 7). The average holding size in state in 2010-11 was 2.25 ha against national average holding size of 1.15 ha. The average size of holdings has been steadily declining over the time. The small size of holdings limits the farmers' capacity to invest in advance technologies and harvest higher yields.
- The number and size of operational holdings in Haryana based on Census data, 2011 clearly indicates that about more than 48 per cent of holdings are marginal having less than 10 per cent of total area, whereas large holdings are having less than 2.83 per cent of total holdings occupied more than 22 per cent of area and that is why the average size of holdings varied significantly from 0.46 ha. (for marginal) to 17.95 ha in the case of large holdings.

Table 7: Number and Area of Operational Holdings in Haryana, 2010-11 (ha.)

Size group	Individual Holdings		Joint Holdings		Institutional Holding		Total Holdings		Average size (ha)
	No.	Area	No.	Area	No.	Area	No.	Area	
Marginal	288881	132925	483400	224915	5861	2635	778142 (48.11)	360475 (9.89)	**0.46**
Small	108831	16 4083	203575	295054	2412	3567	314818 (19.47)	462704 (12.69)	**1.47**
Semi-Medium	89273	25 6590	192236	551277	2319	6606	283828 (17.55)	814473 (22.34)	**2.87**
Medium	41223	23 7482	150427	928243	3044	19708	194694 (12.04)	1185433 (32.52)	**6.09**
Large	2852	4 1620	39401	655508	3576	125392	45829 (2.83)	822520 (22.56)	**17.95**
Total	**531060**	**832700**	**1069039**	**2654997**	**17212**	**157908**	**1617311 (100.00)**	**3645605 (100.00)**	**2.25**

Figures in parentheses indicates percentage to total

Occupational distribution of work force in Haryana

- The occupational distribution of workforce (Table 8) in Haryana depicts a negative growth rate (-13.43%) for workforce in primary sector in a span of 38 years, indicating that structural change in the labour share has occurred at a slow rate. All

the indicators of structural change in Haryana prove that the state economy has undergone structural change, accelerating the economic growth rate, but reducing the significance of agriculture in the development process. The employment opportunities have increased in secondary and tertiary sectors over the period.

Table 8: Occupational Distribution of Workforce, Haryana

Year	Primary Sector	Secondary Sector	Tertiary Sector
1980-81	65.13	14.25	20.62
1990-91	61.44	12.55	26.02
2000-01	52.40	15.97	31.63
2010-11	44.07	19.77	36.16
2017-18	37.40	20.26	42.34
CGR (%)	**-13.43**	**12.28**	**19.34**

Cropping pattern in Haryana

- The gross area sown in the state during 1966-67 was 45.99 lakh ha which increased to 65.02 lakh ha during 2016-17(Table 9). The area under commercial crops i.e. sugarcane, cotton and oilseeds has shown fluctuating trends. Area under principal crops like wheat, paddy, sugarcane, cotton and oilseeds has increased manifold.
- The area under wheat rose by 244.3 per cent with a growth rate of 2.10 per cent, 621.8 per cent for paddy having growth of 3.85 per cent, 211.4 per cent for cotton with the growth of 2.36 per cent, 149 per cent for oilseeds with growth rate of 3.34 per cent while area reduced by 47 per cent for sugarcane showing negative growth of -0.75 per cent, (reasons can be price support policies etc.) and rose by 30.5 per cent only for all food grains with growth of 0.30 per cent in a span of 50 years.
- The contribution of area under wheat and paddy crops to the total gross sown area in the state was 60.70 per cent during 2016-17. The area under wheat crop was 25.58 lakh hectares while that under paddy crop increased to 13.86 lakh hectares in 2016-17. The area under total food grains increased to 45.94 lakh ha.
- The area under total pulses was 11.50 lakh ha in 1966-67, which gradually decreased to 0.67 lakh ha with the negative growth rate of -5.62 per cent in the study period and the area declined under total pulses was mainly shifted to area under wheat and paddy crop.

Table 9: Area under principal Crops in Haryana **(000 ha.)**

Year	Wheat	Paddy	Total pulses	Total F/Grain	Sugarcane	Cotton	Oilseeds	Gross Area Sown
1966-67	743 (16.16)	192 (4.17)	1150 (25.01)	3520 (76.54)	150 (3.26)	183 (3.98)	212 (4.61)	4599
1970-71	1129 (22.78)	269 (5.43)	1159 (23.38)	3868 (78.03)	156 (3.15)	193 (3.89)	143 (2.88)	4957
1980-81	1479 (27.08)	484 (8.86)	795 (14.56)	3963 (72.56)	113 (2.07)	316 (5.79)	311 (5.69)	5462
1990-91	1850 (31.26)	661 (11.17)	742 (12.54)	4079 (68.91)	148 (2.50)	491 (8.30)	489 (8.26)	5919
2000-01	2355 (38.51)	1054 (17.24)	157 (2.57)	4340 (70.97)	143 (2.34)	555 (9.08)	414 (6.77)	6115
2005-06	2303 (35.38)	1047 (16.09)	195 (3.00)	4311 (66.23)	129 (1.98)	584 (8.97)	736 (11.31)	6509
2006-07	2376 (37.08)	1042 (16.26)	169 (2.64)	4348 (67.86)	141 (2.2)	527 (8.23)	622 (9.71)	6407
2007-08	2461 (38.11)	1073 (16.62)	172 (2.66)	4477 (69.32)	140 (2.17)	482 (7.46)	511 (7.91)	6458
2008-09	2462 (37.97)	1211 (18.68)	184 (2.84)	4621 (71.27)	91 (1.40)	456 (7.03)	528 (8.14)	6484
2009-10	2488 (39.17)	1206 (18.99)	132 (2.07)	4541 (71.5)	79 (1.24)	505 (7.95)	523 (8.23)	6351
2010-11	2504 (38.53)	1243 (19.13)	176 (2.7)	4702 (72.35)	85 (1.31)	493 (7.59)	521 (8.02)	6499
2011-12	2531 (39.00)	1234 (19.02)	123 (1.9)	4581 (70.6)	95 (1.46)	602 (9.28)	546 (8.41)	6489
2012-13	2497 (39.16)	1206 (18.91)	75 (1.18)	4302 (67.47)	101 (1.58)	593 (9.30)	568 (8.91)	6376
2013-14	2499 (38.62)	1244 (19.22)	105 (1.63)	4362 (67.41)	102 (1.58)	568 (8.78)	549 (8.48)	6471
2014-15	2628 (40.42)	1277 (19.64)	84 (1.29)	4481 (68.92)	96 (1.48)	647 (9.95)	495 (7.61)	6502
2015-16	2576 (39.62)	1354 (20.82)	63 (0.97)	4453 (68.49)	94 (1.45)	615 (9.46)	527 (8.11)	6502
2016-17	2558 (39.34)	1386 (21.32)	67 (0.92)	4594 (70.66)	102 (1.57)	570 (8.77)	528 (8.12)	6502
CGR (%)	**2.10**	**3.85**	**-5.62**	**0.30**	**-0.75**	**2.36**	**3.34**	**0.67**

Value in parentheses indicate percentage to the gross area sown

Production scenario of various crops in Haryana

- Haryana is among the top ten producers of food grains. State has reached an impressive level of 180 lakh tonnes during the year 2016-17, registering an increase of more than

seven times as compared to 25.92 lakh tonne food-grains production in 1966-67 (Table 10).

- The wheat and paddy crops have played a major role in pushing up this agricultural production. Haryana is a major contributor of food-grains to the Central Pool. More than 60 per cent export of Basmati Rice is taking place from state.

Table 10: Production scenario of major crops in Haryana **(000, Tonnes)**

Year	Wheat	Rice	Total pulses	Total F/Grain	Oilseeds	Cotton*	Sugarcane
1966-67	1059	223	563	2592	92	288	510
1970-71	2342	460	832	4771	99	373	707
1980-81	3490	1359	502.5	6036	188	643	460
1990-91	6436	1834	541.7	9559	638	1155	780
2000-01	9669	2695	99.8	13295	563	1383	817
2005-06	8853	3194	111.8	13006	830	1502	831
2006-07	10059	3371	136	14759	837	1805	965
2007-08	10232	3606	101.1	15294	617	1882	885
2008-09	11360	3299	177.6	16178	911	1862	520
2009-10	10488	3628	97.3	15346	862	1919	570
2010-11	11578	3465	153.1	16568	965	1747	604
2011-12	13119	3757	107	18370	758	2621	695
2012-13	11117	3976	285.6	16226	980	2378	744
2013-14	11800	3998	90.9	16944	899	2025	773
2014-15	10707	4007	54.5	15587	739	1943	710
2015-16	11352	4115	134	16334	852	995	699
2016-17	12384	4453	162	18000	965	2041	822
CGR (%)	**4.45**	**5.36**	**-4.73**	**4.11**	**6.22**	**3.93**	**0.68**

*Production of cotton in terms of thousand bales and each bale of 170 kgs.

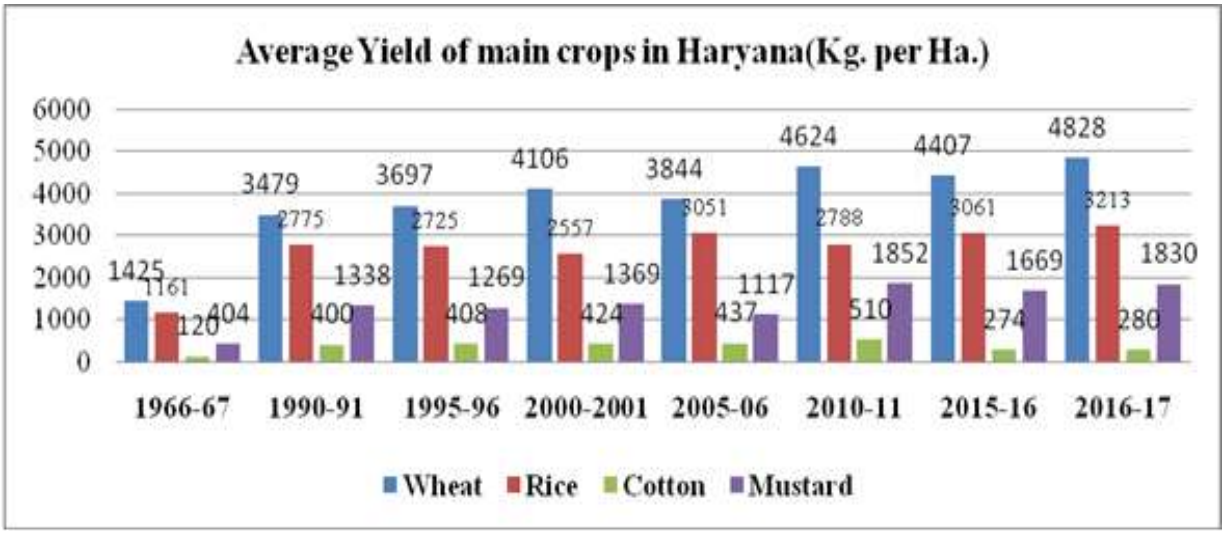
- The production of major crops has showed increasing trend over the period. The production of wheat rose by 976 per cent, rice by 1582 per cent, total food grains by 526 per cent, oilseeds by 989 per cent, cotton by 551 per cent, sugarcane by 65 per cent only in a span of 50 years.
- The total food grain production in the state was 180.00 lakh tonnes in 2016-17. The production of rice was 44.53 lakh tonnes with a growth of 5.36 per cent in study period, wheat was 123.84 lakh tonnes having growth rate of 4.45 per cent, while those of oilseeds and sugarcane was 9.65 lakh tonnes and 8.22 lakh tonnes with growth of 6.22 and 0.68 per cent, respectively during 2016-17.
- The total production of pulses was 5.63 lakh tonne in 1966-67 which drastically declined due to decline in the area and production with a negative growth rate i.e. -4.73 per cent under the pulse crops.

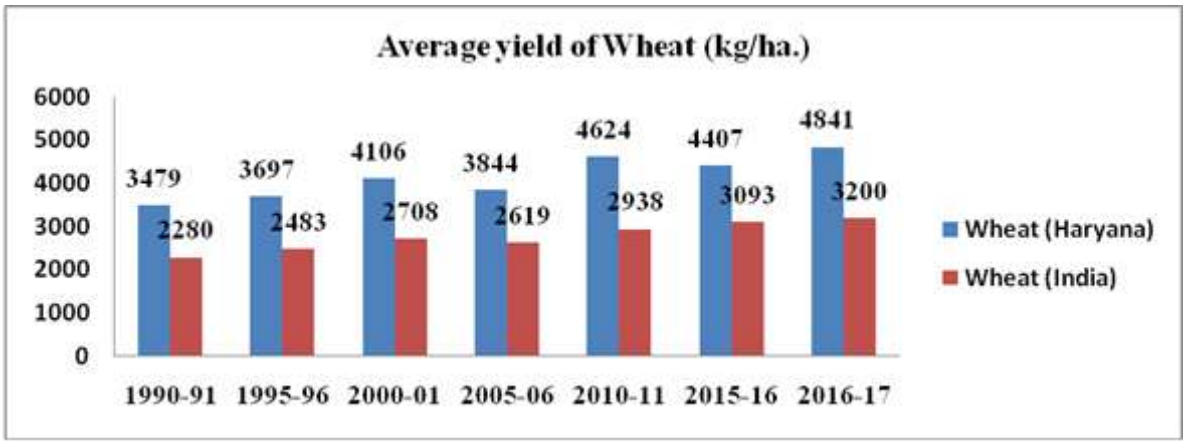
Productivity scenario of major crops in Haryana

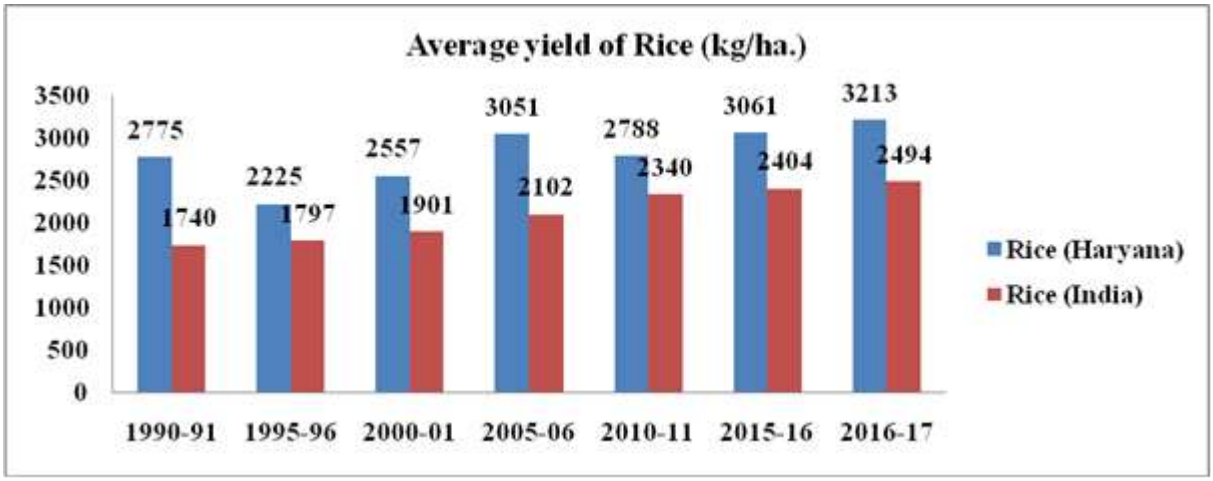
- Adoption of HYV/Hybrids along with production and protection technologies, supported by appropriate infrastructure and policies, led to improvement in crop productivity. However, yields of many crops reached to maximum level.
- Haryana is the 4th largest producer of wheat in the country with approximately 12 per cent of total wheat production. The state stands at 10th place in total rice production.
- The average yield of wheat rose by 238 per cent and of rice by 176 per cent during 50 years. It has remained much higher than the national average yield. The average yield of wheat and rice during 2016-17 in Haryana was 4828 kg. and 3213 kg. per ha respectively (Table 11).

Table 11.Average Yield of major crops in Haryana (Kg. per ha)

Year	Wheat	Rice	Cotton	Mustard
1966-67	1425	1161	120	404
1990-91	3479	2775	400	1338
1995-96	3697	2725	408	1269
2000-01	4106	2557	424	1369
2005-06	3844	3051	437	1117
2010-11	4624	2788	510	1852
2015-16	4407	3061	274	1669
2016-17	4828	3213	280	1830
CGR (%)	2.30	1.46	3.93	2.89







Factors contributing in growth of agriculture in Haryana

The growth in agriculture in the state was attained over the period due to various factors like expanded irrigation facilities, use of quality seed, adoption of improved production technologies, mechanization of farm operations, increased use of agro-chemicals etc. The details of various contributing factors in growth of agriculture are explained as under:

- The net irrigated area rose from 12.93 lakh ha in 1966-67 to 31.77 lakh ha and intensity of irrigation rose from 37.08 per cent in 1966 -67 to 90.80 per cent in the year 2016-17.
- Haryana is well irrigated as 87 per cent of net sown area is irrigated by tube wells (18.79 lakh ha) and canals (11.93 lakh ha.). The positive growth rate for area irrigated by canals and tubewells indicates that there is continuous increase in irrigated area in the state.
- The number of tractors increased from 5000 in 1966-67 to 2.78 lakh in 2016-17 and it reveals that most of farm operations in cultivation of various crops are mechanised.
- The consumption of fertilizers nutrients increased from 13.34 thousand tonnes in 1966-67 to 1347.39 thousand tonnes in 2015-16 and showed an increase of almost 100 times in 50 years. Per hectare Fertilizer consumption was around 3 kg per hectare in 1966-67 but after green revolution there was a rapid increase in the intensity of use of fertilizers almost more than eight times in the decade i.e. from 1966-67 to 1976-77. Fertilizer consumption was further increased continuously and reached at a level of 367 kg in 2015-16 indicating growth rate of 7.02 per cent per annum.
- At present there are 108 regulated markets with 173 sub-yards in the state for sale of produce and each village is well connected to regulated market with metalled road.
- The storage capacity for agriculture produce in the state increased from 3000 tonnes in 1966-67 to 0.97 lakh tonnes in 2016-17.
- The credit availability from different institutional sources of credit like co-operative banks, commercial banks , regional rural banks etc. increased to Rs. 38266.40 crores in 2012-13 indicating growth rate of 0.23 per cent per annum during period 2007-08 to 2012-13. The contribution of commercial banks in providing credit to agriculture sector was 66 per cent

while other financial institutions are also providing credit to farmers for use of improved production technologies to enhance crop productivity.

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

Haryana is a surplus food state contributing more than 15 per cent to the Central pool. The food grain production has reached up to 180.32 lakh tonnes in 2017-18.About 84 per cent of the total net sown area is irrigated and the most prevalent cropping patterns are rice-wheat and cotton-wheat. The other major crops grown in the state are mustard, pearl millet, sugarcane, vegetables and fruits.

The share of Agriculture exhibited declining trend over the period as the contribution of other sectors increase tremendously. The number of tractors increased from 5000 in 1966-67 to 2.78 lakh in 2016-17 indicating that most of farm operations in cultivation of various crops are fully mechanized. At present 54 regulated markets in the state have been connected with the e-NAM portal (National Agricultural Market) for efficient marketing of agricultural produce and better price realisation to the farmers. The expended irrigation facilities, adoption of improved technologies, mechanization of farm operation, timely availability of credits, establishment of regulated markets etc. resulted into higher productivity of crops in the state.

Salient findings of study:

- Haryana is self-sufficient in food production and contributing more than 15 per cent to the Central Pool and has achieved 180.32 lakh MTs food grain production during 2017-18 registering an increase of more than seven times as compared to 25.92 lakh MTs in 1966-67.
- More than 3/4th of the State has assured irrigation, most suited for rice-wheat production system, whereas rain fed lands (around 1/5th) are most suited for rapeseed & mustard, pearl millet, cluster bean cultivation, agro-forestry and arid-horticulture.
- The share of Agriculture fell from 60.7 per cent in 1969-70 to 42.5 per cent in 1993-94 in a span of 24 years while that of secondary rose from 17.6 per cent to 26.2 per cent and the share of services sector rose from 21.7 per cent to 31.3 per cent during the same period. It means primary sector showed a fall of 18 per cent in 24 -25 years during the pre-reforms period
- The total production of pulses was 5.63 lakh tones in 1966-67 which drastically decline due to decline area and production with a negative growth rate that is -4.75 per cent under the pulse crops
- The number of tractors increased from 5000 in 1966-67 to 2.78 lakh in 2016-17 indicating that most of farm operations in cultivation of various crops are fully mechanized.
- 54 Mandis in the state have been connected with the e-NAM (National Agricultural Market) scheme for efficient marketing of agricultural produce for better price realisation to the farmers.

i	Experiment 5: Impact assessment of sprinkler irrigation on crop productivity in southern zone of Haryana	
ii	**Objectives of the experiment**	• To work out the economics of sprinkler irrigation system. • To examine the resource use efficiency of sprinkler irrigation system. • To identify the constraints in adoption of sprinkler irrigation system.
iii	**Name(s) of the investigators**	• Dr. Vinay Mehala – Planning, preparation of schedule and report writing • Dr. Neeraj Pawar -Data collection and report writing • Dr. Monika Devi – Tabulation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	• Locale of experiment: Haryana • District covered: Bhiwani and Mahendergarh from southern zone of the state • Blocks selected :Mahendergarh and Kanina blocks from district Mahendergarh, and Kairu and Bahal blocks were selected from district Bhiwani • Villages: Bucholi and Gahara villages from Mahendergarh, Dharanbaas and Gopalwas villages from Bhiwani were selected • Number respondents: 15 farmers from each selected village were surveyed • Statistical design/ methods: The statistical tools like mean, percentage, Cobb Douglas Production function and Likert scale were used.
vii	**Observation recorded**	• Sixty farmers were interviewed to work out the economics of sprinkler irrigation. • Information related to inputs use i.e. irrigation, frequency of fertilizers, agro-chemicals from 60 farmers of both district. • Farmers were interviewed to collect information for identifying the constraints in adoption of sprinkler irrigation system.

viii. Results achieved during 2018-19

The cost and returns structure of cultivating of wheat under sprinkler irrigation is presented in table 1.The share of variable cost in the total cost in overall was more than 56 per cent. The rental value of land shared more than 30 per cent of total cost of cultivation. The per hectare overall total cost of cultivation was Rs. 68436 and it was Rs. 69389 and Rs. 67483 in Mahendergarh and Bhiwani districts respectively. The overall gross returns attained were Rs, 100622.50 whereas, in Mahendergarh and Bhiwani districts found to be Rs. 1, 04,410 and Rs.96835 respectively. Overall

net returns derived were Rs. 32186 whereas, Rs. 35021 and Rs. 29352 were found in Mahendergarh and Bhiwani districts respectively. B:C ratio calculated over total cost in Mahendergarh, Bhiwani districts were 1.50 and 1.43 respectively and overall B:C ratio 1.47 indicates that cultivation of wheat is profitable.

The cost of cultivation of mustard under sprinkler irrigation is presented in table 2. The overall variable cost incurred for cultivation of mustard accounted more than 52 per cent of the total cost. The rental value of land shared more than 35 per cent of total cost. The per hectare gross return in Mahendergarh, Bhiwani and overall were estimated at Rs. 89693, Rs. 81107 and Rs. 85400 respectively. The per hectare net returns in Mahendergarh, Bhiwani and overall were estimated at Rs. 28577, Rs. 20973 and Rs. 24775 respectively and B:C ratio over total cost were found 1.47, 1.35 & 1.41 respectively.

Table 1: Cost and return of wheat cultivation under sprinkler irrigation in Haryana

S. No.	Particulars	Mahendergarh	Bhiwani	Overall
1.	Field preparation	6810 (9.81)	7085 (10.50)	6947.50 (10.15)
2.	Seed cost	2590 (3.73)	2535 (3.76)	2562.50 (3.74)
3.	Fert. Investment	5465 (7.88)	5290 (7.84)	5377.50 (7.86)
4.	Irrigation	7720 (11.13)	7410 (10.98)	7565.00 (11.05)
5.	Hoeing/weeding	892 (1.29)	735 (1.09)	813.50 (1.91)
6.	Plant protection	-	-	-
7.	Harvesting & Threshing	13980 (20.15)	12760 (18.91)	13370.00 (19.54)
8.	Misc.	1905 (2.75)	1612 (2.39)	1758.50 (2.57)
9.	Variable cost	39362 (56.73)	37427 (55.46)	38394.50 (56.10)
10.	Mgt and risk charges	7872 (11.34)	7486 (11.09)	7679.00 (11.22)
11.	Rental value of land	20875 (30.08)	21425 (31.75)	21150.00 (30.90)
12.	Transportation	1280 (1.84)	1145 (1.70)	1212.50 (1.77)
13.	Total Cost	69389 (100.00)	67483 (100.00)	68436.00 (100.00)
14.	Production (main)	87860	83720	85790.00
15.	By-product	16550	13115	14832.50
16.	Gross Return	104410	96835	100622.50
17.	Cost of Production (Rs./qtl.)	1453	1483	1468
18.	Return over variable cost	65048	59408	62228.00
19.	Net Return	35021	29352	32186.50
20.	B:C over variable cost	2.65	2.59	2.62
21.	B:C over total cost	1.50	1.43	1.47

Figure in parentheses indicate the percentage of total cost.

Table-2 : Cost and returns of mustard cultivation under sprinkler irrigation in Haryana

S. No.	Particulars	Mahendergarh	Bhiwani	Overall
1.	Field preparation	6780 (11.09)	7135 (11.87)	6957.50 (11. 48)
2.	Seed cost	870 (1.42)	845 (1.41)	857.50 (1.41)
3.	Fert. Investment	4463 (7.30)	4305 (7.16)	4384.00 (7.23)
4.	Irrigation	4825 (7.89)	4490 (7.47)	4657.50 (7.68)
5.	Hoeing/weeding	4686 (7.67)	4130 (6.87)	4408.00 (7.27)
6.	Plant protection	605 (0.99)	485 (0.81)	545.00 (0.90)
7.	Harvesting & Threshing	8190 (13.40)	7680 (12.77)	7935.00 (13.09)
8.	Misc.	1869 (3.06)	1808 (3.01)	1838.50 (3.03)
9.	Variable cost	32288 (52.83)	30878 (51.35)	31583.00 (52.10)
10.	Mgt and risk charges	6458 (10.57)	6176 (10.27)	6317.00 (10.42)
11.	Rental value of land	21250 (34.77)	22100 (36.75)	21675 (35.75)
12.	Transportation	1120 (1.83)	980 (1.63)	1050.00 (1.73)
13.	Total Cost	61116 (100.00)	60134 (100.00)	60625.00 (100.00)
14.	Production (main)	85893	78057	81975.00
15.	By-product	3800	3050	3425.00
16.	Gross Return	89693	81107	85400.00
17.	Cost of Production (Rs./qtl.)	2913	3182	3047.50
18.	Return over variable cost	57405	50229	53817.00
19.	Net Return	28577	20973	24775.00
20.	B:C over variable cost	2.78	2.63	2.71
21.	B:C over total cost	1.47	1.35	1.41

Figure in parentheses indicate the percentage of total cost.

Resource use efficiency

The elasticity of production coefficient with test of significance and standard error for mustard crop was presented in the table 3. The estimated coefficient of multiple determinations (R^2) revealed that selected inputs (human labour, machine labour, seed, fertilizers, plant protection and irrigation) were capable of explaining 72.81, 76.45 and 81.23 per cent variation in mustard production in Mahendergarh, Bhiwani and overall of both districts, respectively. It was seen that for Mahendergarh district, coefficient relating to variables like fertilizers and plant protection were significant, while human labour showing negative significance, hence with more variables either being non or negative significance, elasticity of productions was seen to be decreasing. Similarly, in case of Bhiwani district fertilizers and plant protection were significant, while human labour showing negative significance, hence with more variables either being non or negative significance,

elasticity of productions was seen to be decreasing. Similarly, in case of both the districts as whole, fertilizer and plant protection were significant, while human labour showing negative significance, hence with more variables either being non or negative significance, elasticity of productions was seen to be decreasing.

Table 3: Regression coefficient and standard error of mustard production function in Haryana

N=60

Particulars	**Mahendergarh**	**Bhiwani**	**Overall**
	Coefficients	**Coefficients**	**Coefficients**
Intercept	17.42 (4.43)	11.77 (2.86)	11.90 (2.67)
Human labour	-0.29* (0.29)	-0.15** (0.20)	-0.31* (0.19)
Machine Labour	0.19 (0.35)	0.17 (0.19)	0.18 (0.21)
Seed	0.04 (0.14)	0.03 (0.19)	0.04 (0.11)
Fertilizer	0.15* (0.09)	0.14* (0.05)	0.14** (0.05)
Plant protection	0.02* (0.04)	0.03* (0.04)	0.03* (0.03)
Irrigation total	0.07 (0.14)	0.06*** (0.12)	0.06 (0.10)
Return to scale	0.18 (Decreasing)	0.28 (Decreasing)	0.14 (Decreasing)
R^2 (%)	0.7281	0.7645	0.8123

Figures in parentheses indicate the standard error of estimated parameters
*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

The estimated coefficient of multiple determinations (R^2) revealed that selected inputs (human labour, machine labour, seed, fertilizers, plant protection and irrigation) were capable of explaining 68.56, 71.23 and 65.42 per cent variation in mustard production in Mahendergarh, Bhiwani and overall of both the districts, respectively (Table 4). It was seen that for Mahendergarh district, coefficient relating to variables fertilize cost was significant, while human labour showing negative significance, hence with more variables either being non or negative significance, elasticity of production was seen to be decreasing. Similarly, in case of Bhiwani district machine labour and fertilizer costs were significant hence with more variables either being non or negative significance, elasticity of production was seen to be decreasing. Similarly, in case of Overall of both the districts fertilizer cost and irrigation were significant, while human labour showing negative significance, hence with more variables either being non or negative significance, elasticity of productions was seen to be decreasing.

Table 4: Regression coefficient and standard error of wheat production function in Haryana

N=60

Particulars	Mahendergarh	Bhiwani	Overall
	Coefficients	Coefficients	Coefficients
Intercept	12.83 (7.29)	6.31 (2.28)	10.63 (1.52)
Human labour	-0.14** (0.73)	0.05 (0.12)	-0.12** (0.11)
Machine Labour	0.20 (0.17)	0.23** (0.13)	0.17 (0.10)
Seed cost	-0.01 (0.08)	-0.01 (0.12)	-0.01 (0.07)
Fertilizer cost	0.10** (0.06)	0.14** (0.08)	0.12** (0.03)
Plant protection	0.01 (0.09)	0.01 (0.11)	0.01 (0.06)
Irrigation total	0.11 (0.04)	0.09 (0.07)	0.11*** (0.03)
Return to scale	0.27 Decreasing	0.51 Decreasing	0.28 Decreasing
R^2 (%)	0.6856	0.7123	0.6542

Figures in parentheses indicate the standard error of estimated parameters,*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Marginal value of productivities (MVPs)

Resource use efficiency: In order to examine the resource use efficiency in mustard production, the marginal value productivity (MVP) of inputs whose regression coefficients were found to be statistically significant in mustard production function were compared with their respective unit price. To test the significance of deviation of MVP of an input from its unit price, t-statistics was used. A significant higher MVP of an input from its unit price implies that more of that input can be used to increase the mustard productivity, while a significant lower MVP of an input from its unit price implies that the input is used in excess and needs curtailment.

The present study revealed that the difference between MVP of fertilizer cost and plant protection and its unit was found to positive and significant in Mahendergarh, Bhiwani as well as in overall result of both the districts. While, human labour found to be negatively significant in Mahendergarh, Bhiwani as well as in overall result of both the districts (Table 5).

Table 5: Resource use efficiency of mustard crop in Haryana

Mahendergarh (N=30)					
Resources	**GM**	**B**	**MVP**	**MFC**	**Difference**
Human labour	12432.99	-0.29	-1.68	1.00	-2.68*
Machine labour	6204.08	0.19	2.23	1.00	1.23
Seed cost	1749.65	0.04	1.65	1.00	0.65
Fertilizer cost	2879.73	0.15	3.76	1.00	2.76*
Plant protection	159.63	0.02	9.04	1.00	8.04*
Irrigation	2279.67	0.07	2.22	1.00	1.22

Bhiwani(N=30)					
Human labour	12779	-0.15	-0.95	1.00	-1.95**
Machine labour	6334	0.17	2.18	1.00	1.18
Seed cost	1773	0.03	1.37	1.00	0.37
Fertilizer cost	3478	0.14	3.25	1.00	2.25*
Plant protection	288	0.03	8.41	1.00	7.41*
Irrigation	2085	0.06	2.33	1.00	1.33***
Overall of both the districts (N=60)					
Human labour	12604.63	-0.31	-1.88	1.00	-2.88*
Machine labour	6268.49	0.18	2.21	1.00	1.21
Seed cost	1761.33	0.04	1.73	1.00	0.73
Fertilizer cost	3164.73	0.14	3.38	1.00	2.38**
Plant protection	214.59	0.03	10.68	1.00	9.68*
Irrigation	2180.10	0.06	2.10	1.00	1.10

*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

The difference between MVP of fertilizer cost and its unit was found to positive and significant in Mahendergarh, Bhiwani as well as in overall result of both the districts. While, human labour found to be negatively significant in Mahendergarh, Bhiwani as well as in overall result of both the districts (Table 6).

Table 6: Resource use efficiency of wheat crop in Haryana

Mahendergarh (N=30)					
Resources	**GM**	**B**	**MVP**	**MFC**	**Difference**
Human labour	14657.89	-0.14	-0.83	1.00	-1.83**
Machine labour	7729.86	0.20	2.25	1.00	1.25
Seed cost	2652.02	-0.01	-0.27	1.00	-1.27
Fertilizer cost	2712.09	0.10	3.32	1.00	2.32**
Plant protection	481.18	0.01	2.19	1.00	1.19
Irrigation	4513.21	0.11	2.14	1.00	1.14
Bhiwani(N=30)					
Human labour	13975.17	0.05	0.35	1.00	-0.65
Machine labour	7222.48	0.23	3.07	1.00	2.07**
Seed cost	2438.42	-0.01	-0.24	1.00	-1.24
Fertilizer cost	4262.30	0.14	3.14	1.00	2.14**
Plant protection	501.01	0.01	2.27	1.00	1.27
Irrigation	3973.26	0.09	2.16	1.00	1.16
Overall of both the districts (N=60)					
Human labour	14312.46	-0.12	-0.74	1.00	-1.74**
Machine labour	7471.87	0.17	2.13	1.00	1.13
Seed cost	2542.98	-0.01	-0.25	1.00	-1.25
Fertilizer cost	3399.96	0.12	3.23	1.00	2.23**
Plant protection	490.82	0.01	2.06	1.00	1.06
Irrigation	4234.64	0.11	2.38	1.00	1.38***

*Significance at 1% level, **Significance at 5% level, ***Significance at 10% level

Constraints faced by respondents

Total eight constraints were analyzed by Likert scale and it was found that most of farmers were agree with the given statements *i.e.* 'heavy initial investment' (43.33%), 'fewer subsidies as compared to investment' (33.33%), 'due to high temperature more water loss in irrigation system' (50.00%), 'less efficiency of the sprinkler due to high wind velocity' (51.67%), 'presence of salty water' (45.00%) and 'unavailability of spare parts at proper time in the village market' (38.33), and strongly agree for statement 'irregular supply of electricity in the area' (48.33) (Table 7).

Table 7: Constraints faced by the respondents (N =60)

S. N.	Particulars	SD	DA	N	A	SA	Total Weighted Score	Weighted Mean Score	Rank Order
		1	2	3	4	5			
1)	Irregular supply of electricity in the area	0 (0.00)	1 (1.67)	3(5)	27 (45)	**29 (48.33)**	**264**	**4.40**	**I**
2)	Heavy initial investment.	1 (1.67)	7 (11.67)	2 (3.33)	**26 (43.33)**	24 (40.00)	245	4.08	II
3)	Less efficiency of the sprinkler due to high wind velocity.	1 (1.67)	4 (6.67)	5 (8.33)	**31 (51.67)**	19 (31.67)	243	4.05	III
4)	Declining water table	-	-	6 (20.00)	**46 (76.66)**	8 (13.33)	242	4.03	IV
5)	Due to high temperature more water loss in irrigation system.	2 (3.33)	1 (1.67)	14 (23.33)	**30 (50.00)**	13 (21.67)	231	3.85	V
6)	Presence of salty water.	2 (3.33)	7 (11.67)	10 (16.67)	**27 (45.00)**	14 (23.33)	224	3.73	VI
7)	Unavailability of spare parts at proper time in the village market.	3 (5)	11 (18.33)	4 (6.67)	**23 (38.33)**	19 (31.67)	224	3.73	VI
8)	Fewer subsidies as compared to investment.	3 (5)	15 (25)	10 (16.67)	**20 (33.33)**	12 (20.00)	203	3.38	VII

SD - Strongly Disagree, DA– Disagree, N - Neutral, A - Agree, SA -Strongly Agree

There are two types of variants available in sprinkler irrigation system i.e. H.D.P.E. and aluminium

Table 8: Establishment cost of irrigation structure and sprinkler set

S. No.	Particulars	H.D.P.E.	Aluminium
i.	Sprinkler Set (10 years in H.D.P.E.) (20-25 year in Aluminium) with extra nozzle	11350	40350
ii.	Motor 17HP	80000	80000
iii.	Building	25000	25000
iv.	Boring Well (250-300feet)	21000	21000
v.	Pipes (10 inch)	57000	57000
vi.	Electricity connection	125000	125000
vii.	Extra pipe/ khamba	12500	12500
viii.	Labour	1000	1000
Total		**320000**	**361850**

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

The sprinkler irrigation was found efficient irrigation device and cover higher area as compared to flood irrigation in the study area. The per hectare net returns from wheat in study area was found Rs.32186 with B:C ratio of 1.47. The figures for the mustard crop recorded were Rs. 24775 with B:C ratio of 1.41.The difference between MVP of machine labour, fertilizer, plant protection, irrigation and its unit price was found to positive and significant in both districts which indicate that these inputs were underutilized. The major constraints reported by the respondents in the study area were heavy initial investment, less efficiency (irrigation) due to high temperature &high wind velocity, salty water and erratic supply of electricity.

Salient findings of the study

- Per hectare net returns from wheat in Mahendergarh, Bhiwani and overall were estimated at Rs.35021,29352 and Rs.32186 respectively. The B:C ratio were found 1.50, 1.43 and 1.47, respectively.
- Per hectare net returns from mustard in Mahendergarh, Bhiwani and overall were estimated at Rs. 28577, 20973 and Rs. 24775, respectively. The B:C ratio were found 1.47, 1.35 and 1.41, respectively.
- The difference between MVP of machine labour, fertilizer, plant protection, irrigation and its unit price was found to positive and significant in Mahendergarh district. Similarly in case of Bhiwani district machine labour, fertilizer cost, plant protection and irrigation and overall machine labour, fertilizer cost, plant protection and irrigation was found to positive and significant which indicate that these inputs were underutilized in respective district.
- Heavy initial investment, less efficiency (irrigation) due to high temperature & high wind velocity, salty water and erratic supply of electricity were the main constraints.

I	**Experiment 6: Gap analysis of MSP and harvest price of principal crops in Hisar district of Haryana state**	
ii	**Objectives of the experiment**	• To examine the trends in harvest prices of major agricultural commodities • To analyze the gap in market price and MSP • To identify the constraints faced in getting MSP.
iii	**Name(s) of the investigators**	• Dr. Vinay Mehala Preparation of schedule, collection and compilation of data • Dr. V. P. Mehta – Planning and report writing • Monika Devi – Tabulation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	• Locale of experiment: Haryana • Crops: Paddy, Bajra, Wheat, Mustard, Cotton and Gram • Area covered: Grain Market of Hisar district. • Number and type of respondents: Thirty (30) farmers and Thirty (30) market intermediaries. • Statistical design/ methods: The statistical tools like mean, percentage were used.
vii	**Observations recorded**	• Harvest prices and MSP of principal crops were collect for the period of 1997 to 2017. • Farmers and market intermediaries were interviewed to collect information for identifying the constraints in getting MSP.

viii- Results Achieved 2018-19

To examine the effectiveness of MSP policy for food crops in Haryana, difference between their post- harvest prices (FHP) and minimum support price (MSP) was calculated for different years (Table 1).

- Wheat experienced positive deviations 13 times in 20 years during 1997-2017, negative for one year and there was no deviation for six years out of total 20 years of study. This means that the average FHP was equal to or ruled higher than MSP most of the times. The adjusted difference (positive) between MSP and FHP was as low as 65 per cent of MSP and the negative difference was 30 per cent, in case of wheat.
- Gram shows positive deviations all the times under study. This means that the average FHP was higher than MSP during study.
- Mustard experienced positive deviations 14 times in 20 years during 1997-2017 and negative for six years. This means that the average FHP was higher than MSP most of the times.

- Bajra experienced positive deviations 16 times in 20 years during 1997-2017 and negative for four years. This means that the average FHP was higher than MSP most of the times.
- In case of paddy, positive deviations 15 times in 20 years during 1997-2017 and negative for five years. This means that the average FHP was higher than MSP most of the times.

Table1: Deviation of Market Price vis-à-vis Minimum Support Price of major food crops in Haryana (1997-98 to 2017-18):

Crop	Negative Deviation				Positive Deviation				No Deviation	
	MAND (Rs/q)	AMND	Freq.	%	MAPD (Rs/q)	AMPD	Freq.	%	Freq.	%
Wheat	-7.32	-1.44	1	5	31.10	3.90	13	65	6	30
Gram	0.00	0.00	0	0	572.68	31.59	20	100	0	0
Mustard	-90.67	-4.87	6	30	408.63	21.77	14	70	0	0
Bajra	-62.91	-12.84	4	20	56.70	8.84	16	80	0	0
Paddy	-39.26	-4.90	5	25	98.41	9.65	15	75	0	0
Cotton	-115.04	-7.09	3	15	786.99	29.54	17	85	0	0

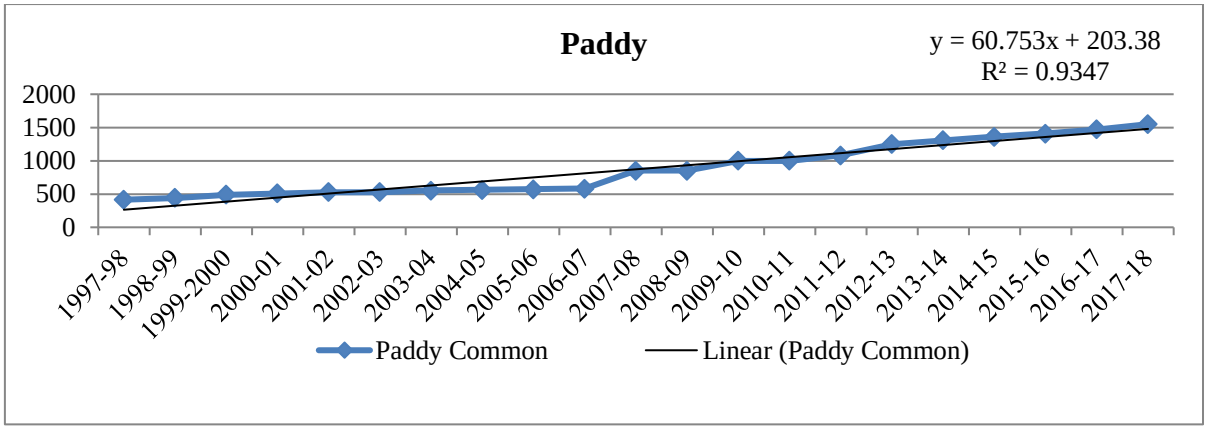
*** MAND -Mean Absolute Negative Deviation, * MAPD -Mean Absolute Positive Deviation**
*** AMND - Adjusted Mean Negative Deviation, * AMPD - Adjusted Mean Positive Deviation**

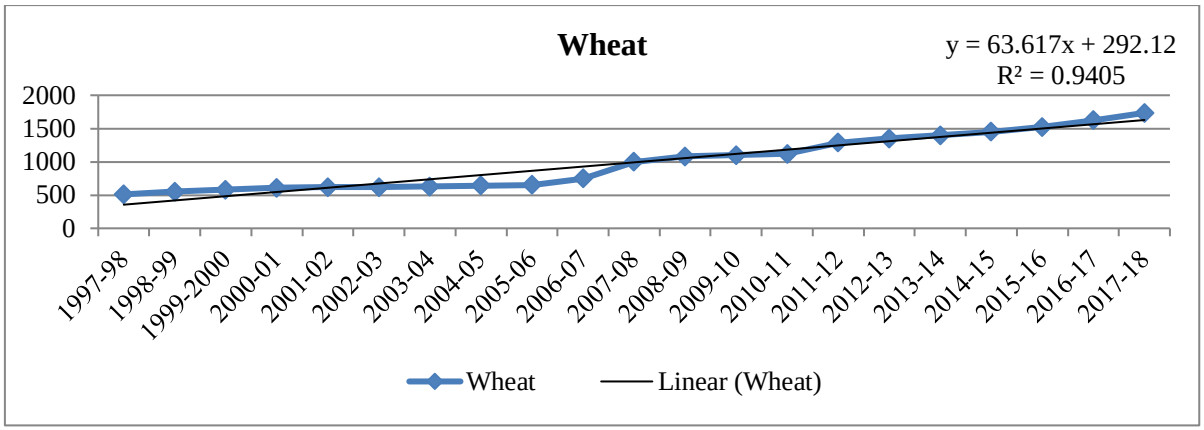
MSP Trends for selected crops (1997-98 to 2017-18):

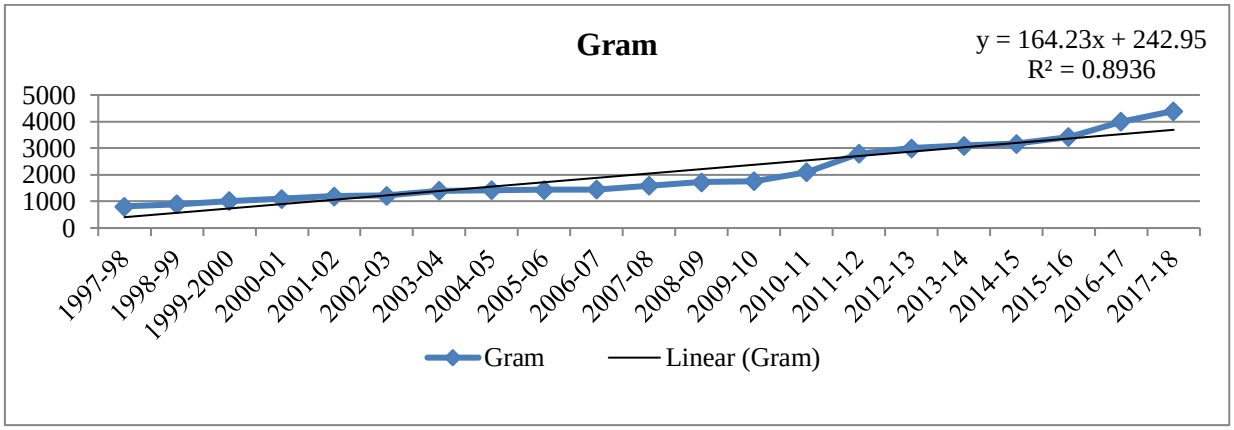
MSP for all the crops was increasing linearly with a high value of R^2 i.e; for Paddy (0.93), Wheat (0.94), Gram (0.89), Mustard (0.90), Bajra (0.92) and Cotton (0.90), (Table 2).

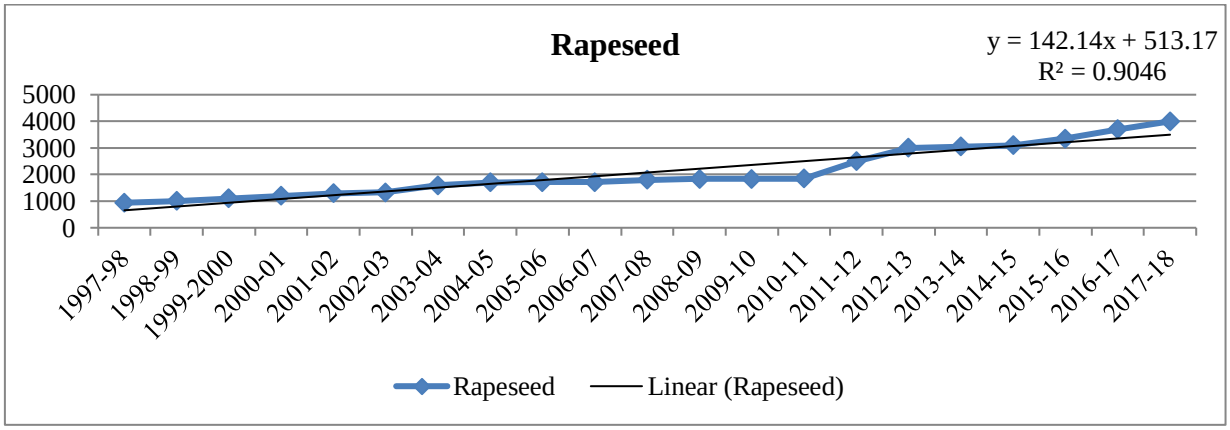
Table 2: Trends in MSP for selected crops in Haryana (1997-98 to 2017-18)

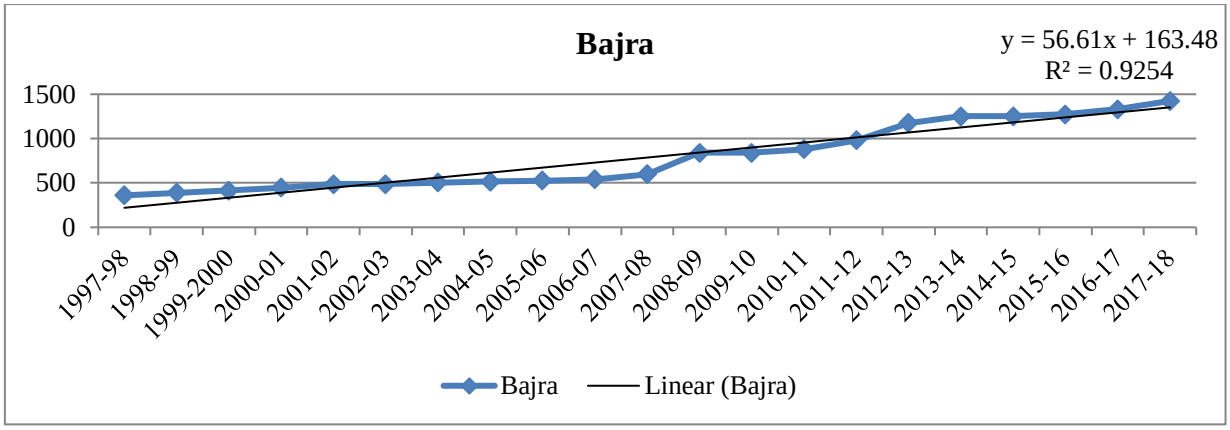
Crop	Equation	R^2	Constant	b1
Paddy	Linear	0.93	203.3	60.75
Wheat	Linear	0.94	292.1	63.61
Gram	Linear	0.89	243.9	164.2
Mustard	Linear	0.90	513.1	142.1
Bajra	Linear	0.92	163.4	56.61
Cotton	Linear	0.90	1023	154.8

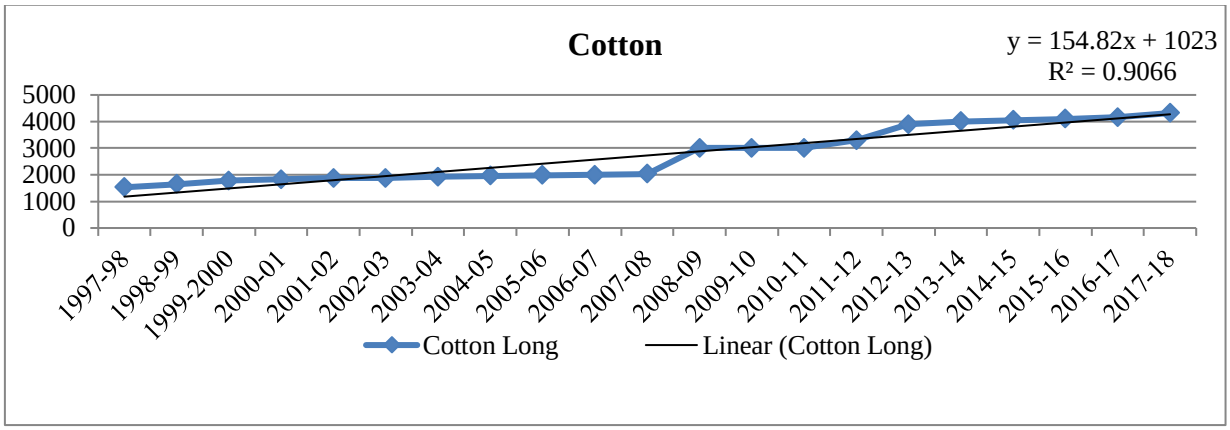

Paddy
y = 60.753x + 203.38
R² = 0.9347
2000
1500
1000
500
0
1997-98
1998-99
1999-2000
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
Paddy Common
Linear (Paddy Common)


Wheat
y = 63.617x + 292.12
R² = 0.9405
2000
1500
1000
500
0
1997-98
1998-99
1999-2000
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
Wheat
Linear (Wheat)

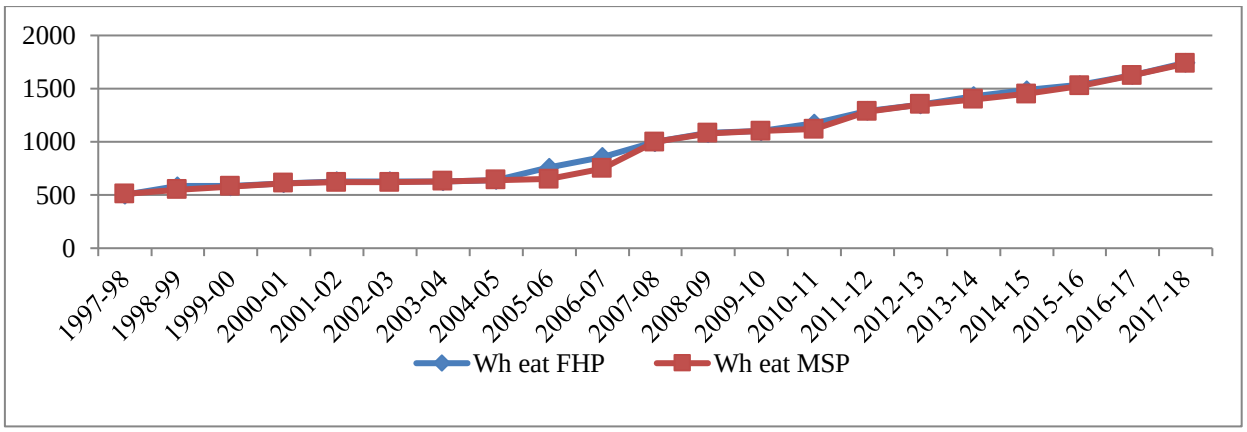

Gram
y = 164.23x + 242.95
R² = 0.8936
5000
4000
3000
2000
1000
0
1997-98
1998-99
1999-2000
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
Gram
Linear (Gram)

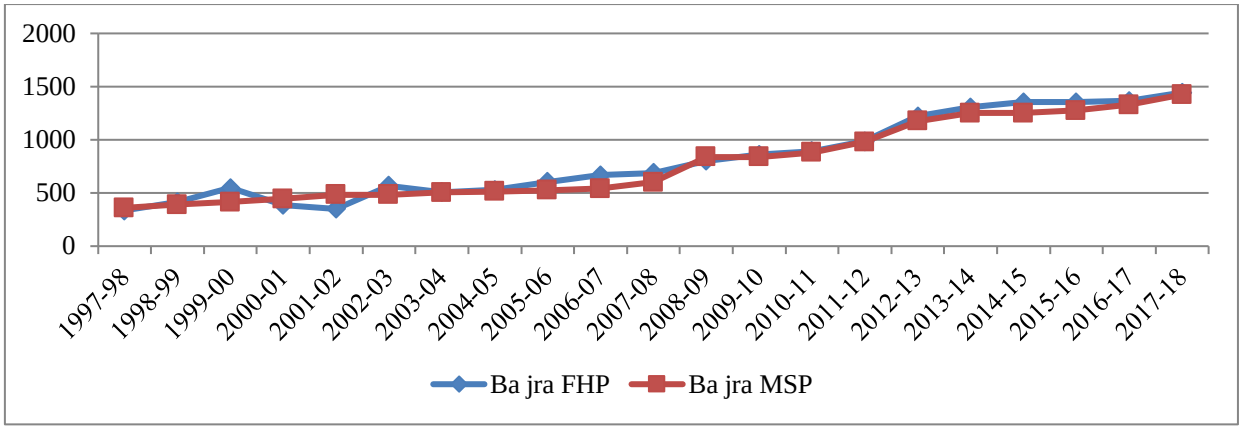

Rapeseed
y = 142.14x + 513.17
R² = 0.9046
5000
4000
3000
2000
1000
0
1997-98
1998-99
1999-2000
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
Rapeseed
Linear (Rapeseed)

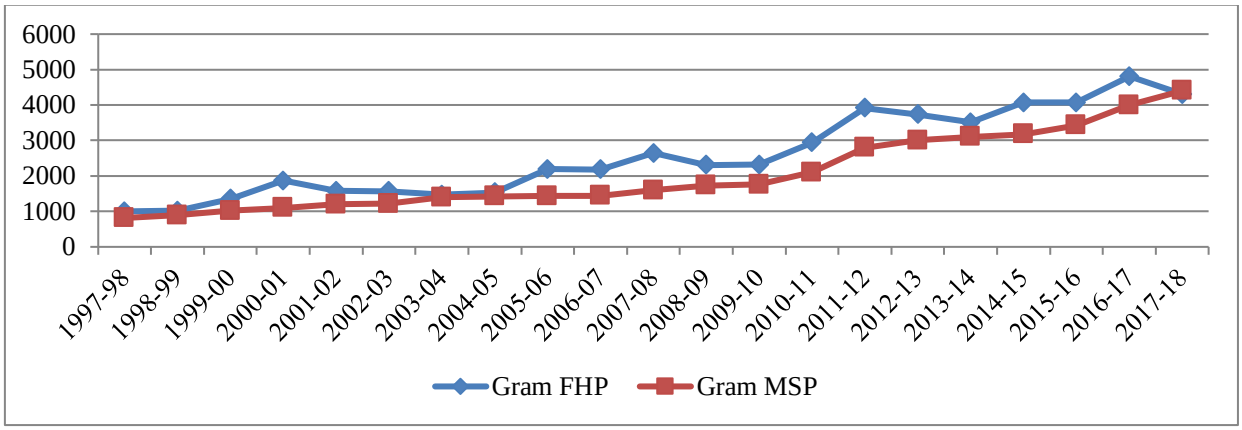


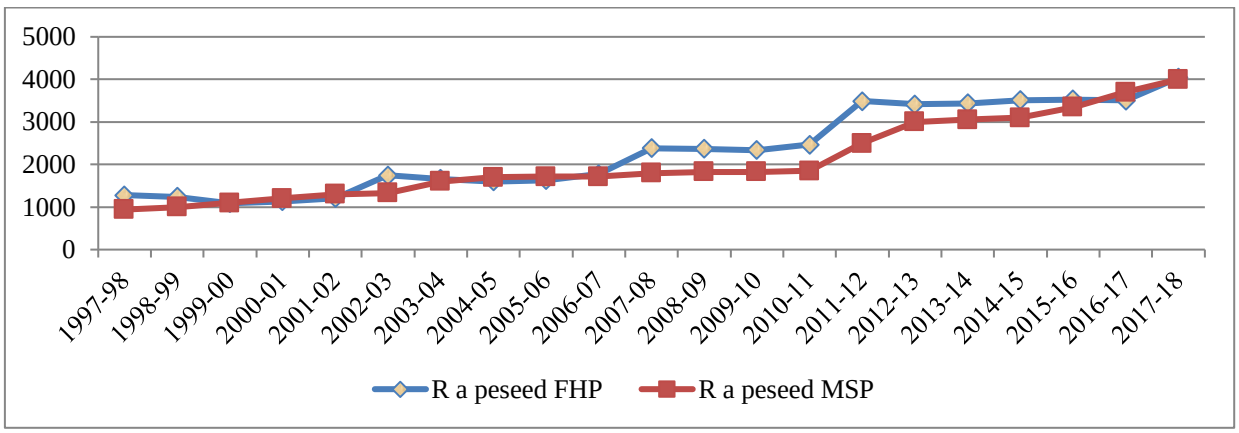


Gap Trend in MSP and FHP:









Most of the farmers were found agree with the statement like 'Online registration of farmers' (53.33%), 'Purchasing limit of produce' (56.67%), 'Illiteracy of farmers (60%), 'Date allotment procedure for purchasing of produce'(46.67), 'During peak season/heavy glut in arrival and low market prices even below MSP' (56.67), but were found neutral for statement like 'Delay in payment' (30.00%). Again most of the farmers under survey were found strongly agree with the statements like 'Problem of moisture content in produce faced by farmers' (43.33%) (Table3).

Most of the market intermediaries were found agree with the statement like 'Low wage rate fixed by government for labour work' (60.00), 'Problem of moisture content in produce faced by middleman' (63.33), 'Delay in payment' (56.67), 'Price fluctuation in agricultural commodities'

(53.33). Again most of the farmers under survey were found strongly agree with the statements like 'Direct payment in farmers bank account' (53.33) (Table 4).

Table 3: Constraints faced by farmers in disposal of farm produce in Hisar market N=30

S.N.	Problems / Constraints	SD (1)	D(2)	N(3)	A(4)	SA(5)	Total Weighted Score	Weighted Mean Score	Rank Order
		1	2	3	4	5			
1	Problem of moisture content in produce	0 (0.00)	1 (3.33)	6 (20.00)	10 (33.33)	13 (43.33)	125	4.17	I
2	Illiteracy of farmer.	0 (0.00)	2 (6.67)	1 (3.33)	18 (60.00)	9 (30.00)	124	4.13	II
3	During peak season/heavy glut in arrival low market prices even below MSP.	0 (0.00)	1 (3.33)	3 (10.00)	17 (56.67)	9 (30.00)	124	4.13	II
4	Online registration of farmers.	0 (0.00)	1 (3.33)	4 (13.33)	16 (53.33)	9 (30.00)	123	4.10	III
5	Complex procedure of documentation.	0 (0.00)	2 (6.67)	4 (13.33)	14 (46.67)	10 (33.33)	122	4.07	IV
6	Purchasing limit of produce.	0 (0.00)	1(3.33)	5 (16.67)	17 (56.67)	7 (23.33)	120	4.00	V
7	Date allotment procedure for purchasing the produce.	0 (0.00)	2 (6.67)	6 (20)	14 (46.67)	8 (26.67)	118	3.93	VI
8	Time consuming process.	2 (6.67)	1 (3.33)	5 (16.67)	13 (43.33)	9 (30.00)	116	3.87	VII
9	Lack of information / proper extension work.	4 (13.33)	2 (6.67)	3 (10.00)	11 (36.67)	10 (33.33)	111	3.70	VIII
10	Date bound procedure	6 (20.00)	3 (10.00)	7 (23.33)	8 (26.67)	6 (20.00)	95	3.17	IX
11	Delay in payment	7 (23.33)	8 (26.67)	9 (30.00)	4 (13.33)	2 (6.67)	76	2.53	X

Table 4: Constraints faced by market intermediaries in procurement of farm produce in Hisar Market N=30

S.N.	Problems / Constraints	SD	D	N	A	SA	Total Weighted Score	Weighted Mean Score	Rank Order
		1	2	3	4	5			
1	Direct payment in farmers bank account	0 (0.00)	0 (0.00)	0 (0.00)	14 (46.67)	16 (53.33)	136	4.53	I
2	Low wage rate fix by government for labour work.	0 (0.00)	0 (0.00)	0 (0.00)	18 (60.00)	12 (40.00)	132	4.40	II
3	Delay in payment.	0 (0.00)	0 (0.00)	6 (20.00)	17 (56.67)	7 (23.33)	121	4.03	III
4	Problem of moisture content in produce faced by middleman.	0 (0.00)	1 (3.33)	4 (13.33)	19 (63.33)	6 (20.00)	120	4.00	IV
5	Price fluctuation in agricultural commodities.	0 (0.00)	0 (0.00)	8 (26.67)	16 (53.33)	6 (20.00)	118	3.93	V
6	**Storage of produce**	**4 (13.33)**	**8 (26.67)**	**6 (20.00)**	**8 (26.67)**	**4 (13.33)**	**90**	**3.00**	**VI**

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

The MSP of all crops was increasing linearly with a value of R^2 i.e. for paddy (0.93), wheat (0.94), gram (0.89), mustard (0.90), bajra (0.92) and cotton (0.90). The maximum positive deviation was observed in case of mustard. The various constraints in disposal of farm produce as reported by the farmers were higher moisture content, heavy glut of produce in post-harvest period, payment in farmers bank account etc.

Salient findings of the study

- MSP for all the crops was increasing linearly with a high value of R^2 *i.e.* for paddy (0.93), wheat (0.94), gram (0.89), mustard (0.90), bajra (0.92) and cotton (0.90).
- Maximum positive deviation was observed in mustard *i.e*. 6 times.
- Problem of moisture contain in produce ranked 1stposition among all the constraints faced by farmers.
- Direct payment in farmer's bank account ranked1st position among all the constraints faced by market intermediaries.
- The major constraints faced by farmers were Problem of moisture content in produce, illiteracy, heavy glut in arrival low market prices even below MSP during peak season.
- The major constraints faced by market intermediaries were direct payment in farmers' bank account, low wage rate fix by government for labour work and delay in payment.

i	**Experiment 7: Measurement of variability and factors affecting agricultural production of principal crops of Haryana**	
ii	**Objectives of the experiment**	• To examine the trends in area, production and productivity of principal crops of Haryana. • To study the variability in area, production and productivity of principal crops. • To analyze the factors affecting agricultural production of Principal crops.
iii	**Name(s) of the Investigator**	• Dr. Monika Devi – Compilation and analysis of data • Dr. V. P. Mehta –Planning and report writing • Dr. VinayMehala - Data collection and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	• **Locale of experiment:** Haryana • **Crops:** Wheat, Gram, Paddy and Cotton • **Period:** 1980-2018 • **Statistical Design/Methods:** Descriptive statistics, trend analysis, coefficient of variation, Index of Cuddy and Della (1978), coefficient of determination and ridge regression techniques were used.
vii	**Observations recorded**	• The present study was based on secondary data. • Data of area, production and productivity for the selected crops were collected. • Data on total cropped area, gross irrigated area, fertilizer consumption, number of tractors, average annual rainfall, consumption of pesticide and indices of agriculture production were also collected.

Viii Results achieved during 2018-19:

It has been observed that all the crops have a positive growth rate for area, production and yield during the study period except gram for which area and production have negative growth rates. Minimum area has been found in the year 1980-81, 2017-18, 1988-89 and 1984-85 for wheat, gram, paddy and cotton, respectively (Table 1).

Table 1: Statistics of area, production and yield for wheat, paddy, gram and cotton in Haryana state: 1980- 2017

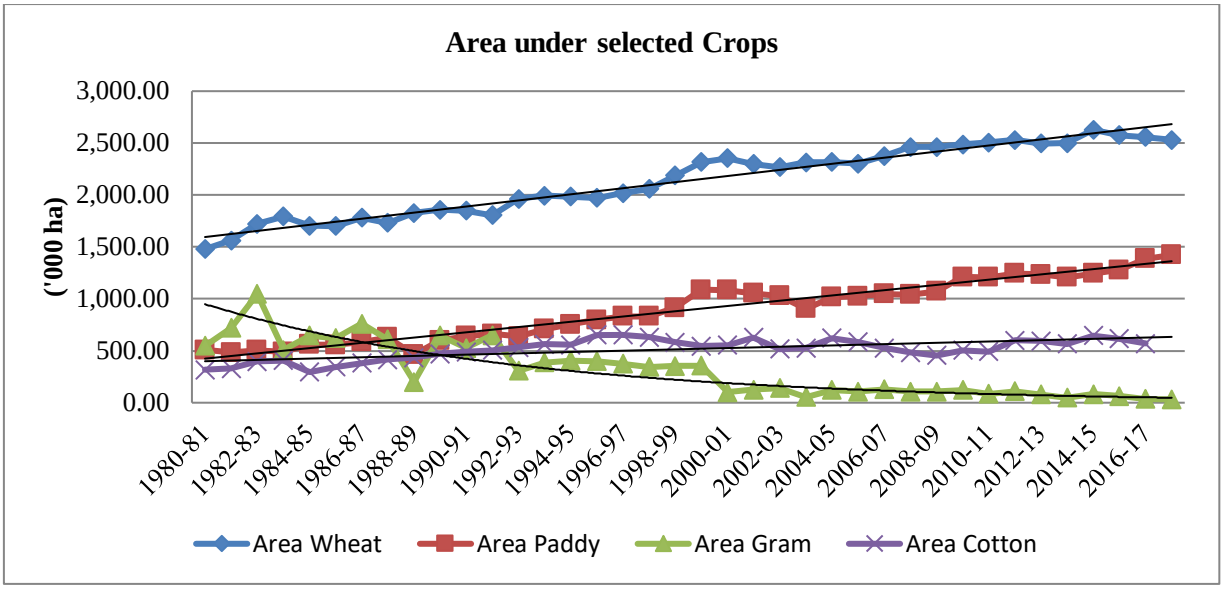
Crop Season	Crop	Area ('000 ha)				Production ('000 tonnes)				Yield (Kg/ha)			
		Min	Max	Mean	CAGR	Min	Max	Mean	CAGR	Min	Max	Mean	CAGR
Rabi	Wheat	1479 (1980-81)	2628 (2014-15)	2138	1.46	3490 (1980-81)	13119 (2011-12)	8286	3.45	2357 (1981-82)	5183 (2011-12)	3768	1.9
	Gram	32 (2017-18)	1046 (1982-	318	-7.38	36 (2017-18)	625 (1986-	222	-5.67	296 (1982-	1189 (2016-	767	1.8

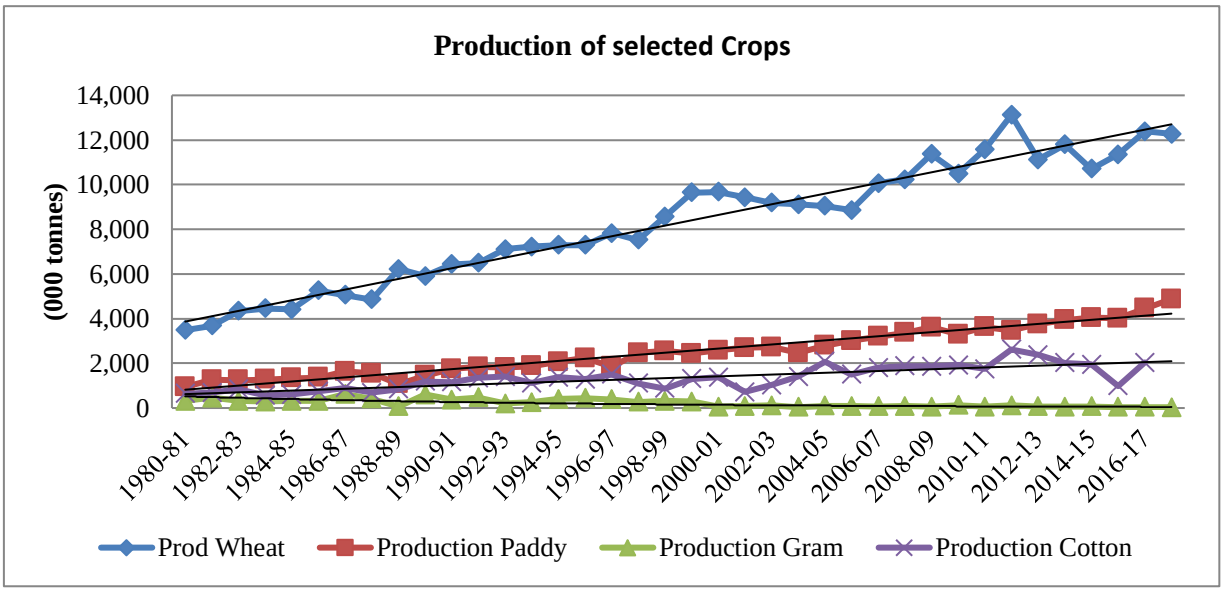
			83)				87)			83)	17)		
Kharif	Paddy	464 (1988-89)	1422 (2017-18)	893	2.81	941 (1980-81)	4880 (2017-18)	2523	4.54	1852 (1980-81)	3431 (2017-18)	2755	1.6
	Cotton	295 (1984-85)	653 (1996-97)	513	1.65	567 (1983-84)	2621 (2011-12)	1338	3.26	195 (2001-02)	740 (2011-12)	439	1.5

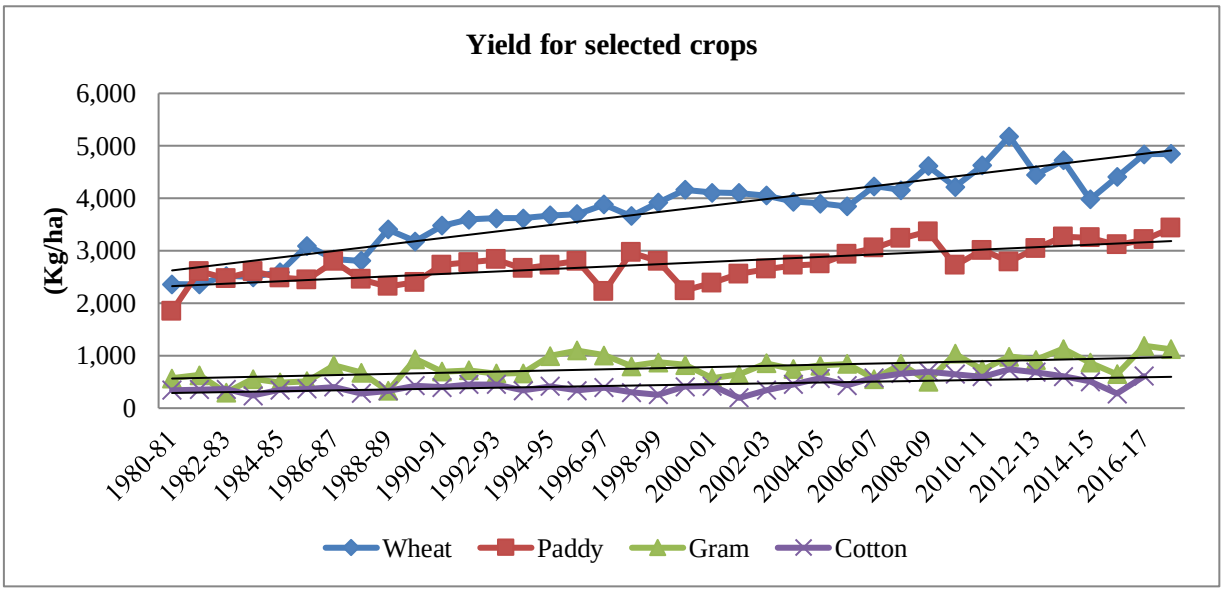
It has been observed that area, production and yield of wheat and rice are following almost linear trends with positive coefficients which are significant at 1 per cent and having a high value of R^2 .In case of gram, area and production are following exponential trend with negative and significant coefficients showing major decline in the area and production whereas yield is showing linear trend with low value of R^2 . Area, production and yield of cotton are following linear trend with relatively low value of R^2 (Table 2).

Table 2: Trends in Area, Production and Yield for selected crops (1980-81 to 2017-18):

Crop	Equation	R^2	Constant	b1
	Area			
Wheat	Linear	0.95	1565**	29.38**
Paddy	Linear	0.94	398.8**	25.35**
Gram	Exponential	0.85	1028**	-0.08**
Cotton	Linear	0.47	309.9**	6.33**
	Production			
Wheat	Linear	0.95	3632**	238.6**
Paddy	Linear	0.95	728.3**	92.05**
Gram	Exponential	0.65	557.5**	-0.06**
Cotton	Linear	0.64	583.01**	39.78**
	Yield			
Wheat	Linear	0.87	2563.54**	61.79**
Paddy	Linear	0.55	2302**	23.21**
Gram	Linear	0.31	553.3**	10.99*
Cotton	Linear	0.40	281.0**	8.30


Area under selected Crops
('000 ha)
3,000.00
2,500.00
2,000.00
1,500.00
1,000.00
500.00
0.00
1980-81
1982-83
1984-85
1986-87
1988-89
1990-91
1992-93
1994-95
1996-97
1998-99
2000-01
2002-03
2004-05
2006-07
2008-09
2010-11
2012-13
2014-15
2016-17
Area Wheat
Area Paddy
Area Gram
Area Cotton


Production of selected Crops
(000 tonnes)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980-81
1982-83
1984-85
1986-87
1988-89
1990-91
1992-93
1994-95
1996-97
1998-99
2000-01
2002-03
2004-05
2006-07
2008-09
2010-11
2012-13
2014-15
2016-17
Prod Wheat
Production Paddy
Production Gram
Production Cotton


Yield for selected crops
(Kg/ha)
6,000
5,000
4,000
3,000
2,000
1,000
0
1980-81
1982-83
1984-85
1986-87
1988-89
1990-91
1992-93
1994-95
1996-97
1998-99
2000-01
2002-03
2004-05
2006-07
2008-09
2010-11
2012-13
2014-15
2016-17
Wheat
Paddy
Gram
Cotton

- Area Graph is also showing the same results as given in table 2 that area under wheat, paddy and cotton is following an increasing trend but there is major decline in the area under gram crop.
- Production of wheat and paddy is increasing whereas production of cotton have ups and down during the study period as it is due to incidence of insect, pest and whitefly and partial drought conditions. Gram production is decreasing rapidly due to the decline in area under crop (production graph).
- Yield of all selected crops is showing linear trends as evolution of high yielding varieties and expansion of irrigation facilities.

Table 3: Variation in Area, Production and Yield of Rabi crops (1980-2017):

Period		Period –I (1980-89)	Period- II (1990-99)	Period –III (2000-09)	Period –IV (2010-17)	Overall (1980-2017)
Crop	**Wheat**					
Area	Mean	1716	2015	2364	2540 $(\cong 1.5\uparrow)$	2139
	CV	6.82	7.39	3.34	1.78	15.63
	R^2	0.68	0.83	0.65	0.19	0.95
	CV_t	3.85	3.04	1.99	1.60	3.35
Production	Mean	4771	7542	9744	11790 $(\cong 2.5\uparrow)$	8287
	CV	18.42	12.74	8.09	6.57	32.82
	R^2	0.87	0.82	0.45	0.00	0.95
	CV_t	6.59	5.45	6.02	6.57	7.26
Yield	Mean	2766	3,731	4116	4632 $(\cong 1.7\uparrow)$	3768
	CV	13.14	5.36	5.31	7.78	19.57
	R^2	0.80	0.74	0.25	0.01	0.87
	CV_t	5.95	2.71	4.61	7.75	7.17
Crop	**Gram**					
Area	Mean	631	411	112	67 $(\cong 9.5\downarrow)$	318
	CV	33.67	24.78	21.29	40.46	81.84
	R^2	-0.13	-0.38	0.01	-0.63	-0.77
	CV_t	35.82	29.14	21.20	51.70	109
Production	Mean	370	340	84	62 $(\cong 6\downarrow)$	222
	CV	44.18	25.11	34.24	38.89	76.80
	R^2	0.03	-0.05	0.06	-0.51	-0.57
	CV_t	43.60	25.68	33.22	47.79	96.23
Yield	Mean	582	835	741	950 $(\cong 1.6\uparrow)$	768
	CV	34.05	18.66	22.74	20.56	28.39
	R^2	0.13	0.22	0.08	0.16	0.31
	CV_t	31.73	16.46	21.80	18.85	23.51

- The overall coefficient of variation of area was 81.84 per cent for gram and 15.63 per cent for wheat and CV was raging between 1.78 to 7.39 per cent in case of wheat showing maximum

variability during second period (Table 3). CV is ranging from 21.29 per cent to 40.46 per cent in case of gram and it has been observed that major area decline was during fourth period.

- The overall coefficient of variation of production was 76.80 per cent for gram and 32.82 per cent for wheat and CV was ranging between 6.57 to 18.42 per cent in case of wheat showing maximum variability during first period. CV varied from 25.11 to 44.18 per cent in case of gram.
- Yield was increasing for both the crops with a variation of 19.57 per cent and 28.39 per cent for wheat and gram, respectively.

Table 4: Variation in Area, Production and Yield of Kharif crops (1980-2017)

Period		Period –I (1980-89)	Period- II (1990-99)	Period –III (2000-09)	Period –IV (2010-17)	Overall (1980-2017)
Crop	**Paddy**					
Area	Mean	538	786	1048	1278 $(\cong 2.5\uparrow)$	893
	CV	10.33	17.80	7.17	6.41	32.42
	R^2	0.28	0.88	0.19	0.73	0.95
	CV_t	8.79	6.22	6.45	3.35	7.39
Production	Mean	1312	2086	2975	4022 $(\cong 3\uparrow)$	2523
	CV	15.60	14.82	12.77	11.37	41.50
	R^2	0.27	0.75	0.80	0.86	0.95
	CV_t	13.33	7.46	5.77	4.26	8.90
Yield	Mean	2444	2676	2838	3139 $(\cong 1.3\uparrow)$	2755
	CV	10.09	9.24	10.78	6.25	12.61
	R^2	0.06	0.13	0.59	0.61	0.55
	CV_t	9.77	8.64	6.92	3.89	8.50
Crop	**Cotton**					
Area	Mean	379	571	541	584 $(\cong 1.5\uparrow)$	513
	CV	14.90	10.14	10.52	8.28	19.43
	R^2	0.51	0.35	-0.37	0.25	0.47
	CV_t	10.44	8.16	12.30	8.98	14.15
Production	Mean	772	1248	1559	1964 $(\cong 2.5\uparrow)$	1339
	CV	23.79	14.78	27.72	26.28	40.23
	R^2	0.42	-0.06	0.56	-0.18	0.64
	CV_t	18.18	15.19	18.38	28.49	24.15
Yield	Mean	346	375	500	575 $(\cong 1.5\uparrow)$	439
	CV	15.82	17.50	31.74	26.17	32.30
	R^2	0.06	-0.31	0.72	-0.31	0.40
	CV_t	15.35	20.03	16.74	29.92	25.01

- Table 4 presents the mean, coefficient of variation, R2 and coefficient of variation around trend of area of paddy and cotton crops in Haryana in different time periods. The overall coefficient of variation of area was 32.42 per cent for paddy and 19.43 per cent for cotton and CV was ranging

between 6.41 to 17.80 per cent in case of paddy showing maximum variability during second period. CV was ranging from 8.28 to 14.90 per cent in case of cotton and it has been observed that major area decline was during third period as this period indicated negative.

- The overall coefficient of variation of production was 41.50 per cent for paddy and 40.23 per cent for cotton and CV was raging between 11.37 to 15.60 percent in case of paddy showing maximum variability for paddy production during first period. CV varied from 14.78 to 27.72 percent in case of cotton.
- Yield was increasing for both paddy and cotton with a variation of 12.61 and 32.30 per cent for paddy and cotton respectively due to evolution of HVY and expansion of irrigation facilities etc.

Factors affecting the Agricultural Production:

$$Y = -49.69 + .0127X_1 + .01897X_2^{**} + .0005X_3^{**} + .0035X_4^{*} + .0003X_5^{***} + .018X_6$$

$$R^2 = 0.94, \qquad adj\, R^2 = 0.93$$

where, Y=Production Index of all agricultural commodities, X_1=Total cropped area, X_2=Gross area irrigated, X_3= Fertilizer consumption, X_4=Consumption of Pesticides, X_5=Number of Tractors, X_6=Average Annual Rainfall

Above model is showing the relationship between agricultural production and different factors affecting the agricultural production.

- There is strong evidence that the above factors have significant impact on agricultural production. Total cropped area, gross area irrigated and rainfall are major factors influencing the Agricultural production.
- The maximum contribution revealed through the model is due to gross are irrigated showing that with one unit (‘000 hectare) increase in gross are irrigated agricultural production index will increase by 0.0189 per centage point.
- With increment of one unit (‘000 hectare) in total cropped area there is an increment of 0.012 per centage point in agricultural production index and rainfall by 0.0179 per centage point.
- Consumption of pesticides and fertilizer are increasing agricultural production by 0.0035 and 0.0007 per centage point respectively. The value of adjusted R^2 is 0.93 which shows that the model selected may be considered satisfactory for explaining the fluctuations in agricultural production.

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

Wheat and paddy have been found most stable crops among the selected crops and gram as most unstable during the study period. Area, production and yield of wheat and paddy were observed

increasing with a steady growth. Production of cotton have ups and down as it is due to incidence of insect, pest, whitefly and partial drought conditions. Gram production has decreased rapidly due to the decline in area under crop. Despite the fall in area and production of gram, yield has increased. It was observed that with decreasing area of gram there is a increment in the area of other rabi crops and it can be concluded that gram crop has been substituted by other rabi crops like; wheat and mustard. The overall coefficient of variation of area, production and yield were observed 81.84 per cent, 76.80 per cent and 28.39 percent for gram and 15.63 per cent, 32.82 percent and 19.57 for wheat. The overall coefficient of variation of area was 32.42 per cent for paddy and 19.43 per cent for cotton and CV. Variation in production have been found 41.50 percent and 40.23 percent in case of paddy and cotton respectively. Mean yield of paddy and cotton has increased around 1.3 and 1.5 times from base period to IV period. Yield was increasing for all selected crops due to evolution of HVY and expansion of irrigation facilities etc. The maximum contribution revealed through the model is due to gross area irrigated, showing that with one unit ('000 ha.) increase in gross are irrigated agricultural production index will increase by 0.0189 percentage point. With increment of one unit ('000 ha.) in total cropped area there is an increment of 0.012 percentage point in agricultural production index. There is strong evidence that the factors taken under consideration have significant impact on agricultural production. Total cropped area, gross area irrigated and rainfall were observed major factors influencing the Agricultural production.

Salient findings of the study:

- It has been found that gram has a negative growth rate for area and production during the study period whereas all other selected crops are showing positive growth for area and production.
- Study reveals that area variability has been maximum in case of gram and minimum in case of wheat during the study period. It is because mean area under gram has been decreased almost ten times from base period to fourth period and it has been replaced by wheat and mustard mostly.
- Area under wheat and paddy is increasing because these crops are being considered as the least risky crops, fixed MSP, HYV and expansion of irrigation facilities. Increment in area under cotton is mainly due to evolution of hybrid varieties of cotton and Bt-Cotton.
- Variability in production is found to be maximum in case of gram and minimum in case of wheat during the study period. It is because mean production of gram has been decreased almost six times from base period to fourth period and area substitution by other crops.
- Yield is showing an increasing trend for all the crops with an increment of about 1.7, 1.3, 1.6 and 1.5 times for wheat, paddy, gram and cotton respectively from base period to fourth period.
- The model selected may be considered satisfactory for explaining the fluctuations in agricultural production as it has the high value of adjusted R^2.
- Gross area irrigated has been found major factors influencing the agricultural production followed by total cropped area.

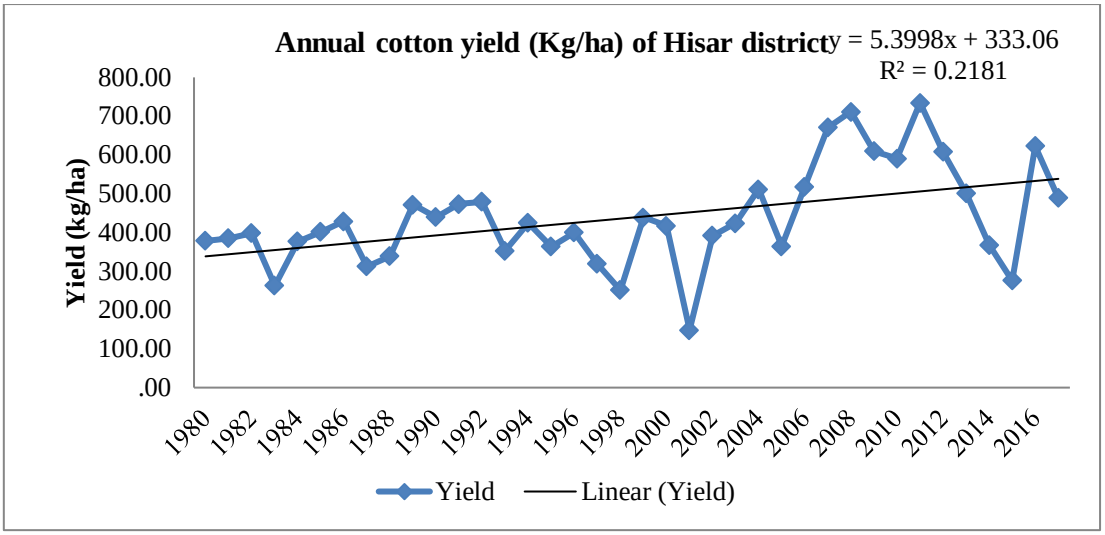
i	**Experiment 8**: **An application of principal component analysis to measure the effect of weather variables on cotton yield**	
ii	**Objectives of the experiment**	• To examine the yield trends of cotton crop over the years in Hisar District. • To study the variability in area, production and productivity of Cotton. • Selection of weather variables based on principal

		component analysis.
iii	**Name(s) of the Investigator**	• Dr. Monika Devi - Planning, analysis of data and report writing • Dr. Vinay Mehala - Monitoring, data collection and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2018-19
vi	**Treatment details**	•**Locale of experiment:** Hisar •**Crop**: Cotton •**Period:** 1980-2018 •**Statistical Design/Methods:** Descriptive statistics, trend analysis, coefficient of variation, coefficient of determination, relative deviation, principal component analysis and multiple linear regression techniques were used.
Vi	**Observations recorded**	•The present study was based on secondary data. •Time series data of crop yield were collected. •Further, weather data for same period on five weather variables, viz., Minimum temperature, Maximum Temperature, Rainfall, Relative Humidity, Sun-shine hours were collected.

Cotton is grown from May-June to October-November and this growth period was divided into different fortnights. The daily weather data were summarized on a fortnightly basis and this fortnight weather data covering full crop season were utilised for studying the effect of weather variables on yield. Data on accumulated rainfall is taken a fortnight before all other variables as this period is expected to have effect on establishment of the crop. Linear model was fitted for cotton yield as there was slight deviation in value of R^2 for all the models. Following graph shows the yield pattern over the years:

Table 1: Trends in yield of cotton crop of Hisar District:

Equation	**R^2**	**Constant**	**b_1**	**b_2**	**b_3**
Linear	0.22	330.0***	5.39***		
Quadratic	0.24	369.36***	-0.41	0.16	
Cubic	0.26	433.11***	-19.29	1.39	-0.02
Exponential	0.14	339.03***	0.01*		



- Study shows that there are ups and downs in cotton yield and linear trend has a value of R^2 equal to 0.218 which is very low and graph is also showing the same.
- It has been observed that there is increasing trend in cotton yield during 1980-1994 and after that there is major decline in yield and it is due to incidence of insect pest and partial drought conditions.
- Yield gets increased after 2003 due to the evolution of Bt-Cotton but again in 2014-2016 a fall has been observed in yield due to the attack of whitefly and partial drought conditions.

Table 2: Mean, Standard Error of Mean and Coefficient of Variation of Cotton yield of Hisar (1980-2017)

Period	**1980-89**	**1990-99**	**2000-09**	**2010-17**	**Overall**
	Period I	Period II	Period III	Period IV	
SD	59.23	72.35	165.89	147.96	128.50
MEAN	375.64	394.26	476.71	523.93	438.36
CV (%)	15.76	18.35	34.75	28.24	29.31
R^2	0.04	0.34	0.64	0.22	0.22
CV_t	15.45	21.24	20.84	24.87	25.88

- Mean yield of cotton has increased from 375 kg/ha in the base period to 524 kg/ha in the fourth period with an overall mean yield of 128 kg/ha. This increase is due to the adoption of high yielding varieties of cotton and expansion of irrigation facilities.
- CV was ranging between 15.8 to 34.7 per cent with an overall variation of 29.3 per cent which was reduced to 25.8 per cent after the elimination of effect of trend.
- There was negative trend during second period that means yield of cotton decreased during period-II. Highest variation has been observed during third period and it is due to the evolution of Bt-cotton and other HYV of cotton.

- Period-IV was also showing overall negative trend and variation in cotton yield as incidence of whitefly and partial drought conditions.

Table 3: Selected Weather Yield Model for Hisar District

Model 1: Trend yield and weather parameters were used as regressors
$Y_{est} = -1114.09 + 1.24Tr + 13.37TMN_3 - 30.34BSH_{10} + 15.66BSH_1 + 4.28RH_6 + 0.49RF_6$ $R^2 = 0.68, \qquad Adj.R^2 = 0.67$
Model 2: Trend yield and PC Scores were used as regressors
$Y_{est} = 83.77 + 0.86Tr + 35.74PC_{12} + 35.12PC_{13} + 27.98PC_{10} + 21.84PC_9 + 25.87PC_5 + 17.86PC_3$ $R^2 = 0.81, \qquad Adj.R^2 = 0.80$
Model 3: Trend yield and higher loading components from component matrix were used as regressors
$Y_{est} = -1033.69 + 1.21Tr + 31.53TMN_3 + 9.86RH_7 + 33.01BSH_7 - 0.40RF_6 - 8.52RH_{10} + 8.66RH_9$ $- 0.67RF_5 + 17.52BSH_6 - 13.62TMX_1 - 44.50BSH_{10}$ $R^2 = 0.77, \qquad Adj.R^2 = 0.75$

where, Y_{est}. - Model predicted yield (q/ha), Tr -Trend yield (kg/ha), PC – Principal Component
TMN - Av. Minimum Temperature, TMX - Av. Maximum Temperature
BSH - Av. Bright Sunshine Hour, RH - Av. Relative Humidity
RF - Accumulated rainfall (1, 2,…, 10/12 refer to different fortnights)

Table 4: Model Based Yield(s) along with Per cent Deviations from Actual Yield(s) of Hisar District

Validation Period	Actual Yield (kg/ha)	FittedYield(kg/ha)			RD (%)		
		Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
2014-15	368.20	520.26	425.72	417.02	-41.29	-15.62	-13.25
2015-16	276.00	523.34	335.90	410.72	-89.61	-21.70	-48.81
2016-17	623.00	552.37	524.23	607.48	11.34	15.85	2.49
2017-18	489.00	561.15	526.32	584.61	-14.75	-7.63	-19.55
Average absolute per cent deviation					**39.25**	**15.19**	**21.02**

From the fitted models, cotton yield forecasts for the years 2014-15, 2015-16, 2016-17 and 2017-18 were obtained. The performance of the forecast models has been compared on the basis of different statistics viz., Adj-R^2, per cent deviation of the forecast from the observed yield.

- A perusal of the results indicates the preference of using prediction equations based on principal component scores (model 2) over the regression models using weather

parameters as predictor variables and higher loading model as model 2 has highest Adj-R^2 and low per cent deviation of the forecast from the observed yield followed by model 3.

- Model 2 shows that PC_3, PC_5, PC_9, PC_{10}, PC_{12} and PC_{13} along with trend yield are fitting the yield with higher value of R^2 and lowest relative deviation among all the three models.
- Model 3 shows that if minimum temperature is below the average minimum temperature during (30-45) days after planting or vegetative stage, it affects yield positively.
- Rise in average maximum temperature TMX_1 shows negative effective during first fifteen days (germination) whereas an increment in average maximum temperature TMX_5 (60-75 days) is showing positive effect on flowering stage.
- Increased relative humidity RH_7, RH_9 and bright sunshine hours BSH_6, BSH7, BSH_9 (75-120 days) above the average, have been found beneficial during flowering stage and reproductive stage (ball formation and maturation).
- Increment in average Relative humidity and bright sunshine hours RH_{10} and BSH_{10} are showing negative effect hence effect could be detrimental at harvesting time.
- Trend yield (Tr) is an important parameter appearing in all the models, which is an indication of technological advancement, improvement in fertilizer/insecticide/ pesticide / weedicide used and increased use of high yielding varieties.

ix- Programme of work for 2019-20: Experiment concluded

Conclusion

It was observed that cotton yield has increasing trend during 1980-1994 and after that there was a major decline in yield due to incidence of insect pest and partial drought conditions. Yield gets increased after 2003 due to the evolution of Bt-cotton but again in 2014-2016 a fall has been observed in yield due to the attack of whitefly and partial drought conditions. Highest positive variation in cotton yield was observed during third period and it is due to the evolution of Bt-cotton, other high yielding varieties of cotton and expansion of irrigation facilities. Study revealed that if minimum temperature remains below the average minimum temperature during (30-45) days after planting or vegetative stage, it affects yield positively. Rise in average maximum temperature TMX_1 shows negative effective during first fifteen days (germination) whereas an increment in average maximum temperature TMX_5 (60-75 days) is showing positive effect at flowering stage. Increased relative humidity RH_7, RH_9 and bright sunshine hours BSH_6, BSH7, BSH_9 (75-120 days) above the average, have been found beneficial during flowering stage and reproductive stage (ball formation and maturation). Increment in average Relative humidity and bright sunshine hours were found having negative effect hence effect could be detrimental at harvesting time.

Salient findings of study:

- It has been observed that there is increasing trend in cotton yield during 1980-1994 and after that there is major decline in yield and it is due to incidence of insect pest and partial drought conditions.
- Yield gets increased after 2003 due to the evolution of Bt-cotton but again in 2014-2016 a fall has been observed in yield due to the attack of whitefly and partial drought conditions.
- Highest positive variation in cotton yield was observed during third period and it is due to the evolution of Bt-cotton, other High yielding varieties of cotton and expansion of irrigation facilities.
- Three models were fitted, model 1 was having trend yield and weather parameters as regressors, model 2 with trend yield and PC scores as regressors and third model was fitted by using trend yield and higher loading components from the component matrix as regressors.
- A perusal of the results indicates the preference of using prediction equations based on principal component scores (model 2) over the regression models using weather parameters as predictor variables and higher loading model as model 2 has highest Adj-R^2 and low per cent deviation of the forecast from the observed yield followed by model 3.
- Model 3 shows that if minimum temperature is below the average minimum temperature during (30-45) days after planting or vegetative stage, it affects yield positively. Rise in average maximum temperature TMX_1 shows negative effective during first fifteen days (germination) whereas an increment in average maximum temperature TMX_5 (60-75 days) is showing positive effect on flowering stage.
- Increased relative humidity RH_7, RH_9 and bright sunshine hours BSH_6, BSH7, BSH_9 (75-120 days) above the average, have been found beneficial during flowering stage and reproductive stage (ball formation and maturation).
- This study has demonstrated the utility of understanding and quantifying the relationships between cotton yield and weather variables. Trend yield (Tr) is an important parameter appearing in all the models, which is an indication of technological advancement, improvement in fertilizer/insecticide/ pesticide / weedicide used and increased use of high yielding varieties

11. New Experiments planned for the 2019-20

i	**Experiment 1: Economic analysis of energy utilization pattern in prevalent cropping systems in Haryana**	
ii	**Objectives of the experiment**	• To work out economics of energy use in major cropping systems • To optimize the energy utilization in cropping systems • To identify the energy constraints of various cropping system
iii	**Name(s) of the investigators**	• Dr. Dalip Kumar Bishnoi Collection, compilation and analysis of data Report writing • Dr. Sanjay Planning, monitoring, finalization of interview schedule
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Anil Saroha, Deptt. of FMPE Calculation of energy parameters for identified crops • Dr. A.K. Dhaka Deptt. of Agronomy Evaluate energy requirement for various crop operations
v	**Year of start**	**2019-20**
	Duration of study	Two Years (2019-20 to 2020-21) During the first year (2019-20), western zone will be surveyed. In second year (2020-21), eastern zone will be covered.
vi	**Treatment details**	• **Locale of experiment:** Haryana • **Zone to be covered :** Eastern and Western zone • **District to be covered :** Sirsa, and Rewari (western zone) • **Block and villages**: Two blocks will be selected from each district and further two villages from each selected block will be taken randomly. • **Number and types of respondents:** Ten farmers(10) from each selected village will be surveyed • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
vii	**Observations to be recorded**	• Eighty farmers will be interviewed to estimate the energy use in prevalent cropping system. • Information related to resource as well as energy use *i.e.* seed, irrigation, fertilizers, agro-chemicals, input-output prices, man-days and machinery hours will be collected from selected respondents. • Farmers will be interviewed to collect information for identifying the energy constraints in major cropping systems.

i	**Experiment 2: An economic analysis of contract farming of field pea in Mahendergarh district of Haryana**	
ii	**Objectives of the experiment**	• To work out the profitability of pea cultivation under contract farming • To analyze the resources use efficiency of field pea cultivation • To study the constraints in contract farming in pea cultivation
iii	**Name(s) of the investigators**	• Dr. Dalip Kumar Bishnoi Analysis of data and report writing • Dr. DP Malik Planning, monitoring, finalization of interview schedule
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Ashok Dhillon, DES KVK Mahendergarh Collection and compilation of data
v	**Year of start**	**2019-20**
vi	**Treatment details**	• **Locale of experiment:** Haryana • **District to be covered :** Mahendergarh • **Block and villages:** Two blocks will be selected from district and further two villages from each selected block will be taken randomly. • **Number and types of respondents:** Fifteen (15) farmers from each selected village will be surveyed • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
vii	**Observations to be recorded**	• Sixty farmers will be interviewed to work out the profitability of pea contract farming. • Information related to resource use i.e. seed, irrigation, fertilizers, agro-chemicals, machinery, input, output prices will be collected from selected farmers. • Farmers will be interviewed to collect information for identifying the constraints regarding production and marketing of pea contract farming.

i	**Experiment 3: Performance of electronic national agricultural markets (e-NAM) in Haryana**	
ii	**Objectives of the experiment**	• To assess the performance and functioning of e-market Haryana from various stakeholders point of view. • To assess the impact of e-market on farmer price realisation and arrivals in regulated market. • To provide lessons learned from markets in Haryana effective implementation of e-NAM.
iii	**Name(s) of the investigators**	• Dr. K.K. Kundu Planning, monitoring, finalization of interview schedule, analysis and report writing, • Dr Neeraj Panwar Collection and compilation of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Ram Niwas, Deptt. of Mathematics and Statistics
v	**Year of start**	**2019-20**
vi	**Duration of study**	Two Year (2019-20 and 2020-21) • Three major commodities from *Kharif* and *Rabi* seasons will be selected for the study, where these are being traded on e-markets. • For each commodity, 20 e-markets, with 10-e markets as treatment and another 10 as control will be selected for collecting prices and arrivals data
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Zone:** 1st year Eastern zone (5 e-markets+5control) and for 2nd year Western zone (5 e-markets +5 control) • **District to be covered :** One district for each e-market • **Number and types of respondents:** Ten stake holders from each market i.e. farmers(10), traders(05)and one market organisation from each selected market will be surveyed • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
viii	**Observations to be recorded**	• 100 farmers will be interviewed to collect the data on prices and arrivals regarding e-NAM. • Data from traders and market organisations

i	**Experiment 4.: Performance and prospective in export of major agriculture commodities in India**	
ii	**Objectives of the experiment**	• To examine trend and growth in export and import of agricultural commodities in the country. • To study the trends in Revealed Comparative Advantage of agriculture products exported from India. • To examine various policy measures to boost up export of agricultural commodities.
iii	**Name(s) of the investigator**	• Dr. V.P. Mehta Analysis and report writing • Dr. J.K. Bhatia Data collection and compilation
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2019-20
vi	**Duration of study**	One year
vii	**Treatment details**	• **Locale of experiment:** Hisar • Major Agricultural commodities: export and import • **Period:** 2000-2018 • **Statistical design/methods:** The data will be analyzed by using major analytical techniques like growth rates, indices of instability and Revealed Comparative Advantage (RCA). The growth rates will be estimated by using semi-log growth model while indices of instability will be measured by using Cuddy Della-Valle index (CDVI).
viii	**Observations to be recorded**	• The present study will be based on secondary data. • Time series data of export and import of agriculture commodities will be collected

i	**Experiment 5.: Economic analysis of pigeon pea cultivation in Haryana**	
ii	**Objectives of the experiment**	• To work out the profitability of pigeon pea cultivation • To analyze the contribution of various resources in pigeon pea cultivation • To study the constraints hindering in cultivation of pigeon pea
iii	**Name(s) of the investigators**	• Dr. Neeraj Pawar Planning, monitoring, finalization of interview schedule and data collection • Dr. Nirmal Kumar Analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	**Nil**
v	**Year of start**	**2019-20**
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Haryana • **District to be covered :** Sonepat and Jhajjar • **Block and villages:** Two blocks will be selected from each district and from each selected block; one village will be selected randomly. • **Number and types of respondents:** Thirty farmers (30) from each selected district will be surveyed • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
viii	**Observations to be recorded**	• Sixty farmers will be interviewed to work out the profitability of pigeon pea. • Information related to resource use i.e. seed, irrigation, fertilizers, agro-chemicals, machinery, input, output prices will be collected from selected farmers of both districts. • Farmers will be interviewed to collect relevant information for identifying the constraints hindering in cultivation of pigeon pea

i	**Experiment 6: Economic feasibility of maize (hybrid) cultivation vis a vis rice cultivation in Haryana**	
ii	**Objectives of the experiment**	• To work out the profitability of maize (hybrid) cultivation • To analyze the contribution of various resources in maize (hybrid) cultivation • To study the economic and social constraints in cultivation of maize (hybrid) • To study the policy measures for effective adoption in cultivation of maize (hybrid)
iii	**Name(s) of the investigators**	• Dr. Neeraj Pawar Planning, monitoring, finalization of interview schedule and data collection • Dr. Sumit, COA, Kaul Analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Subhash Chander, Department of Sociology Inclusion of social factors in interview schedule, analysis and interpretation of social factors
v	**Year of start**	**2019-20**
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Haryana • **District to be covered :** Karnal and Yamunanagar • Block and villages: Two blocks will be selected from each district and from each selected block one village will be selected randomly. • Number and types of respondents: Thirty farmers (30) from each selected district will be surveyed. • **Statistical design/methods:** The statistical tools like mean, percentage etc. and suitable analytical model will be used
viii	**Observation to be recorded**	• Sixty farmers will be interviewed to work out the profitability of maize (hybrid). • Information related to resource use i.e. seed, irrigation, fertilizers, agro-chemicals, machinery, input, output prices will be collected from selected farmers of both districts. • Farmers will be interviewed to collect information for identifying the constraints hindering in cultivation of maize (hybrid) • Various initiatives taken by government for promotion of maize cultivation

i	**Experiment 7 : Assessment of farm level post-harvest losses of wheat in Haryana**	
ii	**Objectives of the experiment**	• To measures the post-harvest losses in wheat at different operations • To study the factor effecting post-harvest losses • To estimate the post-harvest losses for state as whole
iii	**Name(s) of the investigators**	• Dr. Nirmal Kumar Planning, monitoring, finalization of interview schedule and data collection • Dr. Dalip Kumar Bishnoi Compilation, analysis of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	**2019-20**
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Haryana • **District to be covered :** Karnal and Hisar • **Block and villages:** Two blocks will be selected from each district and from each selected block one village will be selected randomly. • **Number and types of respondents:** Thirty farmers (30) from each selected district will be surveyed • **Statistical design/methods:** The statistical tools like mean, percentage and other suitable analytical model will be used
vii	**Observation to be recorded**	• Sixty farmers will be interviewed to measures the extent of post-harvest losses in wheat at different stages • Information related to post harvest losses at farm level during harvesting, threshing, cleaning, transportation, packaging etc. will be collected from selected farmers and intermediaries in Haryana. • Farmers will be interviewed to collect information regarding various factor effecting post-harvest losses at farm level.

i	**Experiment 8** : **Statistical models for forecasting of rice yield using weather variables**	
ii	**Objectives of the experiment**	• To carry out trend analysis and curve fitting for area, production and yield • To study the variability in area, production and yield • To develop forecast models for rice yield
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, compilation and analysis of data • Dr. Monika Devi Data compilation , analysis of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Anurag, Department of Agril. Meteorology Arrange data on various related weathers parameters • Dr. D.P. Malik, Deptt. of Agril. Economics Planning and finalization of report
v	**Year of start**	2019-20
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Kurukshetra district • **Crop:** Paddy • **Period:** 1981-2018 • **Statistical design/methods:** Descriptive and explorative data analysis, discriminant function analysis and some other suitable statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• The present study will be based on secondary data. • Data of area, production and productivity for the paddy will be collected. • Data on weather parameters such as temperature, relative humidity and rainfall, sunshine hours etc. will also be collected.

i	**Experiment 9**: **Prediction of sugarcane production using Artificial Neural Network**	
ii	**Objectives of the experiment**	• To analyse trend for area, production and yield • To study the variability in area, production and yield • To develop forecast models for sugarcane production
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, compilation and analysis of data • Dr. Monika Devi Data compilation, analysis of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Planning and report writing • Dr. Amarjit Kalra, Deptt. of Basic Engineering To validate the use of ANN in analysis of data
v	**Year of start**	2019-20
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Karnal • **Crop:** Sugarcane • **Period:** 1981-2018 • **Statistical design/methods:** Descriptive and explorative techniques, Artificial Neural Network (ANN) and some other suitable statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• The present study will be based on secondary data. • Data on area, production and productivity for the Sugarcane will be collected.

i	**Experiment 10: Sustainability, modelling and forecasting of wheat production in Haryana**	
ii	**Objectives of the experiment**	• To examine the trends for wheat production • Measuring the sustainability of wheat production • To model and forecast the production behaviour of the wheat
iii	**Name of the Investigator**	• Dr. Monika Devi Planning, compilation and analysis of data and report writing • Dr. Joginder Data compilation, analysis of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Planning and report writing
v	**Year of start**	2019-20
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Crop:** Wheat • **Period:** 1981-2018 • **Statistical design/methods:** Descriptive statistics, measures of sustainability, suitable forecasting model (ARIMA, etc.) and some other statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• The present study will be based on secondary data. • Data on area, production and yield for wheat crop will be collected.

i	**Experiment 11: An inter-district analysis of instability and sustainability for gram, cotton and mustard crops in Haryana**	
ii	**Objectives of the experiment**	• To examine the trends of area, production and productivity of selected crops • Measuring the instability of area, production and productivity • Sustainability measure of area, production and productivity
iii	**Name of the Investigator**	• Dr. Monika Devi Planning, compilation and analysis of data • Dr. Joginder Data compilation, analysis of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Data collection and compilation
v	**Year of start**	2019-20
vi	**Duration of study**	**One year**
vii	**Treatment details**	• **Locale of experiment:** Major gram, cotton and mustard growing districts • **Crops:** Gram, cotton and mustard • **Period:** 1990-2018 • **Statistical design/methods:** Descriptive statistics, measures of sustainability, suitable measures of instability (Cuddy Della, etc) and some other statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• The present study will be based on secondary data. • Data on area, production and productivity for selected crops will be collected.

i	**Experiment No. 12: Analysis of fertilizer application in different Kharif & Rabi crops in Haryana**	
ii	**Objectives of the experiment**	• To analyze the pattern of fertilizer use in principal crops in Haryana. • To work out the marginal productivity of the fertilizer application for major crops. • To find out the reasons for not using recommended doses of fertilizers
iii	**Name(s) of the investigators**	• Dr. Vijay Kumar Finalization of data, analysis and report writing • Dr. Veer Sain Collection & Compilation of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Preparation of schedule, monitoring and planning
v	**Year of start**	**2019-20**
vi	**Duration of study**	**Two years**
vii	**Treatment details**	• **Locale of experiment:** Eastern and Western Zone of Haryana. • **Eastern Zone:** Yamunanagar and Karnal were selected for the study. • **Western Zone:** Bhiwani and Mewat were selected for the study. • **Data Collection:** In first year the data for Rabi crops were collected and in second year the data for Kharif crops will be collected. • **Statistical design/methods:** The Production function analysis technique and other descriptive statistics like mean, per cent etc. will be used.
viii	**Observations to be recorded**	• Information related to the fertilizer application in various crops, information regarding irrigated & un-irrigated land holding, reasons to not applying recommended doses of fertilizer to the crops will be collected from the farmers.

i	**Experiment No. 13: An Analysis of Natural Farming in Kurukshetra, Haryana: A Case Study**	
ii	**Objectives of the experiment**	• To analyze the inputs use pattern for cultivation of different crops. • To calculate cost of cultivation for major crops. • To study the benefits and major constraint in cultivation of crops.
iii	**Name(s) of the investigators**	• Dr. Vijay Kumar Planning, monitoring, finalization of interview schedule and report writing • Dr. Sumit Data collection & analysis of data.
iv	**Name(s) of the collaborator(s) with activity profile**	NIL
v	**Year of start**	**2019-20**
vi	**Duration of study**	**Two years**
vii	**Treatment details**	• **Locale of experiment:** Gurukul, Kurukshetra • **Major Crops: Rice, Sugarcane, Wheat** • **Season: Kharif & Rabi** • **Statistical design/methods:** The descriptive statistics like mean, percentage etc. will be used.
viii	**Observations to be recorded**	• Input use pattern in natural farming especially with regard to farming practices. • Information related to resource use i.e. seed, irrigation, FYM, bio-fertilizers, microbial fertilizers, machinery, input, output prices will be collected from the farm. • Production & Yield of major crops and soil health status for the identified area

2. ICAR funded project

i	**Experiment No. 1: 3615/ C(b) Ag. Econ-1-ICAR–NIAP Resource-Use Planning for Sustainable Agriculture**	
ii	**Objectives of the experiment**	• To assess resource endowment and crop suitability matrix for different agro-climatic conditions • To identify zone specific constraints, potentials and interventions to optimize resource use and income enhancement • To develop optimum crop plans under various agro-climatic conditions • To identify technological, institutional and policy interventions for sustainable improvement in farm income and resource use
iii	**Name(s) of the investigators**	• Dr. D.P. Malik Principal Investigator Monitoring planning and execution • Dr. Dalip Kumar Bishnoi, CCPI Preparation of schedule, compilation of progress report as desired by the funding agency • Dr. Neeraj Pawar, Dr. Jitender Kumar Bhatia, Dr. Ashok Dhillon, Dr. Nirmal Kumar CCPIs Collection, compilation of data and report writing • Dr. Nitin Bhardwaj CCPI Analysis of data as desired by the funding agency
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2017-18
	Duration of study	Three years (2017-18 to 2019-20)
vi	**Treatment details**	• Locale of experiment: Haryana • Statistical design/methods: The statistical tools like mean, percentage, regression for input- output matrix and linear programming (LP) for suitability matrix will be used.
vii	**Observation recorded**	• Data on various economic aspects of prevalent cropping patterns as well as new interventions for crop productivity enhancement collected. • Input out-put matrix for eastern as well as western zone of the state were prepared

viii- Results achieved during 2018-19

- Input output matrix for eastern zone related to various prevalent crops like paddy, wheat, cotton, sugarcane, maize, summer mungbean vegetable crops like onion, tomato, cauliflower, potato horticultural crops like guava mango marigold, rose and livestock like buffalo, cross breed as well as for local cattle were prepared and same was submitted to the coordinating agency.
- Input output matrix for western zone related to various prevalent crops like paddy, wheat, cotton, pearl millet, cluster bean, barley , mustard, mungbean vegetable crops like onion, cauliflower, potato horticultural crops like kinnow, guava, ber, and livestock like buffalo, cross breed as well as for local cattle were prepared and same was submitted to the coordinating agency.
- Study on impact of sprinkler irrigation system on cropping pattern in Mahendergarh district of Haryana was carried out and submitted to the funding agency.

Budget for the year 2018-19 (head wise sanction and expenditure details) (in Rs.)

S. N.	Particulars	Allotment	Expenditure	Balance
A.	**Recurring expenditure**			
1	Pay	7,35,000	6,22,260	1,12,740
2	M & S	77,000	76,880	120
3	T.A.	1,00,000	66,955	33,045
4	O E (others)	98,900	98,723	173
5	POL	45,300	40,006	5294
6	Other charges	1,69,800	1,69,477	327
7	Institutional charges	1,05,000	1,05,000	-
	Sub-total (A)	13,31,000	11,79,301	1,51,699
B.	**Non-Recurring expenditure**			
1.	Information Technology (Computer, printer, IT, Software Furniture etc.	2,00,000	1,99,874	126
	Sub-total (B)	2,00,000	1,99,874	126
	Grand Total (A+B)	15,31,000	13,79,175	1,57,825

ix. Programme of work for 2019-20: Continued

- Suitability matrix with the help of linear programming (LP) will be prepared for the eastern and western zones of the state
- As per mandate of the project, study on crop residue management and direct seeded rice will be carried out and same to be submitted to the funding agency.

Other Agencies

1. **Scheme No:** 3066-C(c) Econ.-I.(CS)

Title -: "Comprehensive Scheme studying the Cost of Cultivation of Principal Crops in India-Haryana**"** (financed by Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, Govt. of India)

2. **Year of start**: :1970

3. **Location** : Haryana

4. **Objectives of scheme**: To provide representative and quality data on cost of Cultivation of principal crops in Haryana. The detailed objectives are as under:

- To facilitate data entry at Tehsil / Village level, making the process of data collection, validation and compilation efficient through ICT enabled Web based System.

- To facilitate processing of data and generation of query based report at Central level.

- To monitor the functioning of field–men, field supervisors and Field Officers at different levels through workflow based system

- To scrutinize and validate the data entered by Field-men at the level of field supervisor and field officer through the envisaged workflow based system.

- To reduce the time lag in reporting of data

5. **Any need to modify the objective as per need of the state**: Nil

6. **Constraints, if any :** Shortage of Agriculture Inspectors

7. **Name of investigators with activity profile:**

Name of Scientist	Name of cluster allotted
Field Officer -Vacant	All 30 cluster selected under scheme
Dr. R. S. Pannu	Bana Barahman, Kurali, Jalbera, Samani, Babarpur, Saraisukhi, Majri, Rattangarh, Teek, &Teontha
Dr. Neeraj Pawar	Kasoli, Raipur, Surana, Sasroli, Godhri, Gwalison, Sidhrawali, Madnaka, Khubru&Kulta.
Dr. Nirmal Kumar	Dang Kalan, Sampal, Dahima, Bajeka, Petwar, Dariyapur, Sultanpur, Jamalpur, Bibipur&Bilawal

8. Budget for the year 2018-19 (head wise sanction and expenditure details) (Rs.)

S. N.	Particulars	Allotment	Expenditure	Balance
1	Pay	15954200	16299004	-344804
2	ADA	3815000	3801417	13583
3	GPF	1603000	1590468	12532
4	TA	1080000	409078	670922
5	Gratuity	1883800	1883779	21
6	Medical	690000	689367	633
7	LTC	354000	349725	4275
8	O.E. (NR)	284000	283782	218
9	PSS	1000000	1000000	Nil
10	Other charges	322000	287939	34061
11	M & S	14000	13957	43
	Total	**27000000**	**26608516**	**391484**

I	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
Ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
Iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nitin Bhardwaj** Validation, rectification, RT wise check list, corrections in online data
Iv	**Name s of Collaborators with activity profile**	Nil
V	**Year of start**	2018-19
Vi	**Treatment details**	**Locale of experiment: Haryana**
Vii	**Observations recorded**	• Collection of information on daily basis by A.I.s • Record of data in schedules and data entries in software by agriculture inspectors in monthly basis • Monthly checking of data at each cluster in physical record and software by supervisors/scientists • Random checking of data by SRO/field officer

viii Results achieved during *Kharif* 2018-19

- The cost of cultivation data of kharif crops grown in Haryana state namely Paddy, Cotton and Pearl millet was collected from 30 Centres/clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers of thirty (30) clusters were contacted daily by agriculture inspectors to extract relevant information during kharif season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	Name of supervisor	Number of clusters visited	Number of farmers interacted	Number of schedules checked
July	Dr. R.S. Pannu	10	47	50
	Dr. Neeraj Panwar	04	07	18
	Dr. Nirmal Kumar	04	08	27
August	Dr. R.S. Pannu	10	36	45
	Dr. Neeraj Panwar	04	09	20
	Dr. Nirmal Kumar	04	07	21
September	Dr. R.S. Pannu	10	32	47
	Dr. Neeraj Panwar	07	11	24
	Dr. Nirmal Kumar	04	17	26
October	Dr. R.S. Pannu	10	27	35
	Dr. Neeraj Panwar	05	16	32
	Dr. Nirmal Kumar	04	17	28
November	Dr. R.S. Pannu	10	21	39
	Dr. Neeraj Panwar	10	19	34
	Dr. Nirmal Kumar	06	18	32
December	Dr. R.S. Pannu	10	18	42
	Dr. Neeraj Panwar	02	17	21
	Dr. Nirmal Kumar	04	12	21

- Supervisors visited regularly and check data in records as collected by AIs from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.

- The information recorded by AIs was also crossed checked from the farmers through interaction during visit.
- At the end of the season, the online data entries were forwarded to supervisor by AIs and the data was thoroughly checked in the software with physical records.
- During kharif season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- The online data entries in new software (FARMAP2.0) for Kharif season of year 2018-19 have been completed at the levels of Agriculture Inspectors, field supervisors and field officer.

i	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of Rabi crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nitin Bhardwaj** Validation, rectification, RT wise check list, correction in online data
iv	**Name s of Collaborators with activity profile**	Nil
v	**Year of start**	2018-19

vi	**Treatment details**	**Locale of experiment: Haryana**
vii	**Observation to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/field officer

viii Results achieved during *Rabi* 2018-19

- The cost of cultivation rabi crops data of Haryana state namely Wheat, Gram, Rapeseed & Mustard, Sugarcane, Summer mungbean and Onion was collected from 30 Centres /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers were contacted for collection of data related cost of cultivation of crops during rabi season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	Name of supervisor	Number of clusters visited	Number of farmers interacted	Number of schedules checked
January	Dr. R.S. Pannu	10	14	35
	Dr. Neeraj Panwar	02	11	18
	Dr. Nirmal Kumar	07	19	35
February	Dr. R.S. Pannu	10	25	45
	Dr. Neeraj Panwar	06	16	24
	Dr. Nirmal Kumar	05	14	31
March	Dr. R.S. Pannu	10	25	45
	Dr. Neeraj Panwar	06	16	24
	Dr. Nirmal Kumar	05	14	31
April	Dr. R.S. Pannu	10	15	35
	Dr. NeerajPanwar	06	18	26
	Dr. Nirmal Kumar	05	12	29
May	Dr. R.S. Pannu	10	16	38
	Dr. Neeraj Panwar	06	16	22
	Dr. Nirmal Kumar	03	09	18
June	Dr. R.S. Pannu	-	-	-
	Dr. Neeraj Panwar	-	-	-
	Dr. Nirmal Kumar	-	-	-

- Supervisors visited regularly and check data in records as collected by AIs from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.
- The information recorded by AIs was also crossed checked from the farmers through interaction during visit.
- At the end of the season, the online data entries were forwarded to supervisor by AIs and the data was thoroughly checked in the software with physical records.
- During rabi season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

Submission of data

- Final submission of data will be done in the month of August, 2019 along with data of rabi crops recorded up to 30th June, 2019.
- Validation of data for kharif and rabi seasons will be done in the month of July, 2019.
- Weighing diagram as required by funding agency was also prepared and will be submitted along with data of both seasons.
- The online data entries in new software (FARMAP2.0) for rabi season of year 2018-19 is in progress at the levels of agriculture inspectors and supervisors.

Trainings/Meetings proposed

- Three-computer trainings about online data entries in new software were imparted to Agriculture inspectors at RRS, Uchani, RRS, RRS, Rohtak, and Department of Agricultural Economics during 2018-19 and resolved problems in on line data entries.
- Meetings of AIs were organized by supervisors during 2018-19 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items, keeping daily operation record etc.

Work done in computer lab

- The discrepancies in data as reported by funding agency were rechecked, corrected and re-submitted again well in time.
- The online data entries (kharif & rabi) of data for the year 2017-18 in new software FARMAP 2.0 has been submitted to the funding agency in September ,2018.
- Checking and scrutinized the data RT-wise for both kharif and rabi seasons, data entries in new software FARMAP 2.0 and exporting the data in excel and checking the all outliers in online data entries was done regularly.
- Various queries raised by agriculture inspectors in online data entries for 2018-19 have been resolved by statistician.

- Data for crop complex has been submitted to funding agency for selection of crops for Haryana state for the period 2020-23.

9. **Justification for continuation of scheme**:

The scheme was started in 1970 with an objective to collect quality data from farmers for various kharif and rabi crops in each season of every year to provide basis for fixation of MSP at national Level. The scheme is to be continued taking into consideration-increased use of purchased inputs, mechanization of farm operations etc. to work out cost of cultivation by providing farm level information for fixation of MSP to benefit farmers for sustainability of agriculture in country.

Salient Achievements during 2018-19

- The cost of cultivation of nine important crops of Haryana state namely, paddy, cotton, pearl millet, sugarcane, wheat, gram and rapeseed & mustard, summer mungbean and onion were collected from 30 Centres /clusters located in different Agro-Climatic Zones of Haryana state by cost accounting method.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.
- The data entries in FARMAP2.0 software for the *rabi*and*kharif* seasons for the year 2017-18 have been submitted in September, 2018 to the Ministry of Agriculture and Farmer's Welfare for further analysis, the result of which will be used by the Commission for Agricultural Costs and Prices (CACP) for fixing the minimum support prices of *Kharif* and *Rabi* crops at national level.
- The online data entries in new software (FARMAP2.0) for *Kharif* season of year 2018-19 have been completed at the levels of agriculture inspectors, supervisors and field officer. The online data for entries for rabi season is in progress and will be completed by 15 July 2019.
- The work of data entry operators, progress of online data etc. in computer lab of cost of cultivation scheme was closely monitored to ensure timely submission of data to funding agency.
- The discrepancies in data as reported by funding agency were rechecked, corrected and re-submitted again well in time.

New experiment planned for the year 2019-20

i	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Field Officer (Vacant)** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Joginder** Validation, rectification, RT wise check list, correction in online data
iv	**Names of Collaborators with activity profile**	Nil
v	**Year of start**	2019-20
vi	**Treatment details**	**Locale of experiment: Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/filed officer

i	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of rabi crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Field Officer (Vacant)** Monitoring, supervision, checking & verification and submission of data **Dr. R.S. Pannu** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Joginder** Validation, rectification, RT wise check list, correction in online data
iv	**Name s of Collaborators with activity profile**	Nil
v	**Year of start**	2019-20
vi	**Treatment details**	**Locale of experiment: Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/filed officer

LIST OF PG STUDENTS OF DEPARTMENT

S.N.	Name of Student	Adm. No.	Title of Research Problem	Major Advisor
Ph.D. students				
1.	Jitender Kumar	2013A02D	Role of Sarva Haryana Gramin bank in financing in Agriculture	Dr. V.P.Mehta
2.	Sumit	2014A01D	An Economic Analysis of Beekeeping: Production and Marketing of Honey in Haryana	Dr.R.S.Chauhan
3.	Sadhanala Swetha	2015A02D	Dynamic of Major Oilseeds and Pulses in India	Dr. V.P.Mehta
4.	Kavita	2015A03D	An Analytical Study on Impact of WTO on Agricultural Trade in India	Dr. V.P.Mehta
5.	Raj Kumar	2015A04D	Estimation of Effective Demand and Economics Analysis of Fruit and vegetable Crops in Haryana	Dr. A.K. Rathee
6.	Parveen Kumar	2015A05D	Economic analysis of vegetable cultivation under protected structures in Haryana.	Dr.R.S.Chauhan
7.	MeenuPunia	2015A06D	Agricultural Insurance in India vis-a vis in Haryana : Problems and Prospects	Dr. K.K.Kundu
8.	Swamy H.M.	2016A01D	Spatial and temporal crop diverfication in India and their consequences on agriculture	Dr. U.K.Sharma
9.	Sunita	2016A02D	A study to develop optimum combination of farm enterprises in Haryana	Dr. V.P.Mehta
10.	Sanjay	2016A03D	An Empirical Analysis of Agricultural Credit System in Haryana	Dr.R.S.Pannu
11.	Heena	2016A04D	An Economic Analysis of Organic Farming vis-à-vis Inorganic Farming in Haryana	Dr.D.P.Malik
12.	Davinder Pal Singh	2017A06D	Contract farming in Haryana and Punjab: An Economic prospective	Dr.K.K.Kundu
13.	NeelamKumari	2018A02D	Temporal and Spatial Variability in Pulses and Oilseeds production in India	Dr.D.P.Malik
14.	Nitin Sharma	2018A04D	Economic analysis of chemical fertilizers in India.	Dr.R.S.Pannu
Foreign Ph.D. students				
1.	KabirAbdulaziz	2018A01D	Value chain analysis of staple foods and dairy Products in Haryana	Dr.K.K.Kundu

M.Sc. students				
1.	Mousumi Priyadarshini	2017A01M	Impact study of Mission for Integrated Development of Horticulture in Haryana vis-à-vis Odisha	Dr. K.K. Kundu
2.	Padeep Kamboj	2017A05M	Economic analysis of production and export of basmati rice in Haryana	Dr. Sanjay Kumar
3.	Ritu	2017A06M	Impact of Agricultural Price Policy on Major food crops in Haryana	Dr. V.P. Mehta
4.	Ajay Singh	2017A07M	Economic analysis of establishment techniques of wheat in Haryana	Dr. A.K. Rathee
5.	Sandeep Kumar	2017A08M	Impact of Agricultural Price Policy on Rapeseed-Mustard and Chickpea in Haryana.	Dr. V.P. Luhach
6.	Nisha	2017A09M	An Economic Analysis of sugarcane Cultivation in Haryana	Dr. D.P. Malik
7.	Baljit Kaur	2018A01M	Performance and Functioning of Electronic National Agricultural Market (e-NAM) in Haryana: An economic analysis.	Dr. K.K.Kundu
8.	Dinesh Kumar	2018A02M	An Economic analysis of Laser land leveling practice in Haryana.	Dr. D. K.Bishnoi
9.	Mohit Sehal	2018A03M	An Economic Analysis of Integrated Pest Management (IPM) and Integrated Nutrient (INM) in Paddy (Basmati) crop in Haryana	Dr. Neeraj Pawar
10.	Prateek Sharma	2018A04M	An Economic Analysis of Production and Marketing of Flower crops (Rose and Marigold) in Haryana.	Dr. J.K. Bhatia
Foreign M.Sc. students				
1.	Ali Rezaei	2017A02M	Planting Methods of Paddy Cultivation in Haryana-A Comparative Economic Analysis	Dr. D.K. Bishnoi
2.	Abdul Quasim	2017A03M	Dynamics of export and import of major agricultural commodities in India	Dr. V.P. Mehta

D List of Publications: 2018-19

NAAS rating <6.0

S. N.	Details of Research Paper	NAAS Rating
1	Kumar, S., Satyavan, Bishnoi, D.K. and Kumar, N. (2018). Effect of Integrated Nutrient Management of Yield and Yield Attributes and Economics of Wheat (*Triticumaestivum*L.) under Saline and Non-Non-Saline Irrigation Water. *International Journal of Current Microbiology and Applied Science* 7(5): 618-628.	**5.38**
2.	Nimbrayan, P.K., Sunita, Bhatia, J.K. and Heena (2019). Growth and instability in area, production and productivity of barley in Haryana vis-à-vis India. *Current Journal of Applied Science and Technology* 35(6): 1-8.	**5.32**
3.	Vishwajith, K.P., Sahu, P.K., Mishra, P. Devi, Monika, Dubay, Anurag, Singh, R.B., Dhekale, B.S., Fatih, Chellai and Suman (2019). Modelling and forecasting of mungbean production in India. *Current Journal of Applied Science and Technology* 34(1):1-19.	**5.32**
4.	Kumar, R., Rathee, A.K., Kumar, N. and Luhach, V.P. (2019). Economic appraisal of mango production in Yamunanagar district of Haryana. *Journal of Pharmacognosy and Phytochemistry* 8(2): 1298-1302.	**5.21**
5.	Kumar, J., Kumar, N., Dhillon, A., Sumit and Kumar, R. (2019). Effect of socio-economic characteristics and disposal pattern of milk in Haryana. *Journal of Pharmacognosy and Phytochemistry*8(2): 1462-1464.	**5.21**
6.	Kumari, N., Mehta, V.P., Bishnoi, D.K., Bhatia, J.K. and Kumar, R. (2019). Contribution of Haryana state in food security of India. *Journal of Pharmacognosy and Photochemistry* 8(1): 2265-2268.	**5.21**
7.	Tripathi, S.K., Sharma, B., Ray, R., Devi, Monika, and Mishra, P. (2019). Studies on growth and yield of turmeric under different irrigation and nutrient management strategies at West Bengal, India. *Bulletin of Environment, Pharmacology and Life Science* 8(6):14-20.	**4.95**
8.	Dhillon, A., Bhuker, A., Pawar, N. and Bishnoi, D.K. (2019). Economics of commercial seed vis-à-vis grain production of mustard (*Brassica juncea* L. Czern&Coss) in Haryana. *Indian Journal of Economics and Development* 15(1): 160-162.	**4.82**
9.	Malik, D.P., Bishnoi, D., Kumar, N. and Sumit (2019). A Study into Economics of Vegetable Cultivation in Haryana. *Indian Journal of Economics and Development* 15 (2):1-5.	**4.82**
10.	Bisen, J., Patel, R.K., Kundu, K.K. and Sanjay (2018). Marketing Efficiency between Traditional and Modern Supply Chains of Fruits and Vegetables. *Economic Affairs* 63(2): 441-447.	**4.82**
11.	Sanjay, Seidu, M. and Kundu, K.K. (2018). Growth and Instability in Cotton Cultivation in Northern India. *Economic Affairs* 63(2): 433-440.	**4.82**
12.	Kumar, N., Malik, D.P., Kumar, R. and Sumit (2019). An Economic Analysis of Mango (*Mangiferaindica*L.) Cultivation in Haryana. *Indian Journal of Economics and Development* 15(2): 151-158.	**4.82**
13.	Dhillon, A., Bhuker, A., Pawar, N. and Bishnoi, D.K. (2019). Economics of commercial seed vis-à-vis grain production of mustard (*Brassica juncea* L Czern&Coss) in Haryana. *Indian Journal of Economics and Development* 15(1):160-162.	**4.82**
14.	Arora, A., Malik, D.P. (2019). An overview of cotton seed industry in India: policy implications and perspectives. *Journal of Cotton Research and Development* 33(2): 303-313.	**4.69**
15.	Archana, K., and Kundu, K.K. (2019). Farmers' perceptions towards risk, sources and its mitigating strategies in Haryana vis-à-vis Tamil nadu for *Bt*cotton. *Journal of Cotton Research and Development* 33(1): 157-164.	**4.69**
16.	Kumar, R., Dhillon, A., Yadav, J., Pawar, N. and Bali, Y. (2018). Increasing productivity and profitability of sesame through cluster frontline demonstrations. *Crop*	**4.60**

	Research 53 (5&6): 268-270.	
17.	Kumar, R., Yadav, J., Dhillon, A., Pawar, N. and Bali, Y. (2018). Realizing productivity and profitability of green gram through cluster frontline demonstrations (CFLD's). *Crop Research* 53 (5&6): 265-267.	**4.60**
18.	Kumar, A., Pannu, R.S. and Sumit (2017). An economics of resource use efficiency in production of onion crop in Haryana. *Plant Archives* 17(2): 924-928.	**4.41**
19.	Kundu, K.K., Singh, B. and Sumit(2019). An Economic Analysis of Seed Marketing Channels for Paddy and Wheat Crops in Haryana. *Annals of Biology* 35(1): 117-126.	**4.08**
20.	Malik, D.P., Pawar, N. and Swamy, H.M. (2019). Indices for Measurement of Diversification Level in Haryana Agriculture. *Agricultural Situation in India* 74 (2): 02-09.	**3.15**
21.	Kumar, R., Dhillon, A., Yadav, J., Pawar, N. and Bali, Y. (2018). Increasing productivity and profitability of sesame through cluster frontline demonstrations. *Crop Research- An International Journal* 53 (5& 6): 268-270.	**4.60**
22.	Kumar, R., Yadav, J., Dhillon, A., Pawar, N. and Bali, Y. (2018). Realizing productivity and profitability of green gram through cluster frontline demonstrations (CFLD's). *Crop Research- An International Journal* 53 (5& 6): 265-267.	**4.60**
23.	Malik, D.P., Tomar, B.S., Singh, V.K. and Kapoor, K. (2013). An Economic Analysis of Dairy Enterprise on Haryana Farms. *Haryana Agricultural University Journal of Research* 43(1& 2): 49-57.	-
24.	Bhatia, J.K., Bishnoi, D.K. and Malik. D.P. (2013). Profitability of Flower Crops under Protected Cultivation in Haryana. *Haryana Agricultural University Journal of Research* 43(1& 2): 63-67.	-

Book Chapters

- Kumar, R., Rathee, A.K., Luhach, V.P., Kumar, N. and Sumit (2019). Economic appraisal of ber(*Zizyphusmauritiana*Lamk.) production in Sonepat district of Haryana. In: *Emerging Research Trends in Social Sciences* (SurenderMor (eds). Bloomsbury publishing India Pvt. Ltd, New Delhi: 129-136.
- Sumit, Pawar, N., Kumar, N.,Dhillon, A. and Kumar, R. (2019). Impact of beekeeping enterprise on income and employment generation in Haryana. *Emerging Research Trends in Social Sciences* (SurenderMor (eds). Bloomsbury publishing India Pvt. Ltd, New Delhi: 151-156.
- Heena, Luhach, V. P. and Yadav, Sunita. (2019). Zone wise economic analysis of wheat crops in Haryana. *Emerging Research Trends in Social Sciences* (SurenderMor (eds). Bloomsbury publishing India Pvt. Ltd, New Delhi: 144-150.
- Kumar, P., Chauhan, R.S., Mehta, V.P. and Bhatia, J.K. (2018). A review on economic aspects of protected cultivation in India. *Research trend in Horticultural Sciences* (Dr.Meena, M.L. (eds).Akinik Publications, New Delhi: 43-59.

Papers abstracted/presented in Conferences/Seminars/Symposia/Workshops

- Dhillon, A., Kumar, J., Kumar, N., and Kumar, R. (2019). Constraints faced by dairy owners in adoption of marketing and scientific dairy practices in Haryana. International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 36
- Ritu and Mehta, V.P. (2019). Impact of agricultural price policy on major food crops in Haryana. Global Initiatives in Agricultural and Applied Sciences for Eco Friendly Environment (GIASE-2019)", June, 16-18, 2019, Tribhuvan University, Kathmandu, Nepal: 254.
- Kavita, Kumari N. and Mehta, V.P. (2019). Share of agricultural export and import to agricultural gross domestic product. Global Initiatives in Agricultural and Applied Sciences for Eco Friendly Environment (GIASE-2019)", June, 16-18, 2019, Tribhuvan University, Kathmandu, Nepal: 117.
- Kumar, N., Malik, D.P., Kumar, R. and Sumit (2019). Economic perspective of mango (*MangiferaIndica L.*) Cultivation Haryana". International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 39

- Kumar, R., Rathee, A.K., Kumar, N. and Sumit (2019). Economic analysis of Ber production and marketing in Sonepat district of Haryana" International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 41.
- Bhatia, J.K., Bishnoi, D.K., Malik, D.P., Kumar, N. and Dhillon, A. (2019). Comparative profitability of sugarcane based cropping patterns in Haryana. International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 94.
- Kumar, J., Kumar, N., Sumit and Kumar,R. (2019). Effect of socio-economic characteristics and disposal pattern milk in Haryana" National seminar on entrepreneurship innovation in agriculture for socio-economic empowerment of farmers, March, 12-13, 2019, SKRAU, Bikaner: 85
- Kumar, R., Rathee, A.K., Kumar, N. and Luhach, V.P. (2019). Economic appraisal of mango production in Yamunanagar district of Haryana India. National seminar on "Entrepreneurship innovation in agriculture for socio economic empowerment of farmer, March, 12-13, 2019, SKRAU, Bikaner: 192.
- Malik, D.P. (2019). Initiatives for better access to food in India. XIV Agricultural Science Congress, Feb, 20-23, 2019, NASC, Pusa, New Delhi, India: 395.
- Malik, D.P. (2019). Efficient use of water for sustainable food production in India. XIV Agricultural Science Congress, Feb, 20-23, 2019, NASC, Pusa, New Delhi, India: 399.
- D.P. Malik (2019). Intervention for sustainable production of pulses in India. Agricultural Science Congress, Feb, 20-23, 2019, NASC, Pusa, New Delhi, India: 399.
- D.P. Malik (2019). Promotion of Good Agriculture Practices for Ensuring Food Security in India. International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 94.
- Bishnoi, D.K., Bhatia, J.K., Malik, D.P., Karwasra, J.C. and Kumar, N. (2019). Pattern and extent of crop diversification in Haryana. XIV Agricultural Science Congress, Feb, 20-23, 2019, NASC, Pusa, New Delhi, India: 401.
- Sumit, Chauhan, R.S., Bishnoi, D.K. and Pawar, N. (2019). Economic perspective of Bee-keeping enterprise in Haryana. International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 37.
- Bishnoi, D.K., Bhatia, J.K., Malik, D.P., Pawar, N. and Bhardwaj. (2019). Profitability of Paddy – wheat vis-a-vis alternative cropping patterns in Haryana. International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA), Feb. 2-3, 2019, CCSHAU, Hisar: 94.

Trainings/Seminars/Conferences Attended:

- D.P. Malik, Dr. Dalip Kumar Bishnoi and Dr. Ashok Dhillion attended workshop of project Resource Use Planning for Sustainable Agriculture funded by ICAR Varanasi from august 29-30, 2018.
- Dr. D.P. Malik, Dr. V.P. Luhach, Dr. Nirmal Kumar and Dr.Nitin Bhardwaj Attended National workshop of Cost of cultivation scheme at Trivandrum from September 13-15,2018.
- Dr. D. P. Malik, Dr. J. K. Bhatia, Dr. Nirmal Kumar and Dr. Dalip Kumar Bishnoi attended International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA) held on 2-3 February, 2019 CCS HAU Hisar.
- Dr. D. P. Malik participated as rapporteur for one technical session International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA) held on 2-3 February, 2019 CCS HAU Hisar.
- Dr. J. K. Bhatia attended on 14th Agricultural Science Congress on Innovations for Agricultural Transformationheld at NASC complex New Delhi on 20-23 February, 2019.
- Dr. Nirmal Kumar attended International conference on emerging paradigms in social science research held on B.P. S. Mahila Vishva-Vidyalaya, 25-26 March 2019, Sonepat (Haryana).
- Dr.Nitin Bhardwaj attended Workshop-cum-Seminar on two days' workshop on application of analytical tools and ethics in academic research held on 27-28 February, 2019, Ghaziabad U.P.
- Raj Kumar, SRF attended International symposium on "Innopreneurship: A need of sustainable agriculture" (ISINSA) held on 2-3 February, 2019 CCS HAU Hisar.
- Raj Kumar and Sumit, SRFs attended International conference on emerging paradigms in social science research held on B.P. S. MahilaVishva-Vidyalaya, 25-26 March 2019, Sonepat (Haryana).

- Raj Kumar, SRF attended National seminar on Entrepreneurship innovation in agriculture for socio economic empowerment of farmer held on 12-13 March 2019 SKRAU Bikaner ,Rajasthan.

Popular Articles

- Pawar, N., Ahalwat, D.S., Solanki, Y.P.S., Dhillon, A. and Sangwan, N. (2018). Phasalavshashaokaprabhandan. *Modern kheti*, 16(10): 50.
- Pawar, N., Kumar, N. and Dhillon, A. (2018). DhaankeBhetaruatpadaktavalagatkamkarnekeupaye. *Haryana kheti*, 51(7): 02.
- Dhillon, A., Kumar, R. and Pawar, N. (2018). Krishivavsaye me hisab- kitabkamahtav. *Haryana kheti*, 51(11): 27.
- Dhillon, A., Kumar, R. and Pawar, N. (2018). Kisanokeliye-krishi ran vayastha. *Haryana kheti*, 51(12): 21.
- Solanki, Y.P.S., Siwach, M. and Pawar, N. (2019). Gaheonkasudhbeejkaisetaiyarkarne. *Haryana kheti*, 52 (04): 01.
- Jakhar, D.S., Kumar, N. and Kumar, S. (2018) "Usar / BanjarBhumiKaSudar" *KhetiDunia*,Patiyala. (19.08.2017): 13.

Research Bulletins

- Pawar, N. and Malik, D.P. (2019). Economic viability of kharif crops in Haryana. *Research Bulletin No. 76.* Department of Agricultural Economics, CCS Haryana Agricultural University: P 82.
- Bhatia, J.K., Bishnoi, D.K. and Malik, D.P. (2019). Marketing of Poly House Products in Haryana. *Research Bulletin No.77*.Department of Agricultural Economics, CCS Haryana Agricultural University: P28.

Document on Doubling Farm Income

- **Kundu, K.K.** (2019) Prepared Document on "Strategy on Modernization of Agriculture for - DFI." Prepared for *competent authority*, CCS, Haryana Agricultural University, Hisar: 43.
- **Kundu, K.K.** (2018) Prepared Comments on "Draft Strategy Document for New India@75 – Comments thereof. On 2nd July, 2018.

REVIEW OF RESEARCH SCHEMES (2020-21) AND FINALIZATION OF TECHNICAL PROGRAMME (2021-22)

A. Report by the Head of the Department

1. **Name of the Department:** Agricultural Economics
2. **Staff position** (Scheme wise and post wise details)

Title and Number of scheme	Sanctioned post with number	In position	Name of faculty/staff with designation			Vacant
Research Schemes						
(a)1202-Dte-R-1-Agri (A)-Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming						
1.	Senior Scientist (FM) -01	Nil	Vacant			01
2.	Assistant Scientist-06 (Ag. Economics)	02	Dr. D. P. Malik, Principal Scientist Dr. D. K. Bishnoi, Asstt .Scientist			04
3.	Assistant Scientist- 01 (Sociology)	Nil	Vacant			01
4.	Assistant Scientist -01 (Statistics)	01	Dr. Monika Devi			Nil
5.	Research Associate -01 (Rural Sociology)	Nil	Vacant			01
6.	Assistant -02	01	Sh. Jitender			01
7.	Messenger -01	01	Sh. Krishan Kumar			Nil
(b) 3066-C(c) Econ-1 CS-Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana						
1.	Field Officer (Ag. Economics)-01	01	Vacant			01
2.	Assistant Scientist-03 (Ag. Economics)	03	Dr. Neeraj Pawar, Asstt .Scientist RRS, Rohtak Dr. Sumit, Asstt .Scientist RRS Kaul (from 01.11.2021) Dr. Veer Sain, Asstt. Scientist (upto 28.01.2021) Dr. Vinay Mehla, Asstt .Scientist Deptt. of Agril. Economics, Hisar (from 29.01.2021)			Nil
3.	Assistant Scientist-01 (Statistics)	01	Dr. Joginder, Asstt .Scientist (Statistics)			Nil
4.	Computer/clerk-05	04	Sh. Rahul Sh. Paswan Sh. Sushil (up to 03.06.2021) Smt. Alka Arora Sh. Bhanu Partap*			Nil
5.	Field men/ -30 Agri. Inspectors	14	Agriculture Inspector	cluster	Tehsil	16***
			Sh. Ved Pal Singh	Alawalpur	Palwaal	
			Sh. Mahabir Prasad	Naya Goan	Rewari	
			Sh. Rajender Kumar	Silani	Jhajjar	
			Sh. Mahender Singh	Mandola	M/garh	
			Sh. Bhim Singh	Sohasra	Loharu	
			Sh. Suresh Kumar	Dhamana	Hansi	
			Sh. Shyam Sunder	Dhakal	Narwana	
			Sh. Kuldeep Singh	Kinana	Jind	
			Sh. Sanjeet Kumar	Kheri	Gohana	

				Damkan		
			Sh.MohinderKumar**	Gogripur	Karnal	
			Sh. Raj Kumar	Gadauli	Naraingarh	
			Sh. Nafe Singh	Bhagal	Guhla	
			Sh. Ram Phal	Mundhri	Kaithal	
			Sh. Pawan Kumar	Harnaul	Jagadhri	
6.	Messenger -01	Nil	Vacant			01
Teaching Scheme						
(a) 541/T-1 (B) state – Teaching scheme						
1.	Assistant Professor -06 (Agril. Economics)	03	Dr. V.P. Mehta, Professor (up to 28.02.2021) Dr. K.K.Kundu, Assoc. Professor Mr. Sanjay, Asstt. Professor Ms. Kavita, Asstt. Professor (29.10.2020) Dr. Veer Sain, Asstt. Professor (upto 17.08.2020) Dr. J.S.Papang, Asstt. Professor			03
2.	Steno-Typist-01	01	Sh. Ashok Kumar			Nil
3.	Sweeper-01	01	Vacant			Nil

* working in pay cell of office of Dean COA, ** working at RRS, Karnal, *** Fourteen persons engaged through outsourcing

3. Research Achievements (2020-21):

- The per ha total input energy consumed on 80 sampled farms of Sirsa and Rewari districts of Haryana was found to be highest in paddy-wheat cropping system (53259 $MJha^{-1}$) followed by cotton-wheat (48170 $MJha^{-1}$), pearl millet-wheat (31678 $MJha^{-1}$1), cluster bean-wheat (29832 $MJha^{-1}$), pearl millet-mustard (24996 $MJha^{-1}$) and cluster bean-mustard (23151 $MJha^{-1}$). While, the total energy input consumption per ha based on 80 sampled farms of Karnal and Kurukshetra districts of Haryana was found to be highest in sugarcane *(*70893 $MJha^{-1}$) followed by paddy-wheat (59203 $MJha^{-1}$), maize-wheat (45555 $MJha^{-1}$).

- B-C ratio of cotton worked out was 2.18 for drip, 1.81 for sprinkler and 1.39 for flood irrigation condition based on 60 sampled farms of Bhiwani and Mahendergarh districts. The saving of irrigation water amounted to 28.38 per cent in case of sprinkler irrigation method and 46.58 per cent in case of drip irrigation method as compared to conventional method of irrigation. Electricity saving amounted to 26.73 in drip irrigation method but sprinkler irrigation method was found to be energy intensive as high as 50 per cent cost as compared to conventional irrigation method.

- Highest area under micro irrigation (MI) was in Bhiwani (2.29 lakh acres), Mahendergarh (1.93 lakh acres) and Rewari (0.66 lakh acres) districts. The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by Rewari (23.37 %) and Bhiwani (21.16 %). Based on the mean percentage score, the major constraints faced by MI adopters were heavy initial investment (92.67), less number of subsidy slots available annually (88.33), unavailability of training/demonstration of MI technologies (83.67), high time taken from application to installation (80.00), inadequate and maintenance services centres (74.00).

- Based on 60 sampled vegetable farms of Nuh district, value of B-C ratio was higher than one for vegetables like tomato (1.46), bottle gourd (1.53), okra (1.31), and onion (1.61) indicating profitability of cultivation of these crops. The constraints faced by vegetable growers like untimely availability and high cost of seed, high fluctuation in the price of produce, monopoly of commission agents in the market for fixing price. The price realization of vegetable growers was less than 50 per cent of the price paid by the consumer except in case of okra (57%).

- Majority (71.43%) of vegetable growers were aware about implementation of BBY in the state. More than 50 per cent of respondents had awareness regarding implementing agency, its objectives, crops included under the scheme, registration process and closing date on the portal

and eligibility of farmers under the scheme. But majority of farmers were not aware about area verification and procedure of claiming benefit under BBY.

- The farmers received higher prices of paddy, mustard, cotton and bajra in e-NAM mandis (10) as compared to non-e-NAM mandis (10) in the state. The major constraints like lack of equipment's, inadequate scientific sorting/grading facilities or quality testing machines, internet connectivity etc. impeded online trading on e-NAM portal.
- The monthly per capita expenditure (MPCE) on fruits was more in the southern region with an overall average of ₹40 and ₹57 per person per month in rural and urban areas, respectively. The regions with the least MPCE are the eastern and north eastern regions with around ₹18 per person in rural areas and ₹38-39 in the urban areas of both regions.
- State wise monthly expenditure on fruits, Goa has the highest MPCE with overall average of ₹81 in rural and ₹117 in urban area followed by Kerala and Haryana with overall average of ₹121 and ₹102 in rural and urban area Kerala and ₹40 in rural and ₹70 per person in urban Haryana. The factors like income, own price and price of other fruits affect the proportion of income spent on each fruit.
- Karnal, Kurukshetra, Yamunanagar, Jind, Kaithal and Sirsa district of Haryana state were found highly developed in agricultural sector according to Composite index and Principal Component method. Nuh, Gurugram, Faridabad, Rewari and Jhajhar were the least developed districts.
- Based on OLR model with two and three groups, 5th Fortnight (2nd March to 16th March) *i.e.* approximately one month before harvesting of wheat was found the suitable time to predict wheat yield using yield data of Karnal and Hisar districts.
- Based on the rice yield data for both Hisar and Karnal districts, 21st fortnight (29 Sept. to 13 Oct.) i.e. approximately one month before harvesting of paddy was found the appropriate time to estimate rice yield using the DFA model.
- No mechanical harvesting of sugarcane was done on 90 sampled farms of Karnal, Rohtak and Yamunanagar districts. It consists of various operations like cutting, de-topping, de-trashing, bundle making and loading. The major problems in harvesting of sugarcane were non-availability of mechanical harvester, scarcity of labour, higher wage rate, dependence on migratory labour etc. Similarly in case of cane transportation, long waiting period for disposal of cane at sugar mills, higher labour charges for loading, timely unavailability of vehicle etc. were observed in the study area.
- India has comparative advantage in case of cereals, pulses, tea, coffee, cashew, cotton lint, bovine meat, sugar and honey. The percentage share of agricultural export (8.82 to 9.40%) to total export and agriculture import (3.04 to 4.46%) to total import increased slightly during time period 2011-12 to 2019-20. The total agricultural import increased at growth rate of 6.40 per cent.
- Johansen co-integration test revealed the existence of co-integration among the prices of cotton in major markets of Haryana during the period before e-NAM, while there is no integration among the markets after e-NAM

4. Emerging/Thrust Areas

- Socio-economic analysis of emerging agricultural problems.
- Demand, supply and price analysis of agricultural inputs and output.
- Resource use efficiency in farm enterprises in different agro-climatic zones.
- Diversification in agriculture, sustainable agriculture , utilization of natural resources
- Marketing of agricultural produce and value addition in agriculture.

5. Action taken report of proceedings of meeting of Review Research Schemes (2020-21) and Finalization of Technical Programme (2021-22) held on 28.07.2021

Sr. No.	Observations	Action taken
1.	Young faculty should submit research project to different funding agencies. **(Action: HOD, Agriculture Economics; All young scientists)**	Meeting organized and Letter issued to all concerned teachers
2.	Cost of cultivation of important fruits (Guava, kinnow and strawberry), vegetable crops (onion, potato, tomato and cauliflower) and protected cultivation may be worked out from the available data. Dr.Sumit (Fruits crops), Dr.Neeraj (Vegetable crops) and Dr Vinay Mehla (Protected cultivation cucumber, capsicum & tomato) should take up this responsibility. **(Action: HOD, Agricultural Economics; concerned scientists)**	To be submitted in the month of December, 2021
3.	Experiment may be planned for fluctuation in water table in Haryana and Basmati rice export by Dr Monika. **(Action: Concerned Scientists)**	Dr Joginder included as Collaborator in experiment to be conducted by Deptt of SWE
4.	Statistical experiments may be planned in consultation with Dr B.K Hooda and got approved from the Directorate. **(Action: Concerned Scientists)**	Four Experiments revised in consultation Dr. Hooda and Project Director
5.	Interview schedule should be prepared up to mid-November for discussion with the all concerned. **(Action: HOD Agricultural Economics)**	Schedules for experiments were finalized in meetings held on 21.10.2021 and 11.11.2021
6.	Details of NASF scheme being run in DHRM should be included in the document. **(Action: HOD Agricultural Economics)**	Project not implemented in the department
7.	All the conclusions drawn may be revised with inclusion of quantification. **(Action: Concerned Scientists)**	Quantification was done in conclusions of all experiments
8.	Expected outcome should be mentioned in all the new experiments along with work timeline. **(Action: Concerned Scientists)**	Expected outcome and worked timeline included
9.	Page 1, Point 2: The post of Research Associate (Rural Sociology) should be checked. **(Action: HOD Agriculture Economics)**	The post included as per ECR
10.	Page 4: ATR point No. 8 should be corrected. **(Action: HOD Agricultural Economics)**	Corrected
11.	Page 5, Point 7: The year should be 2021-22. **(Action: HOD Agricultural Economics)**	Corrected
12.	Page 7-15, Point 7: The salient research findings should be given in concise form in 1-2 pages, not experiment-wise details. **(Action: HOD Agricultural Economics)**	Salient findings described in two pages
13.	Page 17, Expt. 2: The source-wise energy per unit of input may be given as annexure. In Table 1, the point B needs to be checked. The title of table 6 may be corrected as discussed. **(Action: Concerned Scientist)**	Needful done
14.	Page 21-31, Expt. 2: Check the units of table 6 and 7 at Page 27 and 28. The conclusion may be revised with inclusion of quantification. **(Action: Concerned Scientist)**	Conclusion revised and quantified
15.	Page 32-35, Expt. 3: The actual status of three irrigation systems should be added, Village-wise data may be given in consultation of Cotton Section. **(Action: HOD, Cotton Section, GPB; Concerned scientist)**	Village wise data for all three irrigation systems included in consultation with cotton section
16.	Page 36-39, Expt. 4: Add yields of crop and mention varieties/hybrids. Replace 'Mewat district' with 'Mewat zone". The "Untimely availability and seed costly" may be replaced with "Timely non-availability and costly seed". In Table 3, avoid the word "spurious". **(Action: Concerned Scientist)**	Replaced with words as suggested

17.	Page 40-46, Expt. 5: In table 1, Area under micro-irrigation may be given. Specify all notations used. The experiment should be continued with inclusion of crop-wise data under sprinkler and drip irrigation with their separate constraints. **(Action: Concerned Scientists)**	Specified all notations and area under micro-irrigations included and new experiment as suggested proposed for 2020-21
18.	Page 48, Expt. 6: Reanalyze the results in consultation with statistician. **(Action: Concerned Scientists)**	Analysed and revised the results
19.	Page 61-68, Expt. 8: Data of LIG/HIG state-wise may be added in tabulated form. The experiments should be continued with suggestions in the meeting. **(Action: Concerned Scientist)**	Table of LIG/HIG classification for various states included. Experiment with modification proposed for 2020-21
20.	Page 69, Expt. 9: Relook the indicators and results. Delete the name of collaborator. **(Action: Concerned Scientist)**	Relooked the indicators and name of collaborator could not be deleted as experiment completed
21.	Page 79, Expt. 11: The model should be used to predict the wheat yield for the year 2021-21 and present in next year. **(Action: Concerned Scientists)**	Predicted wheat yield will be presented in TP meeting 2022-23
22.	Page 82, Expt. 12: The model should be used to predict the rice yield for the year 2121 and present in next year. **(Action: Concerned Scientist)**	Predicted rice yield will be presented in TP meeting 2022-23
23.	Page 86-100, Expt. 13: Replace 'Paddy' (PR)', 1121' and 'Paddy 1509' with coarse rice, fine rice and very fine rice. Important recommendations from the study may be brought out for forwarding to DEE/Department of Agriculture and Farmers Welfare, Haryana. **(Action: Concerned Scientist)**	Replacement with the words as suggested. Recommendations of experiment sent by concerned scientist to DEE
24.	Page 109, Expt. 14: Check t-value in table 4. **(Action: Concerned Scientist)**	't'-value checked and corrected
25.	Page 112, Expt. 15: All data presented should be included in the results. **(Action: Concerned Scientist)**	Data presented was included in the result part of experiment
26.	Page 116, Expt. 5: Replace 'early' with 'normal sown' cauliflower in the title. **(Action: Concerned Scientist)**	Replaced as suggested
27.	Page 120. Expt. 5: The year of start should be 2021-22. Specify number of respondents and include horticulture procedure also. **(Action: Concerned Scientist)**	Corrected year of start, specified respondent and included horticultural products
28.	Page 125-126, Expt. 10-11: Delete the experiments. **(Action: Concerned Scientist)**	Deleted as suggested
29.	Page 127, Expt. 12: The experiment should be carried out on basmati and non-basmati varieties along with planting methods transplanted and DSR in Karnal district with 60 respondents, 15 from each group. **(Action : concerned scientist)**	Modification in experiment was done as suggested
30.	Page 129: Expt. 14: Correct the scientific name in the title **(Action: Concerned scientist)**	Corrected
31.	Page131, Expt.16: Compare the data of the districts under study to state as whole. **(Action : Concerned Scientist)**	Data for the state as a whole included
32.	Page 142: Delete the accepted papers and only published papers should be given as per format supplied by the Directorate, Specify 'others'. **(Action: HOD, Agricultural Economics)**	Corrections done as per format and specified other as suggested
33.	The revised technical programme should be submitted online through ERP module. Two copies of Technical Programme printed from ERP to send to the Directorate of Research within 21 days**.** **(Action: HOD, Agricultural Economics)**	Submitted by concerned scientists

6. List of research projects (from state as well as outside agencies) in operation along with sanctioned budget (2021-22)

S.N.	Number and name of the scheme	Sanctioned Budget (in Rs.)	Funding Agency
Research Schemes			
a.	**State Funded Scheme**		
1.	**1202-Dte-R-1- Agri (A)-state scheme** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	15400.00	State
b.	**Other Agencies**		
2.	**3066-C(c) Econ-1 CS** Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana.	First instalment of 90.00 lakh has been released	DES, Ministry of Agriculture and Farmers Welfare, Govt. of India.
Teaching scheme			
1.	541/T-1 (B) state – Teaching scheme	2200.00	State
2.	1051/T-1(A) state-Teaching scheme	24000.00	State

7. Research projects completed during 2020-21: Nil

8. Research projects sanctioned/submitted during 2021-22: One (01)

S. N.	Title of the Project	Principal Investigator(s)	Funding Agency	Amount (Rs.)	Status
1.	Strengthening agricultural marketing opportunities for rural farmers through e-marketing platforms	Dr. Narendra Singh Professor and Head Deptt. of Agricultural Economics Navsari Agricultural University-Gujarat Dr. Dalip Kumar Bishnoi, Assistant Scientist, associate as a collaborator with the project	National Agriculture Science Fund (NASF) of Indian Council of Agricultural Research	450.00 lakh Budget proposed for CCSHAU of Rs 20.00lakh	Pre-proposal approved and final proposal submitted and it is under process

9. Scheme-wise summary of experiments

Scheme/project	No. of Experiments				
	Planned (2020-21)	**Conducted (2020-21)**	**Concluded (2020-21)**	**Continued (2021-22)**	**New Expt. (2021-2022)**
1202-Dte-R-1- Agri (A)-state scheme Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	**15**	**15**	**13**	**02**	**14**
3066- C(c) Econ.1 (CS) Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana	**02**	**02**	**02**	**-**	**02**

10. List of equipment's (last three years)

Year	Name of equipment	Quantity	Cost (in Rs.)	Status
2018 - 19	Desktop Computer with printers and UPS	05	339854.00	Functional
	Furniture (chair-19, table-5)	24	2,82000.00	Functional
2019 - 20	Multimedia	01	Transfer from IDP Project	Functional
	Desert cooler	02	24,878.00	Functional
2020-21	Computer (3) and printer (3)	06	199981.00	Functional

11. Recommendations generated for field application : Nil

12. Protection of IPR instruments, if any (patents, registration of variety/ germplasm, copyright etc.) :Nil

B. Details of Each Research Scheme(s) for Review:

1. Scheme No. : 1202-Dte-R-1-Agri (A)

Title: Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

2. Year of Start : 2002-2003

3. Location : Haryana

4. Objectives of the scheme:

- To analyse the resource use efficiency in Haryana farming.
- To carry out studies into different marketing aspects of major farm inputs and products.
- To study the possible agricultural diversification in different zones of Haryana.

5. Any need to modify the objectives as per the need of the state

- No-

6. Budget for the year 2020-21 (head-wise sanction and expenditure details) (in Rs.)

Sr. No.	Particulars	Allotment	Expenditure	Balance
1	O.E(NR)	0	0	0
2	LTC	0	0	0
3	O.E(NR)	0	0	0
4	TA	5500	3001	2499
5	Other Charges	8000	7474	526
6	M & S	5850	5820	30
	Total	**19350**	**16295**	**3055**

7. Salient Research Findings of the Scheme during 2020-21

- In western zone of the state, input energy consumption was found to be highest in paddy-wheat cropping system *i.e.* 53259 $MJha^{-1}$. Whereas, sugarcane was found to be highest input energy consumer *i.e.* 70893 $MJha^{-1}$ in eastern zone of Haryana.
- Highest energy productivity (0.24 kg MJ^{-1}) was achieved in pearl millet-wheat in western zone. Similarly, in eastern zone of Haryana, highest energy productivity (1.23 kg MJ-1) was achieved in sugarcane.
- Higher prices of fuel (diesel), erratic supply of electricity, declining water table, shortage of farm labour, higher prices of fertilizers, non-availability of modern means of farm machinery at peak hours, higher rent charges of farm machinery and high initial investment and less availability of subsidized solar renewable (solar) energy equipment were identified some of the energy constraints in the study area.
- The share of different commodities in different districts in arrivals ranges from about 18 to 60 per cent for paddy, 10 to 57 per cent for wheat, 1 to 10 per cent for cotton and 1.5 to14 per cent for fruits and vegetables respectively. While the other crops represented very small proportion in total arrivals of the produce.
- Some major problems which hinders online trading includes*:* lack of equipment's: It includes lack of scientific sorting/grading facilities or quality testing machines. Also there is lack of internet connectivity which is impeding the progress.

- Delay in implementation: State Agricultural Departments have been finding it difficult to convince all stakeholders- farmers, traders and commission agents- to move to the online platform. While traders fear the taxman, farmers fear lower prices if the produce is assayed.
- The saving of irrigation water amounted to 28.38 per cent in case of sprinkler irrigation method and 46.58 per cent in case of drip irrigation method as compared to conventional method of irrigation.
- Energy saving amounted to 26.73 in drip irrigation method but sprinkler irrigation method was found to be energy intensive by as high as 50 per cent cost when compared to the conventional irrigation method .
- The major constraints faced by farmers were declining water table, brackish water, erratic supply of electricity and blockage in nozzle and filters.
- The gross and net returns of vegetables in Mewat district were Rs. 276025 and 87534 for tomato, 252625 and 87071 for bottle gourd, 331200 and Rs. 78050 for okra, 347875 and Rs. 131242 for onion.
- The constraints faced by vegetable growers were untimely availability and high cost of seed, high fluctuation in price/low-price received on the produce and monopoly of private commission agents in fixing price.
- Haryana ranks 9th among all states in MI coverage with 10.4 per cent of gross irrigated area under micro-irrigation and 4th when observed according to area under MI (9.1 %) as a proportion of gross cultivated area under MI.
- The districts with highest area under MI were Bhiwani (229397 Acres), Mahendergarh (193259 Acre) and Rewari (66495 Lakh Acres). The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by Rewari (23.37 %) and Bhiwani (21.16 %). In total, Haryana had 546455 acres of area under micro-irrigation *i.e.* 6.1 per cent of cultivated area.
- The top five constraints faced by adopters were heavy initial investment (92.67%), less number of subsidy slots available annually (88.33%), unavailability of training/demonstration of MI technologies (83.67%), high time taken from application to installation (80.00%), lack of repair and maintenance services (74.00%).
- In Sonepat, Kurukshetra and Mewat districts, the price of cauliflower, potato, tomato and onion for adopter of BBY was Rs. 750, 500, 500 and 650 while the price of cauliflower, potato, tomato and onion for non- adopter was Rs. 650, 400, 400 and 550, respectively.
- The various constraints faced by the growers were lack of easy availability of J-form in regulated market and BBY portal deals with marketing board instead of Horticulture Department in Sonepat, Kurukshetra and Mewat districts.
- The percentage share of agricultural export as well as import slightly increased from 8.82 to 9.04 per cent and 3.04 to 4.46 per cent, respectively from 2011-12 to 2019-20. Total agricultural import has increased more than double with compound growth rate 6.40 per cent during study period than export (0.47 %) but it showed less stability than agricultural export.
- Maximum growth has showed that export of non-basmati rice with compound annual growth rate 25.70 per cent followed by marine products (7.16 %), spices (5.60 %), coffee (5.32 %), buffalo meat (4.35%), basmati rice (4.34 %) and castor oil (1.98%) with coefficient of variation 19.02, 17.49, 23.26, 20.15 and 16.20 per cent, respectively. Declined growth was observed in oil meals (-12.98 %), raw cotton (-11.40 %) and cashew (-1.47 %)
- Pulses import declined over the years of study period which showed positive sign toward strengthening of agricultural trade. In case of pulses trade position of India shifted from net importer to net exporter.

- The percentage share of marine products, basmati rice, buffalo meat, non-basmati rice and spices export in total agricultural export remained in favour of agricultural trade on other hand raw cotton, oil meals, castor oil, coffee and cashew export percentage share unfavourable for agricultural trade. During the same period of study import percentage share was remained unfavourable in case of fresh fruit, cashew, spices, alcoholic beverages and miscellaneous processed items. The favourable situation for trade was created by pulses, vegetable oil and sugar declined import.
- The monthly per capita expenditure (MPCE) on fruits was more in the southern region with an overall average of ₹40 and ₹57 per person per month in rural and urban areas, respectively. The regions with the least MPCE were the eastern and north eastern regions with around ₹18 per person in rural areas and ₹38-39 in the urban areas of both regions.
- It was observed that, Haryana is the only state in northern region that has a high MPCE on fruits which is around ₹10-₹15 higher than the MPCE of any northern states.
- The factors like income, own price and price of other fruits affect the proportion of income given to each fruit. The demographic factors that increase the expenditure on fruits were literacy which has a positive and significant effect on banana, watermelon, coconut, green coconut, orange, papaya, mango, apple and grape. On the other hand, it was observed that as the household size and number of children per household increases then the share of fruits/ the proportion of income dedicated to fruit expenditure in the total food basket decrease except for guava, watermelon and musk melon.
- Gurugram, Faridabad, Panchkula and Panipat were found highly developed districts in socio-economic sector based on both the methods and Nuh, Fatehabad, Bhiwani, Jind and Kaithal were among the least developed districts.
- It was observed that percentage of urban population to total, population density, number of registered factories and percentage of work force in factories, transport related facilities and teacher pupil ratio primary were important variables for the socio-economic development.
- Karnal, Kurukshetra, Yamunanagar, Jind, Kaithal and Sirsa have been found highly developed districts in agricultural sector according to Composite index and Principal Component method. Nuh, Gurugram, Faridabad, Rewari and Jhajhar were in least developed districts according to agricultural sector.
- Percentage of total cereals and food-grains area to total cropped area, irrigation facilities, total cereals and food-grains yield, number of cattle per lakh population and percentage of agriculture workers contributed highly in agricultural sector development.
- It was observed that 20th fortnight (16th Oct-31th Oct) is the appropriate time for forecasting sugarcane yield. Further, it was also observed that 5th Fortnight (2nd March to 16th March) *i.e.* approximately one month before harvesting is the appropriate time for forecasting wheat yield. 21st fortnight (29 Sept. to 13 Oct.) *i.e.* approximately one month before harvesting is the appropriate time for forecasting the rice yield.
- CAGR of bullock labour is decreasing in Haryana than its competitive producing states. The CAGR of Haryana state is higher for machine labour and fertilizer & manure then Gujarat for Bajra, Punjab for Paddy, Wheat & Cotton, Tamilnadu for Sugarcane & MP for Gram.
- The costs incurred on use of inputs in sugarcane crops as human labour, insecticides and irrigation were more in Tamilnadu than Haryana but Machine labour, seed and fertilizers used in Haryana was at higher side.
- In the eastern zone, more fertilizers have been used in Karnal than Yamuna Nagar district. In overall a maximum of Rs. 4163.39 is expended on fertilizer in sugarcane followed by 2903, 2449 & 2136 in maize, wheat & mustard respectively. However in western zone more fertilizer has been used in Mewat district compared to Bhiwani district. Maximum expenditure on fertilizer was made in wheat crop (2501) followed by Mustard crop (2048).

- In eastern zone, maximum number of farmers reported inadequate availability of funds the main reason to not adopting recommended doses of fertilizers to their crops, however in western zone the most ranked reason is erratic supply of electricity for timely irrigation and in overall it comes the inadequate availability of funds as of eastern zone. The least affected reason among the list found was excessive use fertilizers especially in rented land for overall in both zones.
- Most of the operations in cane cultivation are carried out manually and the use of machinery is limited to field preparation. Further manual harvesting was divided into cutting, detopping, detrashing, bundle making and loading. The overall average labour-use and labour cost in manual harvesting was 91.58 mandays/ha and 48.78 Rs./qtl, respectively.
- It was observed that among harvesting and transportation selected problems, in harvesting major problem was timely availability of mechanical harvester first (100%) which was followed by Availability/ scarcity of labour during harvesting period; Dependence on migratory labour; Higher charges of harvesting by labour and Non-availability of village labour.
- Similarly in transportation major problem were Long waiting period for disposal of cane at sugar mills followed by Higher labour charges for loading; Timely non-availability of vehicle and Not availability of labour for loading of cane.
- Johansen co-integration test revealed the existence of co-integration among the prices of cotton in major markets of Haryana during the period before e-NAM, while there is no integration among the markets after e-NAM

8. Justification for continuation of the scheme

Objectives of the schemes are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers, sustainable utilization of natural resources, diversification in agriculture; resource use is farm enterprise, marketing of agricultural produce and its value addition in Haryana.

9. Constraints, if any: Shortage of scientists in the scheme.

10. TECHNICAL PROGRRAME OF WORK DURING 2020-21

I	**Experiment 1: Economic analysis of energy utilization pattern in prevalent cropping systems in Haryana**	
Ii	**Objectives of the experiment**	• To work out economics of energy use in major cropping systems • To optimize the energy utilization in cropping systems • To identify the energy constraints of various cropping system
Iii	**Name(s) of the investigators**	• Dr. Dalip Kumar Bishnoi Planning, finalization of interview schedule and report writing • Dr. Sanjay Collection, compilation and analysis of data
Iv	**Name(s) of the collaborator(s) with activity profile**	• Dr Anil Saroha, Deptt. of FMPE Calculation of energy parameters for identified crops • Dr Anil Kumar Dhaka Deptt. of Agronomy Evaluation of energy requirement for various crop operations
V	**Year of start**	2019-20
Vi	**Duration of study**	Two Years (2019-20 to 2020-21)
Vii	**Treatment details**	• **Locale of experiment:** Haryana • **Zone covered** : Eastern and Western zone • **District covered :** Sirsa, and Rewari (western zone) • **Block and villages:** Sirsa and Dabwali block from Sirsa district and Rewari and Bawal block from Rewari district were selected randomly. Further villages namely, Jhorarnali, Fairwainkalan (Sirsa), Chautala, Jandwala Bishnoian (Dabwali) and Bariwas, Salhawas (Rewari), Shahpur, Ranoli (Bawal) were selected randomly. • **District covered :** Karnal and Kurukshetra (eastern zone) • **Block and villages:** Indri and Nilokheri block from Karnal district and Ladwa and Babain block from Kurukshetra district were selected randomly. Further villages namely Umarpur, Nanhera (Indri)Taraori and Bhainikhurd (Nilokhri). Whereas, Badarpur, Bakali (Ladwa) and Bhagwanpur , Bint (Babain) were selected randomly.
Viii	**Observations recorded**	• Eighty farmers from western and eighty farmers from eastern zones were interviewed related to various cost, returns, utilization of farm energy in prevalent cropping patterns in the study area

ix. Results achieved during 2020-21

Energy utilization patterns in major cropping system in Haryana

Energy use pattern in major cropping system in western zone of Haryana are presented in Table 1. The per hectare total input energy consumption was found to be highest in paddy-wheat cropping system *i.e.* 53259 $MJha^{-1}$ followed by cotton-wheat (48170 $MJha^{-1}$), pearl millet-wheat (31678 $MJha^{-1}$), cluster bean-wheat (29832 $MJha^{-1}$), pearl millet-mustard (24996 $MJha^{-1}$) and cluster bean-mustard (23151$MJha^{-1}$). Fertilisers alone were highest energy consumer in all the prevailing cropping system except paddy-wheat ranged between 37.64 to 46.17 per cent followed by fuel (diesel) and electricity, accounted for 16.08 to 26.60 per cent and 13.05 to 19.95 per cent share of the total input energy consumption, respectively. In case of paddy–wheat cropping system, electricity were obtained highest share *i.e.* 36.03 per cent due to the more number of irrigation is required in paddy crop followed by fertilizers and fuel accounted share 35.28 and 16.08 per cent respectively.

Similarly, highest output energy were produced in cotton-wheat cropping system *i.e.* 342153 $MJha^{-1}$ followed paddy-wheat (335457 $MJha^{-1}$), pearl millet-wheat (301603$MJha^{-1}$), pearl millet-

mustard (260800 $MJha^{-1}$), cluster bean-wheat (193691$MJha^{-1}$) and cluster bean-mustard (152888$MJha^{-1}$). In case of economic analysis, maximum benefit to cost ratio was obtained in cluster bean-mustard *i.e.* 1.38 followed by pearl millet-mustard (1.32), paddy-wheat (1.28), cluster bean-wheat (1.25), pearl millet-wheat (1.22). Whereas, least benefit cost ratio were obtained in case of cotton-wheat *i.e.* 1.05 in the study area.

Table 1: Energy use pattern for major cropping system in western zone of Haryana ($MJha^{-1}$)

Particulars	**Paddy-Wheat**	**Cotton-Wheat**	**Pearl millet-Wheat**	**Cluster bean-Wheat**	**Pearl millet-Mustard**	**Cluster bean-Mustard**
A. Inputs						
Human	714 (1.34)	1354 (2.81)	589 (1.86)	587 (1.97)	791 (3.17)	789 (3.41)
Seed	1654 (3.11)	1533 (3.18)	1544 (4.87)	1654 (5.54)	167 (0.67)	278 (1.20)
Fertilizers	18789 (35.28)	22239 (46.17)	13686 (43.20)	12138 (40.69)	10261 (41.05)	8713 (37.64)
Chemicals	812 (1.52)	960 (1.99)	120 (0.38)	120 (0.40)	90 (0.36)	90 (0.39)
Machinery	3537 (6.64)	4138 (8.59)	3093 (9.76)	2884 (9.67)	2994 (11.98)	2785 (12.03)
Fuel (diesel)	8563 (16.08)	11660 (24.21)	6639 (20.96)	6498 (21.78)	6298 (25.20)	6157 (26.60)
Electricity	19190 (36.03)	6285 (13.05)	6007 (18.96)	5952 (19.95)	4394 (17.58)	4339 (18.74)
Total Energy Input	53259 (100.00)	48170 (100.00)	31678 (100.00)	29832 (100.00)	24996 (100.00)	23151 (100.00)
B. Output						
Yield (kg/ha)	10418	6081	7581	5831	5000	3250
Yield energy output (MJ/ha)	153145	103553	111441	85716	95388	69663
Straw output (kg/ha)	14585	12838	15213	8638	11825	5250
Straw energy output (MJ/ha)	182313	238600	190163	107975	165413	83225
Total energy output (MJ/ha**)**	335457	342153	301603	193691	260800	152888
C. Economic Analysis						
Cost of Cultivation (Rs./ha)	172570	172428	143678	123928	133284	113534
Gross Returns (Rs./ha)	220617	181336	175011	154974	176600	156563
Net Returns(Rs./ha)	48047	8908	31333	31045	43316	43028
B:C Ratio	1.28	1.05	1.22	1.25	1.32	1.38

Energy use pattern in major cropping system in eastern zone of Haryana are presented in Table 2. The per hectare total input energy consumption was found to be highest in sugarcane *i.e.* 70893 $MJha^{-1}$ followed by paddy-wheat (59203 $MJha^{-1}$), maize-wheat (45555 $MJha^{-1}$). Fertilisers alone were highest energy consumer in paddy-wheat and maize-wheat cropping system, accounted 38.65 and 51.81 per cent share in total input energy consumption, respectively. While, electricity and fuel (diesel), accounted for 20.88 to 36.08 per cent and 14.11 to 14.57 per cent share of the total energy input consumption in paddy-wheat and maize-wheat, respectively. In case of sugarcane, electricity were obtained highest share *i.e.* 37.19 per cent due to the more number of irrigation is required by sugarcane followed by fertilizers and fuel accounted share 23.08 and 14.50 per cent respectively.

Similarly, highest output energy were produced in sugarcane crop *i.e.* 480050 MJha^{-1} followed maize-wheat (379835 MJha^{-1}) and paddy-wheat (351356 MJha^{-1}). In case of economic analysis, maximum benefit to cost ratio was obtained in maize-wheat *i.e.* 1.36 followed by paddy-wheat (1.25) and sugarcane (1.04) in the study area.

Table 2: Energy use pattern in major cropping system in eastern zone of Haryana (MJha^{-1})

Particulars	**Paddy –Wheat**	**Maize-Wheat**	**Sugarcane**
A. Inputs			
Human	714 (1.21)	720 (1.58)	2872 (4.05)
Seed	1654 (2.79)	1764 (3.87)	11025 (15.55)
Fertilizers	22879 (38.65)	23603 (51.81)	16359 (23.08)
Chemicals	812 (1.37)	120 (0.26)	2490 (3.51)
Machinery	3433 (5.80)	3198 (7.02)	1505 (2.12)
Diesel	8352 (14.11)	6639 (14.57)	10277 (14.50)
Electricity	21359 (36.08)	9512 (20.88)	26366 (37.19)
Total Energy Input	59203 (100.00)	45555 (100.00)	70893 (100.00)
B. Output			
Yield (kg/ha)	10912	11275	87500
Yield energy output (MJ/ha)	160406	231148	463750
Straw output (kg/ha)	15276	9395	1000
Straw energy output (MJ/ha)	190950	148688	16300
Total energy output (MJ/ha**)**	351356	379835	480050
C. Economic Analysis			
Cost of Cultivation (Rs./ha)	185006	167055	280875
Gross Returns (Rs./ha)	231013	226881	292000
Net Returns(Rs./ha)	46007	59826	11125
B:C Ratio	1.25	1.36	1.04

Energy use efficiency in major cropping system in Haryana

The energy use efficiency in major cropping system in western zone of Haryana are shown in Table 3. The highest net energy (293983MJ ha^{-1}) were produced cotton-wheat cropping system followed by paddy-wheat (282198MJ ha^{-1}), pearl millet-wheat (269926 MJha^{-1}), pearl millet-mustard (235804 MJha^{-1}), cluster bean-wheat (163858 MJha^{-1}), and cluster bean-mustard (129737 MJha^{-1}). Whereas, highest energy productivity (0.24 kg MJ^{-1}) were achieved in pearl millet-wheat followed by paddy-wheat, cluster bean-wheat, pearl millet-mustard (0.20 kg MJ^{-1}), cluster bean-mustard (0.14 kg MJ^{-1}) and cotton-wheat (0.13 kg MJ^{-1}) respectively. As far as energy output input ratio is concern, highest energy ratio were obtained in pearl millet-mustard *i.e.* 10.43 MJha^{-1} followed by pearl millet-wheat (9.52 MJha^{-1}), cotton-wheat (7.10 MJha^{-1}), cluster bean-mustard (6.60 MJha^{-1}), cluster bean-wheat (6.49 MJha^{-1}) respectively. While, least output-input energy ratio was obtained in case of paddy-wheat *i.e.* 6.30 MJha^{-1} in the study area.

Table 3: Energy use efficiency in major cropping system in western zone of Haryana

Particulars	Paddy-Wheat	Cotton-Wheat	Pearl millet-Wheat	Cluster bean-Wheat	Pearl millet-Mustard	Cluster bean-Mustard
Net Energy yield (MJ/ha)	282198	293983	269926	163858	235804	129737
Energy productivity (kg/MJ)	0.20	0.13	0.24	0.20	0.20	0.14
Energy ratio (MJ/ha)	6.30	7.10	9.52	6.49	10.43	6.60

The energy use efficiency in major cropping system in eastern zone of Haryana is shown in Table 4. The highest net energy (409157 MJ ha^{-1}) were produced sugarcane crop followed by maize-wheat (334280MJ ha^{-1}), paddy-wheat (292153 $MJha^{-1}$), respectively. Similarly, highest energy productivity (1.23 kg MJ^{-1}) was achieved in sugarcane, followed by maize-wheat (0.25 kg MJ^{-1}) and paddy-wheat (0.18 kg MJ^{-1}) cropping system, respectively. As far as energy output input ratio is concern, highest energy ratio were obtained in maize-wheat *i.e.* 8.34 $MJha^{-1}$ followed by sugarcane (6.77 $MJha^{-1}$) and paddy-wheat (5.93 $MJha^{-1}$) respectively, in the study area.

Table 4: Energy use efficiency in major cropping system in eastern zone of Haryana

Particulars	Paddy-Wheat	Maize-Wheat	Sugarcane
Net Energy yield (MJ/ha)	292153	334280	409157
Energy productivity (kg/MJ)	0.18	0.25	1.23
Energy ratio (MJ/ha)	5.93	8.34	6.77

Energy constraints in major cropping system in Haryana

Energy constraints in major cropping system in western zone of Haryana are presented in Table 5. Results of the study revealed that hundred per cent farmers were stated that higher prices of fuel are the major constraints. Whereas, erratic supply of electricity, declining water table, higher prices of fertilizers, shortage of farm labour, non-availability of modern means of farm machinery, higher prices as well as higher rent charges of farm machinery and high initial investment and less availability of subsidized renewable (solar) energy equipment were observed some of the energy constraints in study area.

Table 5: Energy constraints in major cropping system in western zone of Haryana

Sr. No.	Constraints	Per cent response
1	Higher prices of fuel/diesel	100.00
2	Erratic supply of electricity	87.50
3	Declining water table	87.50
4	Higher prices of fertilizers	83.75
5	Shortage of farm labour	85.00
6	Non availability of modern means of farm machinery viz; lazer land leveller, planters(seed drill, turbo happy seeder, raised bed cum farrow planter etc.) especially at peak hours	82.50
7	Higher prices and rent charges of farm machinery	80.00
8	High initial investment and less availability of subsidized renewable (solar) energy equipment	80.00

Energy constraints in major cropping system in eastern zone of Haryana are presented in Table 6. Results of the study revealed that hundred per cent farmers were stated that higher prices of fuel are the major constraints. Whereas, declining water table, shortage of farm labour, erratic supply of electricity, higher rent charges of farm machinery, non-availability of modern means of farm machinery and higher prices of fertilizers were identified some of the energy constraints in study area.

Table 6: Energy constraints in major cropping system in eastern zone of Haryana

Sr. No.	Constraints	Per cent response
1	Higher prices of fuel/diesel	100.00
2	Declining water table	97.50
3	Shortage of farm labour	90.00
4	Erratic supply of electricity	87.50
5	Higher rent charges of farm machinery	87.50
6	Non availability of modern means of farm machinery viz; lazer land leveller, planters(seed drill, turbo happy seeder, raised bed cum farrow planter etc.) especially at peak hours	87.00
7	Higher prices of fertilizers	83.75

x. Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

- The per hectare total input energy consumption was found to be highest in paddy-wheat cropping system *i.e.* 53259 $MJha^{-1}$ followed by cotton-wheat (48170 $MJha^{-1}$), pearl millet-wheat (31678 $MJha^{-1}$), cluster bean-wheat (29832 $MJha^{-1}$), pearl millet-mustard (24996 $MJha^{-1}$) and cluster bean-mustard (23151 $MJha^{-1}$) in western zone of Haryana.
- The per hectare total input energy consumption was found to be highest in sugarcane *i.e.* 70893 $MJha^{-1}$ followed by paddy-wheat (59203 $MJha^{-1}$), maize-wheat (45555 $MJha^{-1}$) in eastern zone of Haryana.
- Fertilisers alone were highest energy consumer in all the prevailing cropping system except paddy-wheat ranged between 37.64 to 46.17 per cent followed by fuel (diesel) and electricity, accounted for 16.08 to 26.60 per cent and 13.05 to 19.95 per cent share of the total energy input consumption, respectively in western zone of Haryana.
- Fertilisers alone were highest energy consumer in paddy-wheat and maize-wheat cropping system, accounted 38.65 and 51.81 per cent share in total input energy consumption, respectively. While, electricity and fuel (diesel), accounted for 20.88 to 36.08 per cent and 14.11 to 14.57 per cent share of the total input energy consumption in paddy-wheat and maize-wheat, respectively in eastern zone of Haryana.
- Highest energy productivity (0.24 kg MJ^{-1}) was achieved in pearl millet-wheat followed by paddy-wheat, cluster bean-wheat, pearl millet-mustard (0.20 kg MJ^{-1}), cluster bean-mustard (0.14 kg MJ^{-1}) and cotton-wheat (0.13 kg MJ^{-1}) respectively in western zone of Haryana.
- Similarly, highest energy productivity (1.23 kg MJ^{-1}) was achieved in sugarcane, followed by maize-wheat (0.25 kg MJ^{-1}) and paddy-wheat (0.18 kg MJ^{-1}) cropping system, respectively in eastern zone of Haryana.
- Higher prices of fuel (diesel), erratic supply of electricity, declining water table, shortage of farm labour, higher prices of fertilizers, non-availability of modern means of farm machinery at peak hours, higher rent charges of farm machinery and high initial investment and less availability of subsidized renewable (solar) energy equipment were identified some of the energy constraints in the study area.

Conclusion

It was concluded from the study that paddy-wheat and sugarcane cropping system were found to be highest input energy consumers in western and eastern zone of Haryana, *i.e.* 53259 and 70893 $MJha^{-1}$, respectively. The highest output energy was found in cotton-wheat and sugarcane cropping systems in the study area. In case of economic analysis, maximum benefit to cost ratio were obtained in cluster bean-mustard and maize-wheat cropping system in western and eastern zone, respectively. As far as efficient energy utilization is concern, highest energy productivity was achieved in pearl millet-wheat (0.24 kg MJ^{-1}) and sugarcane (1.23 kg MJ^{-1}) cropping system in western as well as eastern zone respectively. Higher prices of fuel (diesel), erratic supply of electricity, declining water table, shortage of farm labour, higher prices of fertilizers, non-availability of modern means of farm machinery at peak hours were identified some of the energy constraints in the study area. Therefore, potential of energy conservation needs to be realised through mass education campaign and by providing economic incentive to conservation and imposing disincentives on inefficient use and sustained efforts are needed to look for an economically suitable alternative to paddy crop which is largely responsible for power and groundwater consumption.

i	**Experiment 2: Performance of electronic national agricultural markets (e-NAM) in Haryana**	
ii	**Objectives of the experiment**	• To assess the performance and functioning of e-market in Haryana from various stakeholders point of view. • To assess the impact of e-market on farmer price realisation and arrivals in regulated market. • To provide lessons learned from markets in Haryana to effective implementation of e-NAM.
iii	**Name(s) of the investigators**	• Dr. K.K. Kundu Planning, monitoring, finalization of interview schedule, • Dr Neeraj Panwar Collection and compilation of data • Dr. Sumit Collection of data and analysis and report writing,
iv	**Name(s) of the collaborator**	• Dr. Ram Niwas, Deptt. of Mathematics and Statistics
v	**Year of start**	2019-20
vi	**Duration of study**	Two Years (2019-20 and 2020-21) • The major commodities from kharif and rabi seasons were selected for the study, where these are being traded on e-markets. • For these commodities, 20 e-markets, with 10-e markets as treatment and another 10 as control will be selected for collecting prices and arrivals data
vii	**Treatment details**	• **Locale of experiment:** Haryana • The selected markets were from eastern zone (5 e-NAM markets namely, Kaithal, Pundri, Karnal, Nissing and Taraori+5non e- NAM as control namely, Jundla, Kunjpura, Nilokheri, Dhand and Siwan) while from western zone (5 e-NAM markets namely, Rohtak, Jhajjar, Rewari, Palwal and Sonipat + 5 non e-NAM as control namely, Sampla, Bhadurgarh, Kosli, Hathin and Kharkhoda) • Number and types of respondents: Ten stake holders from each market *i.e.* farmers (10), traders (05)and one market committee/ organisation from each selected market were surveyed • Statistical design/methods: The descriptive statistical tools like mean, percentage etc. were used
viii	**Observations recorded**	• Primary and secondary data related to status of e-NAM and non-markets in Haryana were collected • Schedule for collection of primary data for various stakeholders were prepared

ix. Results achieved during 2020-21

Performance and functioning of e-market Haryana from various stakeholders point of view e-NAM in Haryana

The e-NAM system was implemented in Haryana with its initial launch in April 2016 in 8 states across country. As of October 2017, 54 mandis are connected through e-NAM in Haryana. The Haryana State Agricultural Marketing Board (HSAMB) has been assigned the task of connecting the mandis under e-NAM platform (*Economic Survey of Haryana, 2016-17)*. Out of total regulatedmarkets, 37 have been connected in 1st phase of e-NAM and then 54 mandis, next phases. Now 81 mandies have been connected. This shows how much the e-NAM system has grown since online trading give the mandis a wide coverage in reaching their clients and attracting potential new customers. Currently, there are over 150 commodities including staple food grains, vegetables and fruits are currently listed in its list of commodities available for trade. Total traded value of the market is estimated at Rs. 36,275 crore with total traded quantity of 1.5 crore MT. there are over 73 lakh registered farmers, over one lakh registered traders and 53,163 commission agents on the e-NAM platform. The selected APMC markets/mandis linked with e-NAM platform in Haryana implemented e-NAM at different points of time.

Table 1: Staffing arrangements in the selected e-NAM mandis

Sr. No.	Particulars	Number
1.	Mandi Secretory	1
2.	Assistant Secretory	1
2.	President	1
3.	Assistant Supervisors	9-16
4.	Accountant	1
	Auction Recorder	1
5.	Peon	3-5
6.	Watchmen	2-4
7.	Computer Operator	3-5

Table 2: Infrastructural facilities and services provided to stakeholders in selected mandis

S. No.	Facilities and Services:	Availability in Number of Mandis					
		e-markets (e-NAM)			Non e-markets (non-e-NAM)		
		Yes	No	Total	Yes	No	Total
1.	Sitting hall for farmers	10 (100)	0	10 (100)	2 (20)	8 (80)	10 (100)
2.	e-Auction Platform	10 (100)	0	10 (100)	0	10 (100)	10 (100)
3.	Bid room	10 (100)	0	10 (100)	4 (40)	6 (60)	10 (100)
4.	Grading and Assaying Laboratory	8 (80)	2 (20)	10 (100)	3 (30)	7 (70)	10 (100)
5.	Mechanical Graders	3 (30)	7 (70)	10 (100)	2 (20)	8 (80)	10 (100)
6.	Audio Visual aids	10 (100)	0	10 (100)	0	10 (100)	10 (100)
7.	Garbage Disposal System	9 (90)	1 (10)	10 (100)	5 (50)	5 (50)	10 (100)
8.	Parking	7 (60)	3 (30)	10 (100)	6 (60)	4 (40)	10 (100)

Note: Figures in parentheses represent per cent to total

In the selected APMCs the staffing arrangement is presented in table 1. In the selected APMCs the staffing arrangement and the size of the sanctioned work force were nearly similar.

The infrastructural facilities and services provided in the selected e-NAM and non e-NAM markets are presented in Table 2. Availability of sitting hall facility, e-Auction platform, Bid room and Audio Visual aids in e-NAM mandies was 10 (100.00%) and in non e-NAM mandies only 20.00, 40.00 per cent facility of sitting hall and bid management were available.

Grading and assaying laboratories 8 (80.00%) out of 10 and 3 (30.00%) out of 10 selected e-NAM and non e-NAM mandis were provided, similarly for the facilities for inspection regarding the quality of the produce before the e-auction in e-NAM platform were available. Facility of the mechanical graders was available only 30.00 per cent in e-NAM mandies. Sufficient parking 7 (70.00 %) selected e-NAM mandis and 6 (60.00 %) out of 10 selected non e-NAM mandis had premises for tractors, trucks etc. Over all very good and adequate facilities and services were created and made available to all the stakeholders in the selected markets by the market committees.

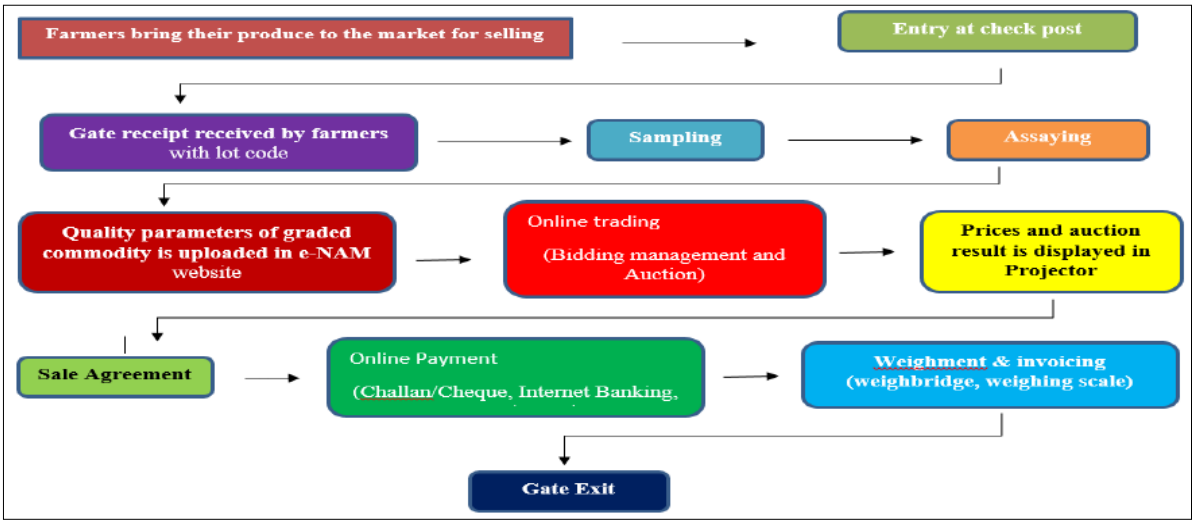


Fig. 1e-NAM auction process in selected APMCs

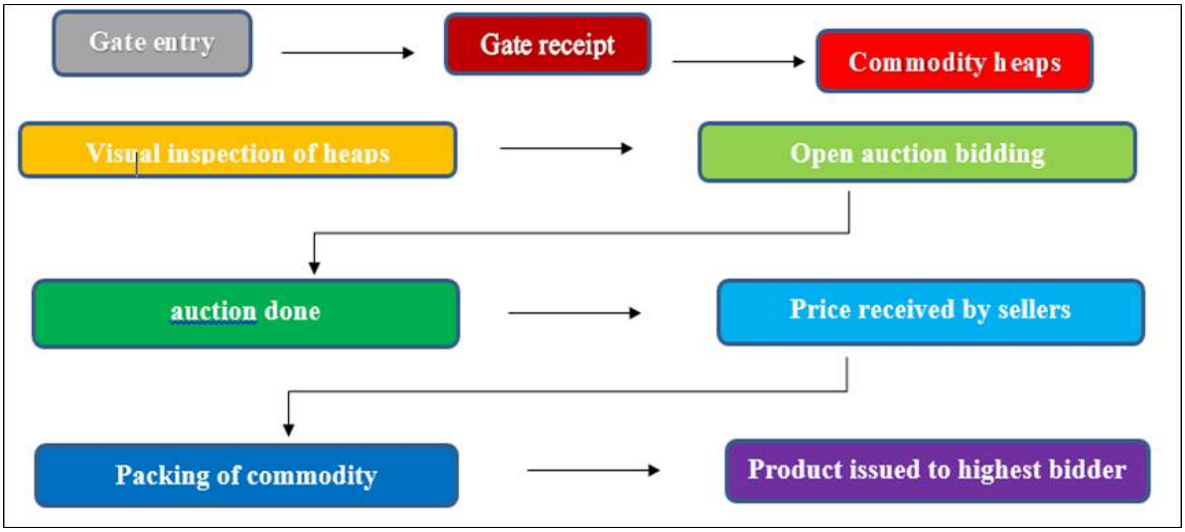


Fig. 2 Non e-NAM auction process in selected APMCs

e-NAM process/method of sale

One check post centre is set up at the main gate of the market also details of the farmers like name of the farmer or trader, address, commodity (s) to sell, type of the vehicle, number of the vehicle, except bullock cart is fill up by the market employee. The sale of the farmer's produce was settled through open auction and e-NAM auction in the selected APMCs. The sample of the produce or commodity is given a lot number which is then taken to the assaying lab for grading purpose in this method of sale in e-NAM system. The farmer's produce is registered in e-NAM website for online bidding after the grading is completed. The price of the commodity and auction results are displayed in the projector or computer screens in front of the farmers shortly after bidding is finished. If they want in the course of the bidding process, the farmer has the choice to accept or reject the price offer by the buyers. In the process of the e-NAM auction, sellers and traders were unable to understand the process and observed that due to computerization and complexity of trading discourage them to trade their produce in the e-NAM auction at one point. More training initiative should be taken within the market or in the villages about e-NAM with a view to make e-NAM system more functional for the traders and farmers (figure 1).

Table 3: Registered e-NAM stakeholders of selected markets in Haryana

Districts	Market	Farmers	Traders	Commission agents	FPOs
Eastern Zone					
Kaithal	Kaithal	122649 (41.59)	221 (26.85)	829 (36.52)	1 (25.00)
	Pundri	29000 (9.83)	129 (15.67)	256 (11.28)	0
Karnal	Karnal	57041 (19.34)	357 (43.38)	701 (30.88)	2 (50.00)
	Nissing	50705 (17.20)	70 (8.51)	356 (15.68)	0
	Tarori	35485 (12.03)	46 (5.59)	128 (5.64)	1 (25.00)
Sub-Total		**294880 (100.00)**	**823 (100.00)**	**2270 (100.00)**	**4 (100.00)**
		62.07	**42.80**	**90.51**	**10.26**
Western Zone					
Rohtak	Rohtak	47663 (26.45)	339 (30.82)	198 (92.96)	0
Jhajjar	Jhajjar	7793 (4.32)	86 (7.82)	15 (7.04)	19 (54.29)
Rewari	Rewari	28379 (15.75)	259 (23.55)	0	10 (28.57)
Palwal	Palwal	35979 (19.97)	106 (9.64)	0	2 (5.71)
Sonipat	Sonipat	60354 (33.49)	285 (25.91)	0	4 (11.43)
Sub-Total		**180189 (100.00)**	**1100 (100.00)**	**213 (100.00)**	**35 (100.00)**
		37.93	**57.20**	**9.49**	**89.74**
Overall		**475069 (100.00)**	**1923 (100.00)**	**2508 (100.00)**	**39 (100.00)**

As of 31st May 2021, there are a total 475069 farmers, 1923 traders 2508 commission agents and 39 FPOs registered under all the selected mandies in both the eastern and western zones of Haryana. In eastern zone highest number of registered farmers was in Kaithal mandi(41.59%) followed by Karnal(19.34%), Nissing (17.20%) and Tarori (12.03%) of registered farmers on e-NAM platform. Number of registered traders were highest in Karnal(43.38%) followed by Kaithal (26.85%), Pundri (15.67%) and Nissing (8.51%). Highest number of registered Commission agents were in Kaithal(36.52%) followed by Karnal(30.88%) and Nissing(15.68%). Main registered FPOs were reported in Karnal(50.00%) followed by Kaithal and Tarori (25.00%). Similarly in western zone highest number of registered farmers was in Sonipat(33.49%) followed by Rohtak(26.45%), Palwal (19.97%) and Rewari (15.75%) of registered farmers on e-NAM platform. Number of registered traders were highest in Rohtak(30.82%) followed by Sonipat (25.91%), Rewari (23.55%) and Palwal (9.64%). Highest number of registered Commission agents were in Rohtak(92.96%) followed by Jhajhar(7.04%). Registered FPOs were reported in Jhajjar(54.29%) followed by Rewari (28.57%) and Sonipat (11.43%). The number of the stakeholders registered on e-NAM is reported in Table 3.

Impact of e-market on arrivals and farmer price realization in selected markets

The arrival patterns of the selected markets for agricultural crops were analysed for triennium ending average of the periods 2017-18 to 2019-20 for e-NAM and Non e-NAM mandies in eastern and western zones of Haryana presented in Table 4. In eastern zone total arrival of wheat and paddy

Table 4: Average annual arrivals of wheat and paddy in selected mandies (Triennium ending 2019-20) (qtl.)

Districts	Eastern Zone					
		e-NAM			Non e-NAM	
	Mandies	Wheat	Paddy	Mandies	Wheat	Paddy
Karnal	Karnal	2146355 (60.68)	5727032 (78.93)	Jundla	40165 (21.08)	72663 (13.25)
	Nissing	348075 (9.84)	13011 (0.18)	Kunjpura	35276 (18.51)	111264 (20.29)
	Tarori	84440 (2.39)	279537 (3.85)	Nilokheri	39839 (20.91)	2883 (0.53)
Kaithal	Kaithal	174353 (4.93)	253894 (3.50)	Dhand	63630 (33.39)	345138 (62.95)
	Pundri	783900 (22.16)	982280 (13.54)	Siwan	11663 (6.12)	16357 (2.98)
Sub- total		**3537122 (100.00)**	**7255755 (100.00)**		**190572 (100.00)**	**548305 (100.00)**
% to Overall of Sub-total		**85.42**	**86.11**		**14.63**	**58.14**
Western Zone						
Rohtak	Rohtak	0.00	507020 (43.33)	Sampla	268049 (24.07)	17612 (4.46)
Jhajhar	Jhajjar	159762 (26.46)	6608 (0.56)	Bhadurgarh	127137 (11.42)	0
Rewari	Rewari	74498 (12.34)	38996 (3.33)	Kosli	37657 (3.38)	0
Palwal	Palwal	146531 (24.27)	277187 (23.69)	Hathin	387151 (34.77)	89119 (22.58)
Sonipat	Sonipat	222909 (36.92)	340287 (29.08)	Kharkhoda	438556 (39.39)	287979 (72.96)
Sub- total		**603700 (100.00)**	**1170097 (100.00)**		**1113419 (100.00)**	**394710 (100.00)**
% to Overall of Sub-total		**14.58**	**13.89**		**85.45**	**41.86**
Overall (Sub-Total of Eastern + western zone)		**4140822**	**8425852**		**1302937**	**943014**

Note: Figures in parentheses represent per cent to sub-total in eastern and western zone

crops were 3537123 and 7255755 quintals and 190572 and 548305 quintals in selected e-NAM and non e-NAM mandies, respectively. In e-NAM mandies highest arrivals of wheat crop were in Karnal i.e. 60.68 per cent followed by Pundri (22.16%), Nissing (9.84%) and Kaithal (4.93%) and highest arrivals of paddy crop in Karnal (78.93%) followed by Pundri (13.54%), Tarori (3.85%) and Kaithal (3.50%). The highest arrivals of wheat crop in non e-NAM mandies were Dhand (33.39%) followed by Jundla (21.08%), Nilokheri (20.91%) and Kunjpura (18.51%) and highest arrivals of paddy in Dhand (62.95%) followed by Kunjpura (20.29%), Jundla (13.25%) and Siwan (2.98%). Similarly in western zone total arrival of wheat and paddy crops were 603700 and 1170097 quintals and 1113419 and 394710 quintals in selected e-NAM and non e-NAM mandies, respectively. Highest arrivals of wheat crop was in Sonipat i.e. 36.92 per cent followed by Jhajhar (26.46%), Palwal (24.27%) and Rewari (12.34%) and highest arrivals of paddy crop in Rohtak (43.33%) followed by Sonipat (29.08%), Palwal (23.69%) and Rewari (3.33%). The highest arrivals of wheat crop in non e-NAM mandies was in Kharkhoda (39.39%) followed by Hathin (34.77%), Sampla (24.07%) and Kosli (3.38%) and highest arrivals of paddy in Kharkhoda (72.96%) followed by Hathin (22.58%) and Sampla (4.46%). The triennium ending average of arrivals of mustard, cotton and bajra crops in western zone are presented in Table 5. Total arrivals of mustard, cotton and bajra crops were 188324, 356217 and 805381 quintals and 44132, 41945 and 74178 quintals in selected e-NAM and non e-NAM mandies, respectively. In e-NAM mandies highest arrivals of mustard, cotton and bajra crops were in Rewari i.e. 85.52, 88.53 and 93.05per cent, respectively and in non e-NAM mandies highest arrivals of mustard and bajra in Kosli i.e. 67.64 and 32.26 per cent, respectively. The arrival of cotton was only in Hathin mandie *i.e.* 41945 quintals.

Table 5: Average annual arrivals of mustard, cotton and bajra in selected mandies (Triennium ending 2019-20) (qtl.)

Districts	Mandies	e-NAM			Mandies	Non-e NAM		
		Mustard	**Cotton**	**Bajra**		**Mustard**	**Cotton**	**Bajra**
Rohtak	Rohtak	2544 (1.35)	4207 (1.18)	-	Sampla	9148 (20.73)	-	21654 (29.19)
Jhajjar	Jhajjar	23810 (12.64)	-	37177 (4.62)	Bhadurgarh	1964 (4.45)	-	3841 (5.18)
Rewari	Rewari	161059 (85.52)	315346 (88.53)	749446 (93.05)	Kosli	29850 (67.64)	-	23932 (32.26)
Palwal	Palwal	910 (0.48)	36664 (10.29)	18300 (2.27)	Hathin	3170 (7.18)	41945 (100.00)	7457 (10.05)
Sonepat	Sonepat	-	-	459 (0.06)	Kharkhoda	-	-	25942 (34.97)
Total		**188324 (100.00)**	**356217 (100.00)**	**805381 (100.00)**		**44132 100.00**	**41945 (100.00)**	**74178 (100.00)**

Note: Figures in parentheses represent per cent to Total

The triennium ending average of annual price of wheat and paddy in e-NAM and non e-NAM mandies are presented in Table 6. In all the selected markets of both the zones the price for wheat is almost same (Rs. 1733 per quintal) over the years in all the selected mandis, wheat is the most stable grain across all the markets under study. The price range for paddy shows variation in all the markets under study and average price was (Rs. 2891 and Rs. 2832 per quintal in eastern and western zones , respectively and overall average of both the zones was Rs. 2862 per quintal.). In eastern zone highest price of paddy in Nissing mandi was (Rs. 3250 per quintal) followed by Kaithal (Rs. 2953 per quintal), Tarori (Rs. 2944 per quintal) and Pundri (Rs. 2828 per quintal) and in non e-NAM mandi the highest price of paddy in Dhand mandi (Rs. 3229 per quintal) followed by Nilokheri (Rs. 3007 per quintals), Jundla (Rs. 2947 per quintal) and Kunjpura (Rs. 1772 per quintal). Similarly in western zone highest price of paddy in Rewari mandies was (Rs. 3447 per quintal) followed by Rohtak (Rs.

3017 per quintal), Sonipat (Rs. 2947 per quintal) and Palwal (Rs. 2647 per quintal) and in non e-NAM mandi the highest price of paddy in Sampla mandi (Rs. 2823 per quintal) followed by Hathin (Rs. 2083 per quintals) and Kharkhoda (Rs. 1919 per quintal). It has been observed that high price of paddy received in e-NAM mandies as compared to non e-NAM mandies in both the zones.

The triennium ending average of annual price of mustard, cotton and bajra crops in western zone are pre presented in Table 7. Highest price of mustard crop in e-NAM mandies was observed in Rohtak mandi (Rs. 4150 per quintal) followed by Jhajjar (Rs. 4000 per quintal), Rewari (Rs. 3669 per quintal) and Palwal (Rs. 3178 per quintal) and in non e-NAM mandi the highest price of Mustard was observed in Samplamandi (Rs. 3850 per quintal) followed by Bhadurgarh (Rs. 3667 per quintals), Kosli (Rs. 3633 per quintal) and Hathin (Rs. 3067 per quintal). Similarly in cotton and bajra crops higest price were observed in Palwalmandi for cotton crop (Rs. 5437 per quintal) and in non e-NAM mandi only Hathin mandi received cotton and price observed was Rs. 5250 per quintal. Highest price for bajra crop in e-NAM mandiwas observed in Rewari mandi (Rs. 1644 per quintal) followed by Jhajjar mandi (Rs. 1572 per quintal), Palwal mndi (Rs. 1510 per quintal) and Sonipatmandi (Rs. 1150 per quintal) and in non e-NAM mandi highest price observed in Koslimandi (Rs. 1667 per quintal) followed by Hathin mandi (Rs. 1483 per quintal), Sampla and Bhadurgarhmandi (Rs. 1450 per quintal). The average prices for mustard, cotton and bajra were observed to be Rs. 3749, 5335 and 1469, respectively in e-NAM markets and Rs. 3554, 5250 and 1375, respectively in non e-NAM markets. It has been observed that high price of mustard, cotton and bajra crops received in e-NAM mandies as compared to non e-NAM mandies in western zone.

Table 6: Average annual prices of wheat and paddy in selected mandies (Triennium ending 2019-20) **(Rs./q)**

Districts	e-NAM			Non e-NAM		
	Mandies	**Wheat**	**Paddy**	**Mandies**	**Wheat**	**Paddy**
Karnal	Karnal	1733	2478	Jundla	1733	2947
	Nissing	1733	3250	Kunjpura	1733	1772
	Tarori	1733	2944	Nilokheri	1733	3007
Kaithal	Kaithal	1733	2953	Dhand	1733	3229
	Pundri	1733	2828	Siwan	1733	1732
Average price		**1733**	**2891**		**1733**	**2537**
Western Zone						
Rohtak	Rohtak	-	3017	Sampla	1733	2823
Jhajjar	Jhajjar	1733	2104	Bhadurgarh	1733	-
Rewari	Rewari	1619	3447	Kosli	1619	-
Palwal	Palwal	1733	2647	Hathin	1733	2083
Sonepat	Sonepat	1733	2947	Kharkhoda	1733	1919
Average price		1733	2832		1733	2275
Over-all Average		1733	2862		1733	2406

Note: Figures in parentheses represent per cent to sub-total in eastern and western zone

Table 7: Average annual prices of mustard, cotton and bajra in selected mandies (Triennium ending 2019-20) (Rs./q)

Districts	e-NAM				Non e-NAM			
	Mandies	Mustard	Cotton	Bajra	Mandies	Mustard	Cotton	Bajra
Rohtak	Rohtak	4150	5233	-	Sampla	3850	-	1450
Jhajhar	Jhajhar	4000	-	1572	Bahadurgarh	3667	-	1450
Rewari	Rewari	3669	-	1644	Kosli	3633	-	1667
Palwal	Palwal	3178	5437	1510	Hathin	3067	5250	1483
Sonipat	Sonipat	-	-	1150	Kharkhoda	-	-	1117
Average price		**3749**	**5335**	**1469**		**3554**	**5250**	**1375**

Lessons learned from markets in Haryana effective implementation of e-NAM.

Finally it could be concluded that the lessons learned from e-NAM mechanism can be conceptualised as follows:

- Making agricultural market reforms and digitalised market linkages successful; there is a need for consistency in central agricultural marketing policy, complementary reform process and a collaborative centre-state approach are necessary.
- In 2016, the electronic national agricultural market (e-NAM) was launched with a lot of expectations. The e-NAM was intended to be a market based mechanism for efficient price discovery by the farmers as indicated in the previous section that in e-NAM mandis higher and better price realization as compared to non-e-NAM mandis.
- In the first phase, 585 markets across 16 states and 2 Union territories were covered to which Haryana covered 37 markets initially and then 54 markets linked with e-NAM. Haryana has carried out these amendments and finally linked 81 mandis/markets with e-NAM, but several other states could not or did not carry out these amendments and thus, the e-NAM proved to be less effective than desired
- Further, even with the onset of COVID-19 crisis, improving the market functioning received a renewed attention. e-NAM has been expanded up to 1000 markets (i.e. 415 more markets) in India and from 54 to 81 markets in Haryana. Farmers have been allowed to sell and transport directly from registered warehouses and Farmer Producer Organisation (FPOs) and also app based transport mechanism have been developed.
- Another important issue is sometime the multiple market failures and the resultant inter-linkage of rural markets with e-NAM platform due to failure of credit and insurance market may lead to farmers' dependency on local input dealers or middle-man to meet his/her farming needs must be taken care of .

Opinion of farmers and traders cum CAs with respect to benefits and limitations of e-NAM

The Table 8 revealed that e-markets helped in reducing the collusion among traders. About 30 per cent of farmers said that collusion reduced among traders and74 per cent said that transparency increased. About 67 per cent said that there is real price discovery. None of the farmers informed that they got timely payment. About 80 per cent of the commission agents cum traders mentioned that it is easy to understand and use e-market. 14 per cent of commission agents cum traders mentioned that

there was timely account transfers online, 44 per cent said that there was less procedural hurdles and 90 per cent said that there was direct money transfer to their accounts.

Table 8: Opinion of farmers and traders cum CAs with respect to benefits of e-NAM markets in eastern and western zone of Haryana

Stakeholders	Opinion	Respondents
Farmers (n=100)	Reduced collusion among traders cum CAs	30 (30)
	Transparency increased	74 (74)
	Real-Time Price Discovery	67 (67)
	Quality Certification, Warehousing, and Logistics	62 (62)
	Payment and Delivery Guarantee	78 (78)
	Enhanced Accessibility to the Market	47 (47)
Traders cum CAs (n=50)	Direct money transfer to bank	45(90)
	Easy to use	40 (80)
	Less paper work	44 (88)
	Timely payment transfers	14 (28)

Note: Figures in parentheses represent per cent to total

Opinion of farmers and traders cum CAs with respect to limitations of e-NAM is presented in the Table 10. The results revealed that about 78 per cent of the farmers reported that they did not understand the process flow of e-markets, and 86 per cent expressed fear about deduction of their loans from payments received from e-markets.

Among traders cum commission agents, only 48 per cent mentioned that they do not have computers, but were facilitated by the officers of the e-markets. About 50 per cent stated fear of taxation of returns from their accounts, as now every transaction is detectable and transparent and done online with Aadhar-linked bank accounts. About 62 per cent informed about slow broadband connectivity, and 68 per cent mentioned that there was a sudden stoppage of the system resulting in partial implementation of the scheme. Although in all the e-markets there are centralized generators for continuous supply of electricity, these are not efficient in some of the e-markets.

Table 9: Opinion of farmers and traders cum CAs with respect to limitations of e-NAM markets in eastern and western zone of Haryana

Stakeholders	Disadvantages	Respondents
Farmers(n=100)	Did not understand the process	78 (78)
	Fear of deduction of loan by banks	86 (86)
Traders cum CAs(n=50)	Some traders cum CAs do not have computers, but facilitated by officers or through internet centres	24(48)
	Fear of taxation of traders cum CAs	25 (50)
	Slow internet connectivity	31 (62)
	Sudden stoppage of the system (partial implementation)	34 (68)

Note: Figures in parentheses represent per cent to total

In the selected e-markets to know the opinions of farmers, traders cum commission agents and administrative staff were interviewed (Table 1). Most of the farmers were aware of e-auctions (79%) and computer entry at the gate (88%) in the e-markets, but in the non e-NAM markets, 36 per cent of the farmers knew about e-markets functioning and process. Many of the farmers in e-NAM also did not know about the bidding process followed in e-markets. Most of the traders knows about e-auction, computerized entry at hate and highest bidder will win the bid e-NAM markets but in non e-NAM markets only few traders knows about these type of facilities.

Table 10: Awareness of stakeholders about e-NAM markets of Haryana

Operation	Farmers	Traders cum	Farmers (non e	Traders cum

	(n=100)	CAs (n=50)	market) (n=50)	CAs (non e market) (n=50)
Implementation of e-auction	79 (79)	50 (100)	18 (36)	20 (40)
Computerized entry at gate	88 (88)	50 (100)	15 (30)	18 (36)
Highest bidder will win bid	96 (96)	50 (100)	18 (36)	8 (16)
Bid results declaration	91 (91)	44 (88)	8 (16)	6 (12)
Direct payment to bank through online system	25 (25)	50 (100)	0(0)	0(0)

Note: Figures in parentheses represent per cent to total

This will support in handling of the load at the gate more professionally during peak time in *Rabi* and *Kharif* and lessen the waiting time for farmers at the entry gate. Table 64 indicated that about 70 per cent farmers were aware about launch of e-NAM mobile application in different languages and 80 per cent know about BHIM app payment facility as an easy mode off payments; the steps for improvements of the e-NAM system. Similarly 70 per cent official told about improved website with e learning modules, while all were where about grievance redressal management system and integration with farmer database (100%) are the improvement of the lesson learned (Table 11).

Table 11: Improvements implemented for the problems by the government

Improvements implemented for the problems by the government	Respondents
Farmers response (n=100)	
Launch of e-NAM mobile app. Mobile app has been made multilingual	72 (72)
BHIM payment facility. Aimed at easing the mode of payment to farmers	83 (83)
Mandi officials response (n=10)	
New improved websites with e-learning module for latest information on events, dynamic training calendar etc.	7 (70)
Grievance Redressal Management System: help Mandi Secretary to raise technology issues related to portal or software and its operation	10 (100)
Integration with Farmer Database: so that the registration process becomes easier. This help in managing the load at the Gate during peak time to reduce waiting time of farmers	10 (100)

Note: Figures in parentheses represent per cent to total

ix. Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

- The total number of e-linked markets increased from 585 to 1063 in India and from 54 to 81 e-markets in Haryana from 1st January 2019 to 5th May 2020.
- Since its implementation in 2016, e-NAM has been successful with an achievement of unprecedented progress. The number of market as well as coverage in terms of states integrated into the system has seen a significant increase over the years.
- The share of different commodities in different districts in arrivals ranges from about 18 to 60 per cent for paddy, 10 to 57 per cent for wheat, 1 to 10 per cent for cotton and 1.5 to14 per cent for fruits and vegetables respectively. While the other crops represented very small proportion in total arrivals of the produce.
- Govt. plans to link 22,000 mandis and all 7,500 APMCs with e-Nam platform by 2022. Haryana has also planned to link all its market to link with e-NAM platform and to do online trading in a transparent manner.

- Some major problems which hinders online trading includes*:* lack of equipments: It includes lack of scientific sorting/grading facilities or quality testing machines. Also there is lack of internet connectivity which is impeding the progress.
- Delay in implementation: State Agricultural Departments have been finding it difficult to convince all stakeholders- farmers, traders and commission agents- to move to the online platform. While traders fear the taxman, farmers fear lower prices if the produce is assayed.
- In the selected APMCs the staffing arrangement and the size of the sanctioned work force were nearly similar. Over all very good and adequate facilities and services were created and made available to all the stakeholders in the selected markets by the market committees.
- It has been observed that high price of paddy, mustard, cotton and bajra crops received in e-NAM mandies as compared to non e-NAM mandies in both the zones.
- Majority of the farmers were aware of e-auctions and computer entry. Most of the farmers were satisfied with the e-NAM concept but traders cum commission agents did not favour it.None of the farmer or trader reported timely payments in e-NAM system.
- In e-NAM there is limit of 50 kg of produce to sale and if there is cheating from both the ends producers as well as buyers e-NAM is responsible. Till now e-NAM is partially functioning.

Conclusion

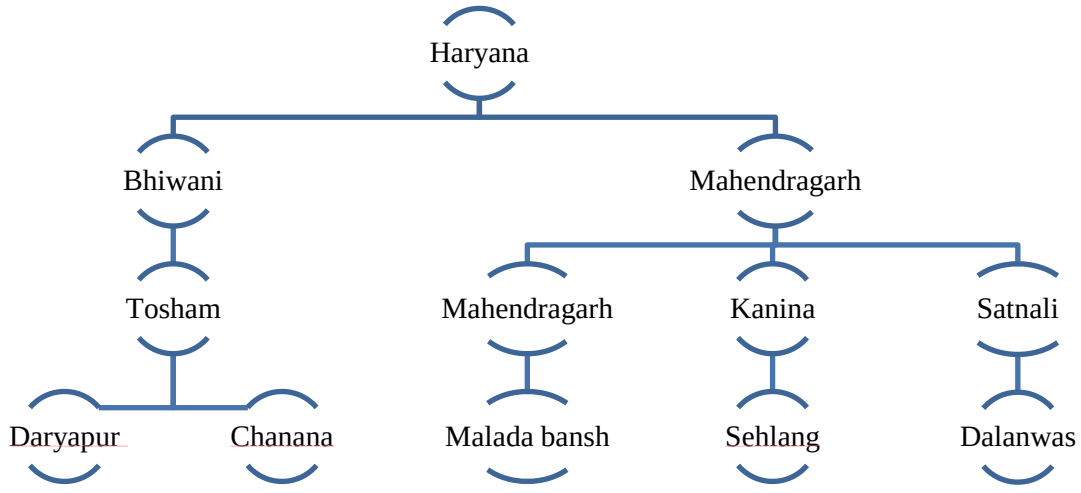
The Electronic National Agricultural Market (e-NAM) was conceptualized in the year 2015 and implemented on 14 April, 2016 by the government of India. e-NAM is a virtual market with a physical end. e-NAM is a unified national market which attracts buyers from different states/regions of the country through online auction of the produce. In the selected APMCs the staffing arrangement and the size of the sanctioned work force were nearly similar. Over all very good and adequate facilities and services were created and made available to all the stakeholders in the selected markets by the market committees. In eastern zone total arrival of wheat and paddy crops were 3537123 and 7255755 quintals and 190572 and 548305 quintals in selected e-NAM and non e-NAM mandies, respectively. Similarly in western zone total arrival of wheat and paddy crops were 603700 and 1170097 quintals and 1113419 and 394710 quintals in selected e-NAM and non e-NAM mandies, respectively. Total arrivals of mustard, cotton and bajra crops were 188324, 356217 and 805381 quintals and 44132, 41945 and 74178 quintals in selected e-NAM and non e-NAM mandies, respectively. The overall average price of wheat and paddy crop in both the zones were Rs. 1548 and Rs. 2862 per quintal in e-NAM markets and Rs. 1722 per quintal and 1951 per quintal in non e-NAM markets. The average price of mustard, cotton and bajra were Rs. 2999, 2134 and Rs. 1175 per quintal in e-NAM markets and Rs.2843, 1050 and Rs. 1433 per quintal in non e-NAM markets. It has been observed that high price of mustard, cotton and bajra crops received in e-NAM mandies as compared to non e-NAM mandies in western zone. Majority of the farmers were aware of e-auctions and computer entry. Most of the farmers were satisfied with the e-NAM concept but traders cum commission agents did not favour it. None of the farmer or trader reported timely payments in e-NAM system. In e-NAM there is limit of 50 kg of produce to sale and if there is cheating from both the ends producers as well as buyers e-NAM is responsible. Till now e-NAM is not in full functioning.

i	**Experiment No. 3 : A study of micro-irrigation systems in cotton cultivation in arid zone of Haryana**	
ii	**Objectives of the Experiment**	• To work out economics of sprinkler and drip irrigation technologies in cotton cultivation • To estimate the water and electricity saving in micro

		irrigation technologies • To study the constraints in adoption of micro irrigation technologies in cotton cultivation
iii	**Name (s) of the investigators**	• Dr. Neeraj Pawar Planning, finalization of interview schedule collection of data and compilation of data. • Dr. Sanjay Analysis and Report writing
iv	**Name (s) of the collaborators with activity profile**	Nil
v	**Year of start**	• 2020-21
vi	**Duration of experiment**	• 1 Year
vii	**Treatment details**	• **Locale of experiment**: Haryana • **Districts covered**: Mahendergarh and Bhiwani. • **Blocks & villages covered:** Tosham (Dariyapur & Chanana), Mahendergarh (Malada bansh), Kanina (Sehang), Satnali (Dalawas) • **Sample size:** 60 farmers • **Statistical design /method**: Statistical tools like mean, percentage, Garret ranking technique were used.
viii	**Observations recorded**	• 60 farmers were interviewed to work out the economics of sprinkler and drip irrigation system • Information related to pump set (H.P), number of irrigations per acre, hours per irrigation per acre of farmer, input use i.e. irrigation frequency, agro chemicals, machine hours, man hours and constraints in adoption of these technologies were also recorded

ix Results achieved during 2020-21

Figure 1: Sampling design of the study



Cost and returns of Bt. cotton

The costs and returns of Bt. cotton cultivation worked out for flood irrigation method, sprinkler irrigation method and drip irrigation method are presented in Table 2. The total variable expenses which included expenditure incurred on preparatory tillage, seed, fertilizer, irrigation, plant protection measures, picking and miscellaneous charges came out to be 45156, 48101 & 47070, respectively. The variable expenses accounted for 62.48 per cent 58.77 per cent and 58.30 per cent of the total expenses, respectively. The total expenses incurred were highest in case of sprinkler

irrigation method (81846) followed by drip irrigation method (80744) and least in case of flood irrigation method (72274).

As a proportion of total cost incurred on cultivation of Bt. cotton, picking cost accounted was highest in the case of drip irrigation method (24.43 %) followed by sprinkler irrigation method (20.71 %) and flood irrigation method (15.53 %). Moreover, the largest portion of the total cost was incurred upon rental value of land in case of drip irrigation method (28.11 %), followed by sprinkler irrigation method (27.74 %) and flood irrigation method (26.98 %).

The gross returns (main & by-product) from Bt. cotton cultivation were highest in the case of drip irrigation method (Rs. 102870), followed by sprinkler irrigation method (Rs. 86969) and were least in the case of flood irrigation method (63190). Moreover, the net returns came out to be highest in case of drip irrigation method (Rs. 22126) followed by sprinkler irrigation method (Rs. 5123) and were least in case of flood irrigation method (- 9084).

The returns over variable cost came out to be Rs. 18030, 38868, 55800 three methods of irrigation respectively. BC ratio over variable cost was highest in the case of drip irrigation method (2.18) followed by sprinkler irrigation method (1.81) and least in the case of flood irrigation method (1.39).

Water and energy saving

The results of the analysis of water and energy saving in drip and sprinkler irrigation method of Bt. cotton in comparison with flood irrigation method are presented in Table 3. The highest water consumption was observed in the case of flood irrigation method (3144.96 kl) followed by sprinkler irrigation method (2252.25 kl) and least amount of water was consumed in drip irrigation method (1680 kl) in comparison with the conventional method of irrigation. The saving of irrigation water amounted to 28.38 per cent in case of sprinkler irrigation method and 46.58 per cent in case of drip irrigation method.

Electricity consumption was found to be highest in case of sprinkler irrigation method (1121.9kwh) followed by flood irrigation method (814.6 kwh) and least consumption was formed in case of drip irrigation method (596.8 kwh). When it comes to energy saving, sprinkler irrigation method was found to be energy-intensive by as high as 50% when compared to the conventional irrigation method. However, drip irrigation method helped in saving 26.73 per cent of electricity when compared to flood irrigation method.

Table 1: Village wise area

Sr. No.	Distt.	Block	Village	Total Cultivated Area (ha.)	Area Under Cotton (ha.)	Method of Irrigation
1	Mahendergarh	Mahendergarh	Malra bansh	274	200	Sprinkler system 100%
2	Mahendergarh	Satnali	Dalenwas	1195	243	Sprinkler/mini Sprinkler system 100%
3	Mahendergarh	Kanina	Sehlang	858	170	Flood system >95%
4	Bhiwani	Tosham	Daryapur	1984	1039	Drip system >90%

5	Bhiwani	Tosham	Channana	994	487	Drip system >90%

Table 2: Cost and returns of Bt. cotton cultivation under different irrigation systems

(Rs.ha^{1})

S. No.	Operations	FIM	SIM	DIM
1.	Preparatory Tillage	7665	6563	6150
		(10.61)	(8.02)	(7.62)
2.	Seed Cost	3638	3675	2290
		(5.03)	(4.49)	(2.84)
3.	Fertilizer Investment	6960	5870	6038
		(9.63)	(7.17)	(7.48)
4.	Irrigation	4280	5325	4180
		(5.92)	(6.51)	(5.18)
5.	Plant Protection	9863	7850	6950
		(13.65)	(9.59)	(8.61)
6.	Picking	11225	16950	19725
		(15.53)	(20.71)	(24.43)
7.	Misc.	1525	1868	(1737
		(2.11)	(2.28)	(2.15)
A.	**Total Variable Cost**	45156	48101	47070
		(62.48)	(58.77)	(58.30)
9.	Mgt. +Risk Charges	6293	9620	9414
		(8.71)	(11.75)	(11.66)
10.	Rental Value	19500	22700	22700
		(26.98)	(27.74)	(28.11)
11.	Transportation	1325	1425	1560
		(1.83)	(1.74)	(1.93)
B.	**Total cost**	72274	81846	80744
		(100)	(100)	(100)
13.	a) Production (main) (Rs.)	61065(11.50q)	85119(16.03q)	100890(19.0q)
14.	B) By Product	2125	1850	1980
C.	**Gross Return (Rs.)**	63190	86969	102870
D.	**Return over variable cost (Rs.)**	18034	38868	55800
E.	**Net Returns (Rs.)**	-9084	5123	22126
F.	**B:C ratio over variable cost**	**1.39**	**1.81**	**2.18**

Note: FIM-Flood irrigation method, SIM- Sprinkler irrigation method, DIM-Drip irrigation method

Table 3: Water and energy saving in drip and sprinkler irrigated in Bt. cotton (ha^{-1})

S. No.	Particulars	FIM	SIM	DIM
1.	Pump Set (H.P)	10	10	10
2.	No. of Sprinklers/drippers per ha	-	125	10500
3.	Water discharge*	28.8	0.11	0.004
4.	No. of irrigations	5.6	7.8	32
5.	Hours per Irrigation	19.5	21	1.25
6.	Water consumption (kl)	3144.96	2252.25	1680.0
7.	Electricity Consumption (kwh/ha)	814.6	1221.9	596.8
8.	Energy saving (%)	-	-50	26.73
9.	Water saving (%)	-	28.38	46.58

*Note: FIM: Flood irrigation method, SI: Sprinkler irrigation method, DIM: Drip irrigation method; *: 2.5" diameter pipe in FIM, per sprinkler/dripper per hour; kl: kilo litre= 1000 litre;*

Constraints faced by farmers

The analysis of constraints faced by farmers who had adopted sprinkler irrigation method and drip irrigation method was done using Garret ranking technique. According to the weighted mean score declining water table (4.27) was the most prominent problem being faced by the farmers. This was closely followed by the constraint of brackish water (4.13) and erratic supply of electricity (3.97) in the study area. Moreover, problems such as high wind speed and high temperature (3.85), blockage in nozzles and filters (3.78), unavailability of spare parts (3.73) and unsatisfactory quality of the material (3.62) were the pressing problems faced by the respondent farmers (Table 4).

Table 4: Constraints faced by the respondents

(N= 60)

S. No.	Particulars	Total weighted score	Weighted mean score	Rank order
1.	Declining water table	256	4.27	I
2.	Brackish water	248	4.13	II
3.	Erratic supply of electricity	238	3.97	III
4.	High wind speed and high temperature	231	3.85	IV
5.	Blockage in nozzle and filters	227	3.78	V
6.	Unavailability of spare parts	224	3.73	VI
7.	Material quality not up to mark	217	3.62	VII

ix. Programme of work for 2021-22: Experiment Concluded

Salient findings of the study

- B:C ratio over variable cost were 2.18 for drip irrigation method, 1.81 for sprinkler irrigation method and 1.39 for flood irrigation method.
- The saving of irrigation water amounted to 28.38 per cent in case of sprinkler irrigation method and 46.58 per cent in case of drip irrigation method as compared to conventional method of irrigation.
- Energy saving amounted to 26.73 in drip irrigation method but sprinkler irrigation method was found to be energy intensive by as high as 50 per cent of cost when compared to the conventional irrigation method.
- The major constraints faced by farmers were declining water table, brackish water, erratic supply of electricity and blockage in nozzle and filters.

Conclusion

The cultivation of Bt. cotton under drip method of irrigation system was found to be beneficial with higher net returns (Rs. 22126 ha^{-1}) over flood and sprinkler irrigation system. Water and electricity saving are the significant advantage of D.M.I .over sprinkler & conventional method of irrigation. The major constraints faced by farmers declining water table, brackish water & erratic supply of electricity. Drip method of irrigation is more viable then conventional & sprinkler irrigation.

i	**Experiment No. 4: Prospects of vegetable cultivation in Nuh district (Mewat Zone) of Haryana**	
ii	**Objectives of the Experiment**	• To investigate the costs involved and returns obtained from the cultivation of vegetable crops • To study the price spread of vegetable crops under different marketing channels • To identify the production and marketing constraints
iii	**Name (s) of the investigators**	• Dr. Neeraj Pawar Planning, finalization of interview schedule, collection of data, compilation and analysis of data

		• Dr. Janailin S. Papang Report writing
iv	**Name (s) of the collaborators with activity profile**	Nil
v	**Year of start**	• 2020-21
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• **Locale of the experiment :**Haryana • **District covered :** Mewat zone (Nuh) • **Blocks covered** : Firozepur Jhirka (Onion), Nagina (Tomato and Bottle gourd), Punhana (Bhindi), • Statistical design /method: statistical tools like mean, percentage etc. used.
viii	**Observations recorded**	• 60 farmers were interviewed to collect information regarding various inputs used, output, prices, produce disposal pattern and identifying constraints in production and marketing • 10 market intermediaries were interacted to collect information regard in various marketing costs and margins.

ix. Results achieved during 2020-21

Cost and returns of cultivation of vegetables in Nuh district of Haryana

The costs and returns of tomato production are presented in Table 1. Harvesting was the major components of total variable expenses incurred which constitute around 27 per cent of the total cost in Nuh district of Haryana. Harvesting also includes sorting and packing of the product. The other components of total expenses incurred in cultivation of tomato in Haryana were rental value of land (21.88%), management and risk charges (8.75%), transportation charges (8.75%), plant protection (8.02%), fertilizer (7.34%) and field preparation (6.98%). The share of seed cost to total cost was only 4.18 per cent while irrigation cost was 2.23 per cent. The large share of rental value of land to the total cost shows that the land rent is high in the study area. The average yield of tomato was 452.5 q/ha with gross returns of ₹ 2, 76,025 and net returns of were ₹ 87,534 in 2020-21. The value of B: C ratio of 1.46 indicates profitability of tomato cultivation in the study area. The total cost of tomato cultivation was estimated to be ₹188,491 per hectare.

Similar pattern of cost were observed as that of tomato in which the harvesting constitute the major share of total variable expenses (14.80% of total cost) in Nuh district of Haryana. The other components of total expenses incurred in cultivation of bottle gourd were rental value of land (24.92%), field preparation (11.54%). management and risk charges (10.88%), transportation charges (9.81%). The share of seed cost to total cost was 9.66 per cent which is much higher as compared to tomato. The other cost include plant protection, fertilizer and irrigation cost (Table 1). The total cost of bottle gourd cultivation was estimated to be ₹1, 65,554 per hectare. The average yield of bottle gourd was 537.5 q/ha with gross returns of ₹2,52,625 and net returns of were ₹ 87,071 in 2020-21. The value of B: C ratio is above 1 which indicates profitability of bottle gourd cultivation in the Nuh district of Haryana.

Table 1: Cost and returns of tomato, bottle gourd, okra and onion in Nuh district of Haryana (Rs.ha^{-1})

Sr. No.	Item	Tomato	Bottle gourd	Okra	Onion
A. Variable cost					

1	Field Preparation	13160 (6.98)	19113 (11.54)	18388 (7.26)	39300 (18.14)
2	Seed cost	7878 (4.18)	16000 (9.66)	36650 (14.48)	16750 (7.73)
3	Fertilizer investment	13843 (7.34)	10913 (6.59)	12675 (5.01)	9148 (4.22)
4	Irrigation	4400 (2.33)	5250 (3.17)	8500 (3.36)	9025 (4.17)
5	Plant Protection	15125 (8.02)	10500 (6.34)	24350 (9.62)	15275 (7.05)
6	Picking /uprooting*	50250 (26.66)	24500 (14.80)	51250 (20.24)	38750 (17.89)
7	Miscellaneous	4295 (2.28)	3770 (2.28)	5813 (2.30)	4989 (2.30)
8	Total Variable cost	108951 (57.80)	90046 (54.39)	157626 (62.27)	133237 (61.50)
B. Fixed cost					
9	Management and risk charges	21790 (11.56)	18008 (10.88)	31524 (12.45)	26646 (12.30)
10	Rental value of land	41250 (21.88)	41250 (24.92)	46250 (18.27)	41250 (19.04)
11	Transportation charge	16500 (8.75)	16250 (9.81)	17750 (7.01)	15500 (7.15)
12	Total fixed cost	79540 (42.19)	75508 (45.61)	95524 (37.73)	83396 (38.49)
C. Total cost (A+B)		188491 (100.00)	188491 (100.00)	165554 (100.00)	253150 (100.00)
D. Returns structure					
13	(a) Main product (q)	276025	252625	331200	347875
	(b) By-product	-	-	-	-
14	Gross return	276025	252625	331200	347875
15	Return over Variable cost	167074	162579	173574	214638
16	Net returns	87534	87071	78050	131242
17	B:C Ratio Over Variable Cost	2.53	2.81	2.1	2.16
18	B:C Ratio Over Total Cost	1.46	1.53	1.31	1.61

*Note: Values in parenthesis indicate percentage of total cost; * uprooting in case of onion*
**major varieties:Tomato-Alankar,US-2853 and Himsona, Bottle gourd-Mahyco-4 and Mahyco-10, Okra-Sona,Bio-seeds and Jindal, Onion-Arjun,Ganga,Parshant,NAFED Sardar.*

The costs and returns structure of okra cultivation in Nuh district of Haryana are presented in Table 1. Harvesting and seed cost were the major components of total variable expenses incurred which constitute around 20 and 14 per cent of the total cost respectively. The other components of total expenses incurred were rental value of land (18.27%), management and risk charges (12.45%), transportation charges (7%), plant protection (8.02%), field preparation (7.26%) and fertilizer (5%). The share of irrigation cost was only 3.36 per cent. The large share of rental value of land to the total cost shows that the land rent is high in the study area. The total cost of okra cultivation was estimated to be ₹2, 53,150 per hectare. The average yield of okra was 240 q/ha with gross returns of ₹3,31,200 that yield a net returns of ₹78,050 in 2020-21. The value of B:C ratio above 1 indicates that cultivation of okra in Nuh district is a profitable enterprise.

Table 2: Average price received by the farmer over the consumer's price for vegetable crops

Sr No	Vegetable crops	Average Price received by farmers (Rs/kg)	Average consumers price (Rs/kg)	Farmer's share in consumer's price (%)

1	Tomato	6.10	13.50	45.18
2	Bottle gourd	4.70	14.00	33.57
3	Okra	13.80	24.50	56.32
4	Onion	11.50	24.00	47.91

The details of the costs and returns structure of okra cultivation in Nuh district of Haryana are presented in Table 1. In contrast to the other vegetables under study the highest variable cost was incurred on field preparation (18.14%) followed by harvesting (17.89%). The other major variable cost includes seed cost (7.73%) and plant protection (7%). Among the fixed cost incurred, rental value of land share the maximum cost to total cost (19%) followed by management and risk charges (12.30%) and transportation charges (7%). The total cost of onion cultivation was estimated to be ₹ 2,16,633 per hectare. The average yield of onion was 302 q/ha with gross returns of ₹3,47,875 with a net returns of ₹1,31,242 in 2020-21. The value of B:C ratio above 1 indicates profitability of onion cultivation in Mewat district of Haryana.

The average price received by farmers for the selected vegetables are presented in Table 2. Among the selected crops, okra farmers received the highest share in consumer's rupee as compare to tomato, onion and bottle gourd. The lowest is observed in case of bottle gourd.

Constraints faced by vegetable growers

The various constraints faced by the growers in production and marketing of vegetables in Nuh district is shown in Table 3. The results revealed that untimely availability and high cost of seed is the major constraint faced by the farmers which is followed by non-availability sufficient electricity for irrigation. Whereas, in marketing the major constraint was due to high fluctuation in price/low-price received on the produce and monopoly of private commission agents in fixing price.

Table 3: Constraints faced by the vegetable growers (N= 60)

S. No.	Particulars	Total weighted score	Weighted mean score	Rank order
A.	**Production constraints**			
1.	Timely non-availability and costlier seed	274	4.57	I
2.	Erratic supply of electricity for irrigation	267	4.45	II
3.	Non-availability of effective agro-chemicals in the market	258	4.30	III
4.	Scarcity of labour	246	4.10	IV
5.	Inadequate recent know-how	234	3.90	V
B.	**Marketing constraints**			
1.	Low price realization	268	4.47	I
2.	Collusion of traders	252	4.20	II
3.	High transportation charges due to distant market	243	4.05	III
4.	Non-existence of processing unit	237	3.95	IV
5.	Lack of co-operative marketing system in village	232	3.87	V

ix. Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

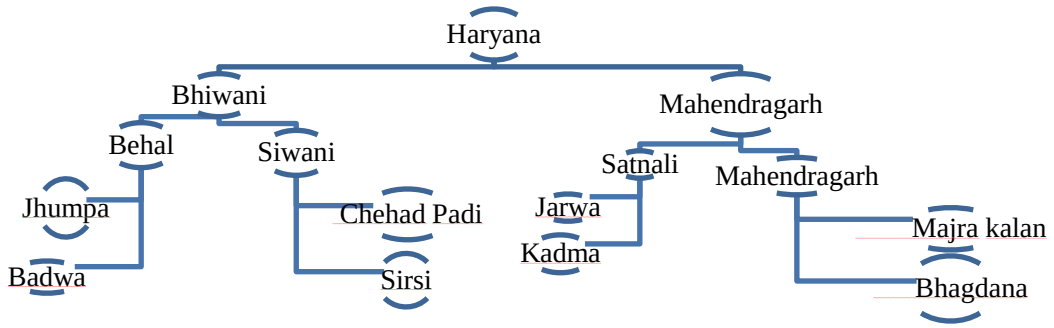
- The gross and net returns of vegetables in Nuh district were Rs. 276025 and 87534 for tomato, 252625 and 87071 for bottle gourd, 331200 and Rs. 78050 for okra, 347875 and Rs. 131242 for onion.
- B: C ratio over total cost were 1.46 for tomato,1.53 for bottle gourd, 1.31 for okra, and 1.61 for onion.
- The constraints faced by vegetable growers were timely non-availability and costly seed, high fluctuation in price/low-price received on the produce and monopoly of private commission agents in fixing price.

Conclusions

The higher net returns (Rs. 87534, 87071, 78050 and 131242 per ha. for tomato, bottle gourd, okra and onion) and benefit cost ratio (>1) of all vegetables revealed that vegetable cultivation is a profitable and promising enterprise in Mewat district. The constraints faced by farmers indicated that the market system of vegetables in Mewat district is inefficient and improvement has to be made.

i	**Experiment No 5: Outreach and adoption determinants of micro irrigation system in Haryana**	
ii	**Objectives of the experiment**	• To study the status of micro-irrigation technologies in Haryana • To identify factors affecting the adoption of micro irrigation technologies • To examine the constraints in adoption of micro-irrigation technologies
iii	**Name(s) of the investigators**	• Dr. Sanjay: Planning, preparation of schedule, collection, and compilation of data • Dr. Janailin S. Papang: Monitoring, analysis and report writing
iv	**Name(s) of the collaborator**	• Nil
v	**Year of start**	• 2020-21
vi	**Duration**	• 1 year
vii	**Treatment details**	• **Locale of the experiment:** Bhiwani and Mahendergarh • **Sample:** Two blocks each from Bhiwani and Mahendergarh district were selected. Further, two villages from each of the selected block were picked up randomly • **Number and type of respondents:** 120 farmers i.e. 60 adopters and 60 non- adopter farmers. • **Statistical design/methods:** Descriptive statistics, Standard Deviation, Logit Model, etc.
viii	**Observations recorded**	• Data related to numbers of beneficiaries, area coverage and financial assistance • Data related to socio- economic variables, financial variables, land, capital, cropping patterns, incentives etc. was collected

Figure 1: Sampling design of the study



Note: Siwani and Satnali were OE blocks whereas Behal and Mahendergarh were non-OE blocks; Adopter farmers were selected from OE blocks and non-adopters from non-OE blocks

ix Results achieved during 2020-21

Status of micro irrigation in Haryana

The state-wise proportion of area under micro-irrigation in India is given in in Table 1. The states with the highest area under micro irrigation as a proportion of gross irrigated area are Andhra Pradesh, Maharashtra and Karnataka. Haryana ranked 9th position with 10.40 per cent of gross irrigated area under micro-irrigation. However, Andhra Pradesh, Karnataka and Gujarat were the top three states when seen according to share of micro irrigation in gross cultivated area and Haryana ranked fourth in this list.

Table 1: State-wise proportion of area under micro-irrigation in India (2018-19) (in per cent)

S. No.	States	Share in MI in GIA	Share in MI in GCA
1.	Andhra Pradesh	38.7	20.6
2.	Maharashtra	33.9	6.9
3.	Karnataka	31.3	10.5
4.	Gujrat	21.6	10
5.	Rajasthan	18.6	7.6
6.	Chhattisgarh	17.0	5.2
7.	Tamil Nadu	15.2	8.4
8.	Jharkhand	13.6	2.1
9.	**Haryana**	**10.4**	**9.1**
10.	Orissa	7.5	2.2
11.	Telangana	7.0	4.2
12.	Kerala	6.7	1.2
13.	Madhya Pradesh	5.3	2.2
14.	Himachal Pradesh	4.6	1.0
15.	Punjab	0.6	0.6
16.	Uttar Pradesh	0.5	0.4
17.	Others	5.6	2.8

Note: GCA: Gross cropped area; GIA: Gross irrigated area

Table 2: District-wise proportion of area under micro-irrigation in Haryana (2019-20) (in Acre)

District	Cultivated area	Area under MI	Percentage
Mahendragarh	373280	193259	51.77
Rewari	284580	66495	23.37
Bhiwani	1015954	229397	21.16
Gurugram	133750	8550	6.39

Jhajjar	290500	15991	5.5
Mewat	276638	15030	5.43
Yamuna nagar	299610	3416	1.14
Hisar	756303	6216	0.82
Rohtak	337022	1274	0.38
Karnal	522190	1224	0.23
Sirsa	1082702	2399	0.22
Panchkula	48062	99	0.21
Panipat	325662	619	0.19
Fatehabad	544305	929	0.17
Sonipat	441205	551	0.12
Faridabad	100000	93	0.09
Jind	606058	546	0.09
Ambala	294848	125	0.04
Palwal	265762	89	0.03
Kurukshetra	300972	74	0.02
Kaithal	656248	79	0.01
Total	**89,55,651**	**5,46,455**	**6.1**

The district-wise proportion of area under micro-irrigation in Haryana up to 2019 is presented in Table 2. The districts with highest area under micro irrigation are Bhiwani (229397 Acres), Mahendergarh (193259 Acre) and Rewari (66495 Lakh Acres). The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by Rewari (23.37 %) and Bhiwani (21.16 %). In addition to these three districts, Gurugram, Jhajhar and Mewat had a significant area under micro irrigation. Rest of the districts of the state had less than 1.15% of their cultivated area under micro irrigation. In total, Haryana had 546455 acres of area under micro-irrigation i.e. 6.1 per cent of cultivated area.

The physical progress of micro-irrigation in Haryana in the period 2006-07 to 2018-19 is presented in Table 3. The area under drip irrigation during this period has grown by a CAGR of 11.20 per cent while, the area under sprinkler irrigation has grown by a CAGR of 15.5 per cent. The composite growth rate of micro-irrigation in the state stood at 14.40 per cent. As per the latest figures, the share of sprinkler irrigation in the state is 78.42 per cent whereas that of drip irrigation system is 21.58 per cent.

Table 3: Physical progress of micro-irrigation in Haryana (2006-07 to 2018-19) (in ha)

Year	Drip	% of Total	Sprinkler	% of Total	Total
2006-07	812	30.34	1864	69.66	2676
2007-08	1041	13.39	6735	86.61	7776
2008-09	2139	9.59	20170	90.41	22309
2009-10	2468	75.75	790	24.25	3258
2010-11	3900	42.60	5254	57.40	9154
2011-12	2751	31.58	5961	68.42	8712
2012-13	2645	40.33	3914	59.67	6559
2013-14	2504	39.35	3860	60.65	6364
2014-15	1550	45.59	1850	54.41	3400
2015-16	1756	56.35	1360	43.65	3116

2016-17	1158	20.03	4624	79.97	5782
2017-18	2105	20.20	8315	79.80	10420
2018-19	2903	21.58	10549	78.42	13452
CAGR (%)	11.20		15.53		14.40
Total	**27732**	**26.93**	**75246**	**73.07**	**102978**

The financial progress of micro-irrigation in Haryana in terms of allocated budget, expenditure and utilization for the period 2006-07 to 2018-19 is presented in Table 4. During this period, the available budget and expenditure has grown by a CAGR of 24.23 per cent and 27.28 per cent, respectively. Utilisation of the budget provided has fluctuated from as low as 25.34 per cent in 2016-19 to as high as 99.4 per cent in 2011-12. Cumulatively, out of the total budget of 540.63 crores 364.55 crores was spent that i.e. 67.43 per cent.

Table 4: Financial Progress of micro-irrigation in Haryana (2006-07 to 2018-19) (Rs. in Cr)

Year	Available budget	Expenditure	Per cent Utilization
2006-07	5.83	2.35	40.31
2007-08	11.24	6.45	57.38
2008-09	21.13	18.91	89.49
2009-10	9.42	8.51	90.34
2010-11	26.24	25.94	98.86
2011-12	40.65	40.34	99.24
2012-13	66.48	62.60	94.16
2013-14	67.84	61.89	91.23
2014-15	30.51	30.29	99.28
2015-16	44.16	20.00	45.29
2016-17	82.21	20.83	25.34
2017-18	56.08	23.87	42.56
2018-19	78.78	42.52	53.97
CAGR (%)	24.23	27.28	2.46
Total	**540.63**	**364.55**	**67.43**

The compound annual growth rate for the period 2012-19 for number of beneficiaries, area coverage and financial growth is presented in Table 5. The highest growth in terms of number of beneficiaries/area covered/ finances was seen in the districts of Rewari, Nuh, Sirsa Bhiwani and Mahendergarh. There were eight districts where the CAGR of number of beneficiaries and area covered was found negative and 13 districts with negative CAGR for the growth in finances. In total, the number of beneficiaries in Haryana state grew by 18.94 per cent, area covered has grown by 7.79 per cent and the finances have increased by a CAGR of 12.72 per cent.

Table 5: CAGR of micro-irrigation spread in Haryana (2012-2019) (in per cent)

District	Beneficiaries	District	Area	District	Financial
Rewari	75.08	Rewari	85.72	Rewari	71.96
Nuh	44.11	Bhiwani	43.93	Bhiwani	40.61
Sirsa	38.71	Sirsa	37.08	Sirsa	31.83
Bhiwani	34.22	Nuh	35.65	Nuh	31.62
Mahendragarh	24.84	Mahendragarh	24.64	Mahendragarh	20.70
Yamunanagar	9.57	Yamunanagar	16.52	Yamunanagar	10.16
Hisar	9.00	Hisar	13.95	Hisar	7.70
Faridabad	8.32	Rohtak	7.89	Fatehabad	0.22
Panchkula	4.92	Kaithal	7.86	Jhajjar	-2.28
Palwal	4.20	Faridabad	7.40	Gurugram	-3.68
Ambala	3.66	Fatehabad	7.24	Jind	-10.70

Rohtak	3.24	Ambala	6.21	Rohtak	-10.75
Fatehabad	2.74	Jhajjar	1.96	Ambala	-12.71
Gurugram	-0.93	Palwal	-1.14	Kaithal	-14.81
Kaithal	-5.63	Gurugram	-1.24	Panchkula	-16.23
Jhajjar	-5.91	Panchkula	-3.21	Palwal	-16.30
Kurukshetra	-11.56	Jind	-3.27	Faridabad	-20.27
Jind	-15.91	Kurukshetra	-18.57	Kurukshetra	-24.16
Karnal	-18.56	Karnal	-20.81	Karnal	-27.49
Sonepat	-19.12	Sonepat	-25.18	Panipat	-34.21
Panipat	-23.46	Panipat	-28.80	Sonepat	-34.26
Total	**18.94**	**Total**	**7.79**	**Total**	**12.72**

Factors affecting adoption

The results of the logistic regression analysis of factors affecting adoption decision of farmers regarding the micro irrigation technologies are presented in the Table 6. All of the variables had signs as hypothesized. The variables such as years of schooling of household head, family type and dependency ratio were found to be negatively related with the adoption decision of the farmer. However, all three of these variables were found to be insignificant. The variable of land holding was found to be positively related but was insignificant.

The effect of the variable, HP of pump was found positive and significant at 1% level. Moreover, Years of schooling household head, off farm income and Share of fruits and vegetables in the total cultivated were found to be related positively with the probability of adoption and were significant at 5% level. The variable showing the effect of any type of agriculture related "Training" availed by the farmer was also found to be positive and significant at 10 % level.

Table 6: Factors affecting adoption of micro-irrigation technologies in Haryana

	Variables	Description	Coefficient	Marginal effect
	Constant		-6.370*	–0.99841
1	Age of HH[#]	Years	-0.0027	–0.00001
2	Years of schooling of HH		1.0447**	0.16373
3	Family type	(1: Nuclear, 0: Joint)	- 0.0006	0.00009
4	Dependency ratio[$]		- 0.0022	–0.00007
5	Off farm Income	Yes= 1, No = 0	0.5569**	0.08728
6	Landholding	Acres	3.1345	0.49126
7	HP of pump		0.5342***	0.08372
8	Training	Yes= 1, No = 0	0.0545*	–0.00855
9	Share of F&V[##]	Area under F&V/ Total	0.0032**	0.00050
	R^2		83.9	

*[#] Household head; * Total members in the family/Earning members; [$] Total members below 14 and above 65/Total members; [##]Area under F& V/Total cultivated area*

Constraints faced by adopters and non-adopters

The results of the analysis of constraints faced by adopters are presented in Table 7. According to the ranks given based on the mean percentage score, the top five constraints faced by

Table 7: Constraints faced by adopters of micro-irrigation technologies in Haryana

S. No.	Particulars	Mean score	Mean % score	Rank
1	Heavy initial investment	4.63	92.67	1
2	Less number of subsidy slots	4.42	88.33	2
3	Proper training/demonstration unavailable	4.18	83.67	3

4	Time from application to installation is high	4.00	80.00	4
5	Repair and maintenance services	3.70	74.00	5
6	Erratic electricity	3.55	71.00	6
8	Unavailability of spares	3.47	69.33	8
9	Original spares unavailable	3.35	67.00	9
10	Expensive spare parts	3.25	65.00	10
11	Documentation issues	1.85	37.00	11
12	Theft	1.42	28.33	12
13	Inferior quality parts	1.03	20.67	13

adopters were heavy initial investment (92.67), less number of subsidy slots available annually (88.33), unavailability of training/demonstration of MI technologies (83.67), high time taken from application to installation (80.00), lack of repair and maintenance services (74.00). Furthermore, erratic supply of electricity (71.00), unavailability of spare parts (69.33), unavailability of original spare parts (67.00), the spare parts being expensive (65.00) were the next five pressing constraints. There were some less problematic but considerable constraints such as requirement of several documents at the time of application (37.00), problem of theft (28.33) and inferior quality of some parts (20.67).

Constraints faced by non-adopters

Results of the constraints faced by farmers who did not adopt micro irrigation are presented in Table 8. The top five constraints faced by these farmers were requirement of a large amount of money to be invested initially (98.33), availability of less number of subsidy slots (97.33), unavailability of demonstration of micro irrigation technology (90.00), small land holding of farmers (77.33), most of the farmers being in either institutional or non-institutional debt (67.33). Moreover, some more constraints in descending order of importance were high cost of maintenance (66.33), spare part related issues (62.33), the number of documents required (54.00) and irregular supply of electricity (53.33).

Table 8: Constraints faced by non-adopter farmers in Haryana

S. N.	Particulars	Mean score	Mean % score	Rank
1	Heavy initial investment	295	98.33	1
2	Less number of subsidy slots	292	97.33	2
3	Demonstration unavailable	270	90.00	3
4	Small landholding	232	77.33	4
5	Already in debt	202	67.33	5
6	Maintenance cost is high	199	66.33	6
7	Spare part issues	187	62.33	7
8	Documents required are many	162	54.00	8
9	Irregular electricity supply	160	53.33	9

x. Programme of work for 2021-22: Experiment continued

Salient findings of study:

- Haryana ranks 9th among all states in micro-irrigation coverage with 10.4 per cent of gross irrigated area under micro-irrigation and 4th when observed according to area under micro-irrigation (9.1 %) as a proportion of gross cultivated area under micro-irrigation.
- The districts with highest area under micro-irrigation were Bhiwani (229397 acres), Mahendergarh (193259 acre) and Rewari (66495 Lakh acres). The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by

Rewari (23.37 %) and Bhiwani (21.16 %). In total, Haryana had 546455 acres of area under micro-irrigation i.e. 6.1 per cent of cultivated area.

- During 2012-19, the area under drip and sprinkler irrigation has grown by a CAGR of 11.20 per cent and 15.5 per cent, respectively. Currently, the share of drip and sprinkler irrigation in the state is 21.58 per cent and 78.42 per cent, respectively.
- During 2012-19, the available budget and expenditure has grown by a CAGR of 24.23 per cent and 27.28 per cent, respectively. Cumulatively, out of the total budget of 540.63 crores 364.55 crores was utilized i.e. 67.43 per cent.
- The highest growth in terms of number of beneficiaries/area covered/ finances was seen in the districts of Rewari, Nuh, Sirsa Bhiwani and Mahendergarh.
- In total, the number of beneficiaries, area covered and finances grew by 18.94 per cent, 7.79 per cent and 12.72 per cent, respectively.
- Years of schooling of household head, family type and dependency ratio were found to be negatively related with the adoption decision but were insignificant. The variable of land holding was found to be positively related but was insignificant.
- Effect of HP of pump was found positive and significant ($p<0.01$). Years of schooling household head, off farm income and Share of fruits and vegetables in the total cultivated were found to be related positively and significantly ($p<0.05$). The variable of agricultural "Training" availed by the farmer affected adoption decision positively and significantly ($p<0.10$).
- The top five constraints faced by adopters were heavy initial investment (92.67), less number of subsidy slots available annually (88.33), unavailability of training/demonstration of MI technologies (83.67), high time taken from application to installation (80.00), lack of repair and maintenance services (74.00).
- The top five constraints faced by these farmers were requirement of a large amount of money to be invested initially (98.33), availability of less number of subsidy slots (97.33), unavailability of demonstration of micro irrigation technology (90.00), small land holding of farmers (77.33), most of the farmers being in either institutional or non-institutional debt (67.33)

Conclusion

Bhiwani (229397 acres), Mahendergarh (193259 acre) and Rewari (66495 Lakh acres) districts has highest area under micro-irrigation in Haryana. The gap between budgets allocated and utilised needs to be narrowed as only two thirds of allocated budget utilized during the study period. Positive and highly significant effect of years of schooling of household head, share of fruits and vegetables and significant effect of training suggest that household heads may be involved in agricultural trainings promoting micro irrigation and diversification to fruits and vegetables, because decision making regarding making changes lies in their hands. Reducing the weight of heavy initial investment by way of back ended subsidy, increasing the number of slots available and provisions for demonstration of micro irrigation can help a long way. Also, ensuring uninterrupted electricity supply to the farms will help accelerate its adoption

i	**Experiment No. 6: Feasibility study of Bhavantar Bharpayee Yojana (BBY) for vegetable crops in Haryana.**	
ii	**Objectives of the experiment**	• To study the awareness of farmers about the BBY scheme • To work out the cost of cultivation of major vegetable crops covered • To examine the price realization of the adopter and non- adopter respondents

		• To identify the constraints faced by farmers in the marketing of vegetables
iii	**Name(s) of the investigators**	• Dr. Veer sain Preparation of schedule, data collection, and report writing • Dr. Vijay Kumar Data collection and compilation
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Joginder Statistical modelling and data analysis
v	**Year of start**	• 2020-21
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **District covered:** Sonepat, Kurukshetra and Mewat. • **Crops covered:** Cauliflower, Potato, Tomato and Onion • **Village covered:** Villages namely, Charsmi, Kheri Tega and Bdoth of Sonepat district and Agol, Bhakdo, Doha, Badka, Khor basi and Paldi of Mewat and Padlu, Damli, Kishangarh of Kurukshetra district were selected. • **Statistical design/methods:** Descriptive statistics, Chi square test and t test was used.
viii	**Observations recorded**	• Information related to awareness, cost and returns and prices of cauliflower, potato, tomato and onion under BBY scheme from sixty (60) respondents and current market price of cauliflower, potato, tomato and onion form twenty four (24) non-beneficiaries respondents were collected. • Perception related to BBY scheme from eighty four farmers respondents were recorded

ix. Results achieved during 2020-21

Awareness about Bhavantar Bharpayee Yojana (BBY) in Haryana

It is apparent from the data presented in Table 1 that majority (71.43%) of the respondents were aware that BBY is being implemented in the state. More than 50 per cent of respondents had awareness regarding implementing agency, its objectives, crops included under the scheme, registration process and closing date on the portal and eligibility of farmers under the scheme. But most of the respondents (more than 50%) were not aware about area verification and procedure of claiming benefit and J- form under the scheme. About 52.38 per cent of respondents were not aware about Toll Free Helpline number of the scheme.

Table1: Awareness about Bhavantar Bharpayee Yojana (BBY) in selected districts of Haryana

N=84

Sr. No.	Statements	Sonepat (21)		Kurukshetra (21)	Mewat (42)	Overall	Ranks
1	Implementation of BBY in the	Aware	15	15	30	60 (71.43)	I

	state	Not Aware	6	6	12	24 (28.57)	
2	Knowledge about the objectives	Aware	15	13	31	59 (70.23)	II
		Not Aware	6	8	11	25 (29.76)	
3	Information related to crops included	Aware	12	12	32	56 (66.67)	III
		Not Aware	9	9	10	28 (33.33)	
4	Knowledge of eligibility of farmers about the scheme	Aware	10	12	34	56 (66.67)	III
		Not Aware	11	9	8	28 (33.33)	
5	Knowledge of registration process and closing date on the portal	Aware	12	13	29	54 (64.29)	IV
		Not Aware	9	8	13	30 (35.71)	
6	Knowledge of J- form under the scheme	Aware	11	10	33	54 (64.29)	IV
		Not Aware	10	11	9	30 (35.71)	
7	Knowledge of procedure about claiming benefit	Aware	12	12	26	50 (59.52)	V
		Not Aware	9	9	16	34 (40.48)	
8	Knowledge about the benchmark yield fixed for the crops	Aware	13	14	21	48 (57.14)	VI
		Not Aware	8	7	21	36 (42.86)	
9	Awareness about the compulsion of area verification under the crops	Aware	11	9	24	44 (52.38)	VII
		Not Aware	10	12	18	40 (47.62)	
10	Awareness about Toll free Helpline No. of the scheme.	Aware	10	8	22	40 (47.62)	VIII
		Not Aware	11	13	20	44 (52.38)	
	Overall awareness	**Aware**				**62.02%**	

Figure in parentheses indicate score obtained by respondents

Table No.2 Relationship between the Demographic Profile and level of awareness towards BBY

			Level of Awareness				χ^2 Value	table value	Remarks
			Low	Moderate	High	Total			
1	**Age**	Young (up to 37 years)	9	8	10	27	0.803	9.488	NS
		Middle (38-55 years)	10	10	14	34			
		Old (above 55 years)	6	10	7	23			
2	**Experience**	Up to 15 years	10	12	10	32	0.909	9.488	NS
		16-30 years	13	12	7	32			
		>30 years	7	7	6	20			
3	**Education**	upto school level	20	10	7	37	0.931	9.488	NS
		Graduate	12	6	6	24			
		Post Graduate	10	7	6	23			
4	**Land holding**	Marginal farmers (< 2.5 acres)	6	6	6	18	0.999	12.592	NS
		Small farmers (>2.5 to 5 acres)	9	10	9	28			
		Medium farmers (> 5 to 10 acres)	6	8	6	20			
		Large farmers (> 10acres)	6	6	6	18			

Significant at 5 percent level

Relationship between the Demographic Profile and Level of Awareness towards Bhavantar Bharpayee Yojana:

Table no.2 depicts the relationship between selected demographic variables and Level of the Awareness of the respondents. It is clear that, the calculated Chi-square value is less than the table value at five per cent level, there does not exists any significant association between age, experience,

education and Land holding of the farmers and level of awareness towards Bhavantar Bharpayee Yojana due to sample size were small. Thus the null hypothesis is accepted.

Cost and returns from cauliflower potato and tomato in Haryana

The per hectare gross returns from cauliflower, potato, onion and tomato were estimated to be Rs.159321.43, Rs. 136619.05, Rs. 151666.67 and Rs. 149142.86 respectively. The net return from cauliflower, potato, onion and tomato were Rs.76418.53, Rs. 67368.67, Rs. 88301.58 and Rs. 67494.20, respectively. The estimated B: C ratio of cauliflower, potato, onion and tomatowere1:1.92, 1:1.98, 1:2.39 and 1:1.83, respectively (Table 3).

In Sonepat district, the price of cauliflower for adopter of BBY was Rs. 750 while the price of cauliflower for non- adopter was Rs. 650. The price of potato for BBY adopter was Rs. 500 whereas price for non-adopter was Rs. 400 in Kurukshetra district. In Mewat district, the price of tomato and onion was Rs. 500 and Rs. 650 for BBY adopter while price for non-adopter was Rs. 400 and Rs. 550, respectively (Table 4).

Table 3: Cost of cultivation for cauliflower and potato in Sonepat and Kurukshetra districts of Haryana **n=21**

Sr No	Cauliflower (Sonepat)			Potato (Kurukshetra)		
	Inputs	**Qty.**	**Value (Rs./ha.)**	**Inputs**	**Qty.**	**Value (Rs./ha.)**
1	Preparatory tillage	15.95	8773.81 (4.23)	Preparatory tillage	22.38	11107.14 (6.42)
2	Pre-sowing irrigation		726.19 (0.35)	Pre-sowing irrigation		654.76 (0.38)
3	Seed/Nursery raising (gram)	436.90	17976.19 (8.67)	Seed/Nursery raising (Q)	34.40	26297.62 (15.19)
4	Seed treatment		660.71 (0.32)	Seed treatment		539.28 (0.31)
5	Sowing/Transplanting		4190.48 (2.02)	Sowing/Transplanting		3642.86 (2.10)
6	Ridging		2500 (1.21)	Ridging		2452.38 (1.42)
7	FYM		7619 (3.68)	FYM		9404.76 (5.43)
8	Fertilizer nutrients		-	Fertilizer nutrients		
	(a) Urea		3542.86 (1.71)	(a) Urea		2357.14 (1.36)
	(b) DAP		6000 (2.89)	(b) DAP		12886.9 (7.44)
	(c) Potash		196.43 (0.09)	(c) Potash		1505.95 (0.87)
	(d) $ZnSO_4$		535.71 (0.26)	(d) $ZnSO_4$		357.14 (0.21)
	Total fertilizer invest		10375 (5.01)	**Total fertilizer invest**		17107.14 (9.88)
9	Fertilizer application cost		940.48 (0.45)	Fertilizer application cost		982.14 (0.57)
10	Irrigation		4821.43 (2.33)	Irrigation		3702.38 (2.14)
11	Hoeing/Weeding		-	Hoeing/Weeding		
	(a) Chemical		-	(a) Chemical		815.47 (0.47)
	(b) Manual		14880.95 (7.18)	(b) Manual		-
12	Earthing up		3809.52 (1.84)	Earthing up		-
13	Plant protection		14821.43 (7.15)	Plant protection		5309.52 (3.07)
14	Harvesting charges		17833.33 (8.60)	Harvesting charges		11726.19 (6.77)
15	Miscellaneous		1226.19 (0.59)	Miscellaneous		648.81 (0.37)
	Total (1 to 15)		111154.76 (53.63)	**Total (1 to 15)**		94390.48 (54.52)
16	Interest on working capital@7%		7780.83 (3.75)	Interest on working capital@7%		6607.33 (3.82)
17	**Variable cost**		118935.60	**Variable cost**		100997.8 (58.34)

			(57.39)			
18	Packaging charges		1925 (0.93)	Packaging charges		6345.24 (3.67)
19	Transportation		21948.81 (10.59)	Transportation		5047.62 (2.92)
20	Management charges @10%		11894 (5.74)	Management charges @10%		10099.78 (5.83)
21	Risk factor @10%		11894 (5.74)	Risk factor @10%		5047.62 (2.92)
22	Rental value of land		40661 (19.62)	Rental value of land		40535.71(23.41)
23	**Total cost**		207257.24 (100.00)	**Total cost**		173125.9 (100.00)
24	Main Product	225.25 @707.14	159321.43	Main Product	289.52@471.43	136619.05
25	**Gross return**		159321.43	**Gross return**		136619.05
26	**Return over variable cost**		111747.19	**Return over variable cost**		96219.92
27	**Net return**		76418.53	**Net return**		67368.67
28	**B:C ratio**		1:1.92	**B:C ratio**		1:1.98

Table: 4: Cost of cultivation onion and tomato in Mewat district of Haryana n=21

Sr. No	Onion			Tomato		
	Inputs	**Qty.**	**Value (Rs./ha.)**	**Inputs**	**Qty.**	**Value (Rs./ha.)**
1.	Preparatory tillage	11.5	6726.19 (4.22)	Preparatory tillage	12.8	6428.57 (3.15)
2.	Pre-sowing irrigation		889.28 (0.56)	Pre-sowing irrigation		910.71 (0.45)
3.	Seed/Nursery raising	13.21	12666.67(7.95)	Seed/Nursery raising	137	6083.33 (2.98)
4.	Seed treatment		666.67 (0.42)	Seed treatment		625.00 (0.31)
5.	Sowing/Transplanting		10345.83 (6.49)	Sowing/Transplanting		2970.24 (1.46)
6.	Ridging		2380.95 (1.49)	Ridging		2500.00 (1.22)
7.	FYM		5166.67 (3.24)	FYM		5571.43 (2.73)
8.	Fertilizer nutrients			Fertilizer nutrients		
	(a) Urea		803.6 (0.50)	(a)Urea		2392.86 (1.17)
	(b) DAP		4142.86 (2.60)	(b) DAP		11571.43 (5.67)
	(c) Potash		1015 (0.64)	(c) Potash		1178.57 (0.58)
	(d) $ZnSO_4$		750 (0.47)	(d) $ZnSO_4$		339.29 (0.17)
				(e) NPK		1130.95 (0.55)
	Total fertilizer invest		6711.31 (4.21)	**Total fertilizer invest**		16613.10 (8.14)
9.	Fertilizer application cost		392.86 (0.25)	Fertilizer application cost		1005.95 (0.49)
10.	Irrigation		7375 (4.63)	Irrigation		7916.67 (3.88)
11.	Hoeing/Weeding			Hoeing/Weeding		
	(a) Chemical		1554 (0.98)	(a) Chemical		0.00
	(b) Manual		8166.67 (5.13)	(b) Manual		8809.52 (4.32)
12.	Earthling up		0.00 (0.00)	Earthling up		9904.76 (4.85)
13.	Plant protection		2761.9 (1.73)	Plant protection		14690.48 (7.20)
14.	Harvesting charges		17619 (11.06)	Picking charges		20976.19 (10.28)
15.	Miscellaneous		826.79 (0.52)	Miscellaneous		773.21 (0.38)
	Total (1 to 15)		84201.78 (52.85)	**Total (1 to 15)**		105779.17 (51.82)
16.	Interest on working capital@7%		5894.12 (3.70)	Interest on working capital@7%		7404.54 (3.63)
17.	**Variable cost**		90095.91 (56.55)	**Variable cost**		11318.37 (55.45)
18.	Packaging charges		4178.57 (2.62)	Packaging charges		4721.43 (2.31)
19.	Transportation		4858.33 (3.05)	Transportation		22329.76 (10.94)

20.	Management charges @10%		9009.59 (5.66)	Management charges @10%		11318.37 (5.54)
21.	Risk factor @10%		9009.59 (5.66)	Risk factor @10%		11318.37 (5.54)
22.	Rental value of land		41250 (25.89)	Rental value of land		41250 (20.21)
23.	**Total cost**		159307.96 (100.00)	**Total cost**		204121.64 (100.00)
24.	Main Product	249.05@607.14	151666.67	Main Product	307.14@485.7	149142.86
25.	**Gross return**		151666.67	**Gross return**		149142.86
26.	**Return over variable cost**		115628.30	**Return over variable cost**		103869.37
27.	**Net return**		88301.58	**Net return**		67494.20
28	**B:C ratio**		1:2.39	**B:C ratio**		1:1.83

Table 5: Average price and price difference of adopter and non-adopter respondents in Haryana (Rs./qtls)

Districts	Crops	Adopter	Non-adopter	Difference
Sonepat	Cauliflower	750	650	100
Kurukshetra	Potato	500	400	100
Mewat	Tomato	500	400	100
	Onion	650	550	100

The various constraints faced by the growers in marketing of vegetables in Sonepat, Kurukshetra and Mewat districts are shown in Table 5. The results revealed that not easily available J-form in regulated market, BBY portal deals with marketing board instead of Horticulture board, difficult process for registration of BBY particular illiterate farmers, Limited time for harvesting of crops, Caping of produce limit and Lack of information about the secured price fixed for the crops.

Table 6: Constraints faced by vegetable growers in Bhavantar Bharpayee Yojana in Haryana N-60

S. No	Problems/Constraints	Sonepat (15)	Kurukshetra (15)	Mewat (30)	Total	Ranks
1	Not easily available J-form in regulated market	12 (80.00)	12 (80.00)	26 (86.67)	50	I
2	BBY portal deals with marketing board instead of Horticulture board	10 (66.67)	12 (80.00)	26 (86.67)	48	II
3	Difficult process for registration of BBY particular illiterate farmers	10 (66.67)	11 (73.33)	25 (83.33)	46	III
4	Limited time for harvesting of crops	11 (73.33)	10 (66.67)	24 (80.00)	45	IV
5	Caping of produce limit for inccentivisation	10 (66.67)	9 (60.00)	25 (83.33)	44	V
6	Lack of information about the secured price fixed for the crops	8 (53.33)	10 (66.67)	20 (66.67)	38	VI

Figure in parentheses indicate score obtained by respondents

Programme of work for 2021-22: Experiment concluded

Salient finding of the study:

- Awareness of respondents was found significant in BBY scheme. The responses points were developing the suitable extension strategies which are focus on information dissemination and awareness generation.
- Chi-square test was applied and it was observed that the results were not significant as p value >0.05.

- The gross return and net returns of vegetables in Sonepat, Kurukshetra and Mewat districts were estimated to be Rs. 159321.43 and 76418.53 for cauliflower, Rs. 136619.05 and 67368.67 for potato, Rs. 151666.67 and 88301.58 for onion, Rs. 149142.86 and 67494.20 for tomato, respectively.
- B: C ratio over all the total cost were 1:1.92, 1:1.98, 1:2.39 and 1:1.83 for cauliflower, potato, onion and tomato, respectively.
- In Sonepat, Kurukshetra and Mewat districts, the price of cauliflower, potato, tomato and onion for adopter of BBY was Rs. 750, 500, 500 and 650 while the price of cauliflower, potato, tomato and onion for non- adopter was Rs. 650, 400, 400 and 550, respectively.
- The various constraints faced by the growers were not easily available J-form in regulated market and BBY portal deals with marketing board instead of Horticulture board in Sonepat, Kurukshetra and Mewat districts.

Conclusions:

The gross return and net returns of vegetables in Sonepat, Kurukshetra and Mewat districts were estimated to be Rs. 159321.43 and 76418.53 for cauliflower, Rs. 136619.05 and 67368.67 for potato, Rs. 151666.67 and 88301.58 for onion, Rs. 149142.86 and 67494.20 for tomato, respectively. Benefit cost ratio were also came to be 1:1.92, 1:1.98, 1:2.39 and 1:1.83 for cauliflower, potato, onion and tomato, respectively. Higher net returns and benefit cost ratio indicated that vegetable cultivation is a profitable and promising enterprise in Sonepat, Kurukhestra and Mewat districts. The constraints faced by farmers indicated that the market system of vegetables in Sonepat, Kurukshetra and Mewat districts is inefficient and improvement has to be made.

I	**Experiment 7: Composition and direction of India's foreign trade for major agricultural commodities**	
Ii	**Objectives of the experiment**	• To determine growth and instability in export and import of agricultural commodities • To find out the export competitiveness of agricultural commodities • To examine the direction and composition of agricultural trade of India in global trade
Iii	**Name(s) of the investigators**	Kavita (Collection, compilation and analysis of data, writing of report)
Iv	**Name(s) of the collaborator(s) with activity profile**	Nil
V	**Year of start**	**2020-21**
Vi	**Duration of Study**	One year
vii	**Treatment details**	• **Locale of experiment:** India • **Period:** 2010-2020 • **Statistical design/methods:** The data was analysed by using major analytical techniques like growth rates, indices of instability and Revealed Comparative Advantage (RCA). The growth rates were estimated by using semi-log growth model while indices of instability were measured by using Coefficient of Variation.
viii	**Observations recorded**	• The present study was based on secondary data. • Time series data of export and import of agriculture commodities were collected from different published

		sources (FAO trade yearbook, APEDA, Statistical abstract of India etc).

ix. Results achieved during 2020-21

Agricultural Export and Import

Foreign trade has played a significant role in economic development of our country. It not only helps us in earning foreign exchange but also provides us with an opportunity of using diversified products produced in every corner of the world. The practice of conducting trade with foreign countries has been followed since ancient times. The history of India traces trade with countries like Greece, Germany, China, Japan, Java and Arabian countries since 1100 B.C. India's rich resources and comparative advantage in various products have attracted a lot of traders across the border. Today, India plays a prominent role in world agricultural trade. The objective of the Indian Government is to occupy top 10 position in agricultural export.India occupies a leading position in global trade of agricultural products. The major export destinations were USA, Saudi Arabia, Iran, Nepal, and Bangladesh. Among the key agriculture commodities exported from India were marine products, basmati rice, buffalo meat, spices, non-basmati rice, cotton raw, oil meals, castor oil, coffee and cashew.

Table 1: Share, growth and stability in India's agricultural exports vis-a-vis total merchandise exports, 2010-2019 **(US$ billion)**

Years	Total Agril. Export	Total Merchandise Export	(%) share of Agril. Export	Total Agril. Import	Total Merchandise Import	(%) share of Agril. Import
2010-11	19.97	226.35	8.82	10.66	350.23	3.04
2011-12	30.29	302.91	10.00	17.26	464.46	3.72
2012-13	38.17	296.81	12.86	20.19	488.59	4.13
2013-14	42.49	313.24	13.56	19.22	466.04	4.12
2014-15	36.18	322.69	11.21	21.30	462.91	4.60
2015-16	28.66	267.44	10.72	22.40	392.87	5.70
2016-17	26.49	264.14	10.03	24.08	361.21	6.67
2017-18	30.42	299.28	10.17	27.39	448.42	6.11
2018-19	30.74	324.78	9.47	21.68	514.46	4.21
2019-20	29.30	324.25	9.04	21.69	486.06	4.46
Growth (%)	**0.47**	**1.88**	-	**6.40**	**1.41**	-
Instability (%)	**20.24**	**10.95**	-	**21.50**	**12.63**	-

The data presented in Table 1 showed that the total agricultural export of India were US$ **19.97** billion in 2010-11. It increased continuously over the years and reached US$ 29.30 billion in 2019-20 with compound growth rate of 0.47 per cent, maximum export US$ 38.17 billion during year 2012-13 whereas total agricultural import was increased US$ 21.69 billion (2019-20) from US$ 10.66 billion (2010-11) with compound growth rate 6.40 per cent during study period. The percentage share of agricultural export as well as import in total trade showed an increasing trend, were increased 9.04 per cent and 4.46 per cent (2019-20) from 8.82 and 3.04 per cent (2010-11), respectively. Agricultural export-import growth in comparison to merchandise trade revealed that agricultural export was increased with compound growth rate 0.47 per cent whereas merchandise export increased with compound growth rate 1.88 per cent. Similarly agricultural import was rapidly increased with compound annual growth rate 6.40 per cent in comparison to merchandise import growth rate 1.41 per cent. Agricultural trade was less stable than merchandise trade as the coefficient of variation

of agricultural export-import was 20.24 and 21.50 per cent in comparison to merchandise trade with coefficient of variation 10.95 and 12.63 per cent.

Table 2: Growth and instability in India's export leading agricultural commodities

Commodity	Quantity (MT)		Value (US$ million)		Growth (%)	Instability (%)
	2010	2019	2010	2019		
Marine Products	785069.04	4454713	2622.72	4371.93	**7.16**	**29.78**
Basmati Rice	2330250	4454713	2493.89	4371.93	**4.34**	**20.15**
Buffalo Meat	726655	1152324	1895.07	3199.6	**4.35**	**23.26**
Non-Basmati Rice	100681	5036190	50.86	2024.66	**25.70**	**41.55**
Spices	688394.40	1192453	1733.59	3622.58	**5.60**	**19.02**
Raw cotton	775105.30	658976	2910.39	1057.82	**-11.40**	**42.78**
Oil meals	6945172	2654681	2437.9	827.55	**-12.98**	**54.66**
Castor oil	424458.11	593881.6	654	894.36	**1.98**	**16.20**
Coffee	230995.68	257018.9	661.77	738.86	5.32	17.49
Cashew	92375	84330	619.23	566.79	**-1.47**	**16.53**

Table 2 showed the growth and instability in India's export leading agricultural commodities, as export of top agricultural commodities from India were increased with positive growth rates except raw cotton, oil meals and cashew export which has declined with negative compound growth rates 12.98, 11.40 and 1.47 per cent. Non-basmati rice export gained importance with maximum export value increased with compound growth rate 25.70 and coefficient of variation 41.55 per cent. Marine products export also gained importance with CAGR 7.16 and CV of 29.78 per cent. Spices, coffee, buffalo meat, basmati rice and castor oil export increased with CAGR 5.60, 5.32, 4.35, 4.34 and 1.98 per cent, respectively with CV of 19.02, 17.49, 23.26, 20.15 and 16.20 per cent, respectively.

Table 3: Growth and instability in major imported agricultural commodities

Commodities	Quantity (MT)		Value (US$ million)		Growth (%)	Instability (%)
	2010	2019	2010	2019		
Vegetable oil	6039018	14722118	5685.09	9672.87	**10.26**	**28.77**
Pulses	2777827	2917059	1645.14	1440.09	**-0.77**	**42.61**
Fresh fruits	630233	993730	790.26	1993.12	**10.86**	**29.20**
Cashew	529734	941419	577.73	1277.71	**8.32**	**26.89**
Spices	124494.4	320989.9	350.97	1438.83	**15.28**	**42.58**
Sugar	827.55	1117726	610.18	350.39	**8.80**	**49.43**
Alcoholic beverages	196846.16	572771.96	225.47	656.06	**14.00**	**37.96**
Wheat	62329.03	185280	145.7	372.26	**10.00**	**27.13**
Misc. processed items	6039018	14722118	5685.09	9672.87	**10.26**	**28.77**

Similarly, growth and instability in major imported agricultural commodities, among different commodities import of major agricultural commodities pulses import shows favourable trade with declined import CGR - 0.77 per cent. Except pulses all other major agricultural commodities (Vegetable oil, fresh fruits, cashew, spices, sugar, alcoholic beverages and miscellaneous processed items) imported in India have increased import value over the ten years of study period with CGR 10.26, 10.86, 8.32, 15.28, 8.80, 14.00 and 10.00 per cent respectively and CV of 28.77, 29.20, 26.89, 49.43, 37.96 and 27.13 per cent respectively (Table 3).

Table 4: Compositional changes in India's agricultural export

Commodities	Percentage Share of top ten exported Agri. Commodity in total Agri Export									
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Marine products	13.13	10.62	9.08	11.81	15.23	16.62	22.34	24.28	15.33	14.92
Basmati rice	12.49	10.62	9.34	11.45	12.49	12.13	12.16	13.69	15.33	14.92

Buffalo meat	9.49	9.38	8.39	10.24	13.22	14.20	14.82	13.25	11.67	10.92
Non-basmati rice	0.25	5.69	6.95	6.88	9.18	8.05	9.64	11.70	9.76	6.91
Spices	8.68	9.00	7.30	5.88	6.72	8.73	10.91	10.20	10.76	12.36
Raw cotton	14.57	14.29	9.82	8.56	5.25	6.76	6.14	6.20	6.85	3.61
Oil meals	12.20	7.99	7.96	6.58	3.66	1.87	3.02	3.56	4.85	2.82
Castor oil	3.27	3.21	2.08	1.71	2.13	2.46	2.55	3.43	2.87	3.05
Coffee	15.07	14.97	12.34	11.29	13.75	17.88	21.40	20.53	18.61	17.87
Cashew	3.10	3.02	1.96	1.98	2.51	2.68	2.98	3.03	2.13	1.93

Marine products, basmati rice, buffalo meat, non-basmati rice and spices were displayed increasing trend whereas raw cotton, oil meals, castor oil, coffee and cashew showed downward trend of percentage share in total agricultural export.

Table 5: Compositional changes in India's agricultural import

Commodities	**Percentage Share of top ten imported Agri. Commodity in total Agri import**									
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Vegetable oil	53.31	47.25	48.80	37.72	45.40	46.85	45.24	42.48	45.61	44.60
Pulses	15.43	11.36	12.14	9.51	13.08	17.42	17.62	10.62	5.26	6.64
Fresh fruits	0.01	5.55	5.64	6.62	7.33	7.57	6.96	7.09	9.17	9.19
Cashew	5.42	6.63	4.91	4.03	5.10	5.98	5.59	5.18	7.41	5.89
Spices	3.29	2.78	2.48	2.97	3.37	3.68	3.57	3.61	5.21	6.63
Sugar	5.72	0.38	2.82	2.04	2.82	2.73	4.24	3.42	2.07	1.62
Alcoholic beverages	2.11	1.55	1.29	1.78	1.91	2.00	2.22	2.19	3.08	3.03
Misc. processed items	1.37	1.11	1.16	1.27	1.34	1.24	1.31	1.27	1.69	1.72

Similarly, import of fresh fruit, cashew, spices, alcoholic beverages and miscellaneous processed items were presented upward trend whereas pulses, vegetable oil and sugar showed decreasing trend of percentage share in total agricultural import.

Table 6: Export competitiveness of agricultural commodities (RCA) 2010-11 to 2019-20

Commodities	**Revealed Comparative Advantage**									
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Cereals	1.83	1.95	2.47	3.06	3.19	2.85	2.71	3.16	3.15	3.11
Pulses	1.37	1.12	0.75	1.27	0.85	0.84	0.92	0.81	1.55	1.32
Oilseeds	0.49	0.44	0.29	0.39	0.56	0.49	0.43	0.41	0.42	0.44
Fruits	0.35	0.26	0.24	0.26	0.30	0.34	0.40	0.38	0.36	0.41
Vegetables	0.82	0.63	0.48	0.57	0.56	0.70	0.71	0.64	0.65	0.62
Alcoholic Beverages	0.10	0.10	0.09	0.09	0.11	0.12	0.13	0.12	0.12	0.12
Sugar & Honey	1.31	1.74	1.48	0.79	1.12	1.58	1.81	1.14	1.35	2.44
Tea	5.32	5.13	3.41	3.19	3.28	4.18	4.41	4.12	4.36	4.87
Coffee	1.04	0.95	0.79	0.81	0.85	0.97	1.11	1.13	1.06	1.08
Cashew	11.11	9.40	6.35	7.96	6.49	6.29	4.89	5.15	4.19	4.33
Cotton lint	11.32	7.11	6.48	8.06	7.50	7.27	6.05	5.52	6.93	3.51
Bovine Meat	2.50	2.62	2.38	3.13	3.56	3.72	3.92	3.70	2.99	2.76

Table 6 revealed that export competitiveness of agricultural commodities measured through revealed comparative advantage. It is a measure of trade specialization that identifies the comparative advantage or disadvantage of a country has for a commodity with respect to country or group of countries. Trade specialization, economic structural and world demand are the factors that contribute to movement in RCA. India has comparative advantage in case of cereals, pulses, tea, coffee, cashew, cotton lint, bovine meat, sugar and honey. RCA value less than one showed comparative disadvantage in export of oilseeds, fruits, vegetable and alcoholic beverages. Thus, India has enormous potential in export of cereals. Pulses, tea, coffee, cashew, cotton lint, bovine meat, sugar and honey. However, efforts will have to be made to ensure that domestic production of agricultural commodities exceeds domestic demand so as to increase export competitiveness.

The agricultural commodities from India were mainly exported to many of the developed and emerging economies. India's direction of export to principal countries is displayed in Table 7. The destination wise analysis of leading export of agricultural commodities from India to many other countries during the period I (2010-15) and period II (2015-20) was showed enormous potential of agricultural export of India. Basmati rice export is very important for India, export of rice to Iran followed by Saudi Arabia was US$ 1034.28 million and US$ 872.63 million during period first, it has declined to US$ 969 million & US$ 847.95 million for period second. Among leading exported commodities maximum basmati rice export from India to Iran, Saudi Arab, UAE, Iraq and Kuwait during both period of study. However, the percentage share of basmati rice export from India was increased in Iraq (5%) from period first to (10%) period second. Remaining four countries showed declined percentage share.

In case of non-basmati rice Bangladesh, Sri Lanka, Benin, Senegal and Nepal were top importer during period I (2010-15) whereas during period II (2015-20) UAE, Somalia and Guinea included in top importer of non-basmati rice by replacing Bangladesh, Sri Lanka and Senegal. Benin country imported maximum percentage share of non-basmati rice exported from India during both period of study. Major buffalo meat export destinations were Vietnam, Malaysia, Egypt, Thailand and Saudi Arab for period I whereas during period II, Thailand and Saudi Arab's position replaced by Indonesia and Iraq. Italy (19%), Germany (9%), Russia (8%), Belgium (6%) and USA (5%) were top five importer of Indian coffee export during period II, whereas more than 50 per cent of coffee exported to other countries from India. Marine Products export was very impressive USA, Vietnam were major importer from India the value of export was US$ 896.65 million and US$ 646.51 million during the years 2010-15, in 2015-20 it has reached to 2076.36 US$ million and 1097.76 US$ million. The percentage share of marine products exported from India to USA (33%), Vietnam (17%), China (8%), Japan (7%) and Thailand (4%) during period II. Top five of importers of castor oil were China (40%), Netherland (15%), USA (10%), France (10%) and Malaysia (04%), same countries remained in top five position of importer of castor oil exported from India.

Spices export is also very important for India, maximum export of spices to U.S.A followed by China was US$ 401.26 million and 318.73 US$ million, during 2015-20 it has reached to US$ 481.37 million & US$ 378.65 million. Major importer countries were USA, China, Hong Kong, Bangladesh and Thailand for Indian spices export. Indian cashew imported by USA, UAE, Netherland, Japan and Saudi Arab *i.e.*,34 per cent and remaining 64 per cent imported by other countries. Only UAE showed declined percentage share among top five importer countries during period II (15%) in comparison to period I (30%).

Table 7. Exports of Select Commodities to Principal Countries (US$ million)

Basmati Rice						**Marine Products**					
2010-15 (I)			**2015-20 (II)**			**2010-15 (I)**			**2015-20 (II)**		
Countries	**Average**	**(%)**	**Countries**	**Average**	**(%)**	**Countries**	**Average**	**(%)**	**Countries**	**Average**	**(%)**
Saudi Arab	872.63	**23**	Saudi Arab	847.95	**21**	U S A	896.65	**22**	USA	2076.36	**33**
Iran	1034.28	**28**	Iran	969.00	**24**	Vietnam	646.51	**16**	China	504.17	**8**
UAE	419.11	**11**	UAE	377.69	**9**	Japan	396.49	**10**	Japan	417.19	**7**
Iraq	180.18	**5**	Iraq	389.95	**10**	Spain	178.56	**05**	Vietnam	1097.76	**17**
Kuwait	243.33	**7**	Kuwait	183.44	**5**	Belgium	155.78	**04**	Thailand	229.66	**04**
Other Countries	982.07	**26**	Other Countries	1221.82	**31**	Other Countries	1737.43	**43**	Other Countries	1992.00	**31**
Non-Basmati Rice						**Castor oil**					
Bangladesh	151.98	**7**	Nepal	228.07	**9**	China	272.98	**35**	China	336.29	**40**
Sri Lanka	61.85	**3**	Benin	248.49	**9**	Netherland	122.67	**16**	Netherland	123.70	**15**
Benin	212.49	**10**	UAE	140.30	**5**	USA	84.78	**11**	U S A	89.70	**10**
Senegal	161.31	**7**	Somalia	116.94	**4**	France	103.44	**13**	France	84.35	**10**
Nepal	98.37	**5**	Guinea	157.13	**6**	Malaysia	16.10	**02**	Malaysia	32.82	**04**
Other Countries	1448.25	**68**	Other Countries	1797.85	**67**	Other Countries	182.99	**23**	Other Countries	173.89	**21**
Buffalo Meat						**Spices**					
Vietnam	1200.65	**35**	Vietnam	1816.78	**48**	USA	401.26	**17**	China	378.65	**12**
Malaysia	339.58	**10**	Malaysia	376.73	**10**	China	318.73	**13**	USA	481.37	**16**
Egypt	292.30	**9**	Egypt	273.81	**7**	Vietnam	123.03	**05**	Hong Kong	79.76	**03**
Thailand	214.93	**6**	Indonesia	176.92	**5**	UAE	104.21	**04**	Bangladesh	98.53	**03**
Saudi Arab	212.87	**6**	Iraq	148.54	**4**	Malaysia	124.57	**05**	Thailand	139.12	**04**
Other Countries	1153.79	**34**	Other Countries	969.21	**26**	Other Countries	1362.63	**56**	Other Countries	1908.23	**62**
Coffee						**Cashew**					
Italy	182.04	**22**	Italy	161.10	**19**	U S A	243.03	**30**	U S A	112.87	**15**
Germany	86.91	**11**	Germany	78.86	**09**	U A E	124.42	**15**	U A E	153.03	**21**
Russia	64.93	**08**	Russia	63.51	**08**	Netherland	68.16	**09**	Netherland	69.47	**09**
Belgium	53.81	**07**	Belgium	50.07	**06**	Japan	48.80	**06**	Japan	72.65	**10**
Turkey	20.23	**02**	U S A	38.89	**05**	Saudi Arab	42.60	**05**	Saudi Arab	68.35	**09**
Other Countries	410.81	**50**	Other Countries	439.44	**53**	Other Countries	279.57	**35**	Other Countries	264.09	**36**

Table 8: Imports of Select Commodities to Principal Countries (US$ million)

Alcoholic Beverages						Misc. Processed Items					
2010-15 (I)			2015-20 (II)			2010-15 (I)			2015-20(II)		
Countries	**Average**	**(%)**	**Countries**	**Average**	**(%)**	**Countries**	**Average**	**(%)**	**Countries**	**Average**	**(%)**
UK	159.63	**53**	USA	223.25	**40**	Nepal	56.28	**26**	USA	73.07	**22**
USA	38.64	**13**	UK	198.48	**36**	USA	34.18	**15**	Nepal	67.11	**20**
Netherland	5.71	**02**	Singapore	42.82	**08**	Bangladesh	16.00	**07**	Bangladesh	22.86	**07**
France	22.07	**07**	Belgium	15.92	**03**	China	13.51	**06**	Germany	11.40	**03**
Singapore	8.67	**03**	UAE	8.678	**01**	Netherland	10.65	**05**	China	22.20	**07**
Other countries	65.81	**22**	Other countries	65.81	**12**	Other countries	89.44	**41**	Other countries	139.06	**41**
Cashew						**Pulses**					
Cote d ivoire	232.69	**26**	Benin	187.64	**14**	Canada	701.52	**33**	Canada	772.14	**28**
Tanzania	159.58	**18**	Tanzania	197.56	**14**	Myanmar	632.32	**30**	Myanmar	551.28	**20**
Guinea	139.67	**15**	Cote d ivoire	307.62	**22**	Australia	231.73	**11**	Mozambique	111.01	**04**
Benin	131.65	**14**	Guinea	181.97	**13**	U S A	106.56	**05**	Tanzania	118.09	**05**
Ghana	92.67	**10**	Ghana	115.30	**08**	Tanzania	90.60	**04**	Russia	140.02	**05**
Other countries	158.47	**17**	Other countries	407.87	**29**	Other countries	371.40	**17**	Other countries	1034.54	**38**
Fresh fruits						**Spices**					
USA	445.77	**39**	USA	794.78	**43**	Vietnam	75.47	**14**	UAE	137.87	**13**
Afghanistan	107.21	**09**	Afghanistan	219.51	**12**	Sri lanka	77.65	**15**	Afghanistan	130.60	**12**
Pakistan	88.39	**08**	UAE	62.60	**03**	Afghanistan	51.38	**10**	Vietnam	132.75	**13**
Iran	70.06	**06**	Iran	112.87	**06**	Madagascar	39.42	**08**	Indonesia	91.70	**09**
Australia	69.08	**06**	Chile	57.32	**03**	China	48.75	**09**	Madagascar	83.89	**08**
Other countries	363.64	**32**	Other countries	611.70	**33**	Other countries	231.15	**44**	Other countries	471.07	**45**
Vegetable oil											
Indonesia	3740.5	**46**	Indonesia	3832.36	**36**						
Malaysia	1570.11	**19**	Argentina	2051.00	**20**						
Ukraine	1132.62	**14**	Malaysia	1839.82	**17**						
Argentina	1120.44	**14**	Ukraine	1565.19	**15**						
Brazil	233.39	**03**	Russia	70.59	**01**						
Other countries	325.246	**04**	Other countries	1158.37	**11**						

Major commodities imported by India from various countries are alcoholic beverages, vegetable oil, pulses, spices, cashew, fresh fruits and miscellaneous processed items.

India imports maximum alcoholic beverages from UK, USA, France, Singapore and Netherland among these countries 53 per cent alcoholic beverages exported to India from UK during period I. Cashew import scenario of India showed that Cote d Ivoire (26%), Tanzania (18%), Guinea (15%), Benin (14%) and Ghana (10%) during period I.

Maximum fresh fruits imported by India from USA (39%) followed by Afghanistan (9%), Pakistan (8%), Iran (6%) and Australia (6%) during first period of study and maximum share of USA (43%) in period II. Indonesia, Malaysia, Ukraine, Argentina and Brazil were major exporter of vegetable oil for India and among these also Indonesia exported 46 per cent of vegetable oil to India.

India's major destination for pulses import were Myanmar (35%) and Canada (29%) followed by Australia, Tanzania and USA whereas spices imported from Vietnam, Srilanka, Afghanistan, Madagascar, China and 44 per cent spices imported to India comes from other than these countries.

x. Programme of work for 2020-21: Experiment concluded

Salient Findings

- The percentage share of agricultural export as well as import slightly increased from 8.82 to 9.04 per cent and 3.04 to 4.46 per cent, respectively from 2011-12 to 2019-20. Total agricultural import has increased more than double with CAGR 6.40 per cent during study period than export (0.47 %) but it showed less stability than agricultural export.
- Maximum growth has showed in export of non-basmati rice with CAGR 25.70 per cent followed by marine products (7.16 %), spices (5.60 %), coffee (5.32 %), buffalo meat (4.35%), basmati rice (4.34 %) and castor oil (1.98%) with CV of 19.02, 17.49, 23.26, 20.15 and 16.20 per cent, respectively. Declined growth observed in oil meals (-12.98 %), raw cotton (-11.40 %) and cashew (-1.47 %).
- Pulses import declined over the years of study period showed positive sign toward strengthening of agricultural trade. As in pulses trade position of India shifted from net importer to net exporter. As well as pulses export also presented the comparative advantage for the country.
- The percentage share of marine products, basmati rice, buffalo meat, non-basmati rice and spices export in total agricultural export were remained in favour of agricultural trade. On the other hand, raw cotton, oil meals, castor oil, coffee and cashew export percentage share were unfavourable for agricultural trade. During the same period of study import percentage share has remained unfavourable in case of fresh fruit, cashew,

spices, alcoholic beverages and miscellaneous processed items. The favourable situation for trade was created by pulses, vegetable oil and sugar declined import.

- Direction wise analysis of export import of various agricultural commodities showed that USA, UK, UAE, Vietnam, Japan, Nepal, Bangladesh, Saudi Arab, Myanmar and Canada were major destinations for agricultural trade of India.
- India has comparative advantage in case of cereals, pulses, tea, coffee, cashew, cotton lint, bovine meat, sugar and honey. RCA value less than one showed comparative disadvantage in export of oilseeds, fruits, vegetable and alcoholic beverages. Thus, India has enormous potential in export of cereals, pulses, tea, coffee, cashew, cotton lint, bovine meat, sugar and honey.

Conclusion

It was concluded that total agricultural trade increased throughout the period of investigation *i.e.,* 2010-11 to 2019-20. It has increased from US$ 19.97 to 29.30 billion for export and US$ 10.66 to 21.69 billion for import. The growth has increased more in agricultural import (CAGR 6.40 %) but stability of agricultural export growth was more than agricultural import. Major exported agricultural commodities showed positive growth except oil meals, raw cotton and cashew whereas in case of imported commodities declined growth showed by pulses import. Cereals, pulses, tea, coffee, cashew, cotton and bovine meat export from India showed enormous potential for export competitiveness in foreign trade.

i	**Experiment no. 8: Expenditure pattern and inequality in consumption of fruits in India**	
ii	**Objectives of the experiment**	• To study the consumption expenditure pattern of fruits across different income groups in different regions of India including Haryana • To assess the inequality in consumption of fruits across different income groups in India • To identify the factors influencing consumption pattern of fruits among different income groups
iii	**Name(s) of the investigators**	• Dr. Janailin S. Papang Collection, extraction, compilation, processing, analysis of data, report writing • Dr. D. P Malik Monitoring and finalization of report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Nil
v	**Year of start**	**2020-21**
vi	**Duration of study**	One year
vii	**Treatment details**	• **Locale of experiment:** All India • **Data :** NSSO data (55th round and 68th round) • **Statistical design/methods:** Descriptive statistics and Gini concentration ratio were used.

viii	**Observations recorded**	• From the data, the observations for different states were extracted separately for analysing consumption expenditure on fruits in both rural and urban areas of all the states/regions. • The data were first divided into four income groups each in rural and urban areas. • For consumption of major fruits, analyses were performed at regional level. • Gini-Concentration ratio was used to calculate inequality for food expenditure and total expenditure on fruits among different income groups.

ix. Results achieved during 2020-21:

The state wise consumption expenditure pattern of fruits across different income groups in India for the 68th round (2011-12) is presented in Table 1. Among all the states Goa and Kerala has the highest monthly per capita expenditure (MPCE) across all income groups in both rural and urban sectors which was then followed by Tamilnadu, Haryana and Karnataka. The MPCE in rural areas for Goa and Kerala were around ₹95 and ₹48.74 per person per month for low income group (LIG) respectively, for lower middle income group (LMIG) it was ₹110 for Goa and ₹72.70 for Kerala, whereas for upper middle income group (UMIG) it was ₹125 and ₹100.74 for Goa and Kerala respectively. In the high income group (HIG) Goa register an expenditure of ₹179 which is much higher than the second highest state Kerala which is only ₹141 per person per month. In the urban areas, a similar pattern was observed in Goa and Kerala with Goa recorded the highest MPCE in the first 3 income groups (₹63, ₹115, and ₹141.53 in LIG, LMIG and UMIG respectively) and Kerala (₹193) highest MPCE in HIG.

Table 1: MPCE on fruits across the income groups in different states (At 2011-12 Prices) (in Rs.)

States	Rural					Urban				
	LIG	LMIG	UMIG	HIG	Overall	LIG	LMIG	UMIG	HIG	Overall
JK	13.13	19.02	26.59	45.55	25.63	17.69	25.84	39.64	70.49	39.83
HP	15.28	21.89	32.21	49.54	27.90	20.10	40.40	61.69	101.35	52.51
UK	13.63	18.74	23.89	53.24	25.66	18.56	34.32	56.55	140.47	52.97
Punjab	15.67	24.18	40.28	51.46	30.65	15.85	31.32	49.52	82.79	43.78
Haryana	19.48	33.94	44.79	61.63	40.14	25.12	47.40	70.87	149.45	70.22
Delhi	13.42	34.65	29.24	31.85	27.03	20.09	28.93	61.30	104.00	45.29
UP	7.79	11.89	17.31	34.14	16.54	9.14	17.44	27.89	83.50	32.92
WB	10.45	17.36	28.60	51.41	24.65	13.50	29.95	47.68	103.03	45.08
Bihar	7.36	12.65	17.20	34.88	15.76	8.95	16.54	27.57	55.09	26.96
JH	7.96	10.63	15.91	30.95	15.71	12.59	24.62	36.21	67.26	36.62
Odisha	8.13	11.56	15.34	30.78	14.96	9.78	19.99	32.72	58.78	30.09
CG	6.45	9.75	14.66	31.43	12.37	9.55	19.36	26.84	83.86	29.28
Gujarat	12.37	18.22	25.08	43.69	22.02	17.47	32.43	48.93	84.29	42.84

MH	13.35	21.19	30.09	40.34	23.77	20.09	39.63	68.14	120.26	56.40
MP	6.38	10.52	15.93	28.75	14.29	9.45	18.34	26.10	63.54	28.24
RJ	10.94	15.04	26.49	40.05	21.96	17.08	24.70	48.51	87.97	40.16
AP	15.16	25.91	32.17	55.41	29.31	20.73	31.99	50.14	89.57	45.42
Goa	95.39	109.92	125.07	178.79	120.95	62.65	114.67	141.53	163.65	117.41
KA	17.52	28.74	38.44	69.82	33.14	16.97	35.74	59.84	111.01	58.08
Kerala	48.74	72.70	100.74	140.91	80.70	54.50	83.20	119.13	193.44	102.01
TN	20.00	30.21	40.53	63.83	34.17	25.71	40.69	57.50	93.94	52.56
ARP	12.08	22.73	33.03	54.41	28.00	12.31	31.42	52.25	73.61	39.70
Assam	8.18	13.31	20.44	41.55	18.07	9.30	21.40	42.21	102.82	43.81
Manipur	7.78	12.23	16.81	26.38	14.56	6.95	13.68	17.54	37.07	18.42
ML	12.29	16.28	18.84	28.76	16.93	17.69	27.66	52.01	81.39	44.95
Mizoram	11.07	16.28	20.62	29.10	16.17	12.17	18.09	29.59	40.01	25.58
Nagaland	16.84	25.13	31.11	54.03	26.07	13.53	27.44	42.18	89.45	46.02
Sikkim	11.86	20.64	22.17	42.71	22.30	14.67	26.35	36.69	48.88	34.93
Tripura	11.03	12.86	17.75	37.75	16.94	7.97	16.07	33.53	57.98	29.76
All-India	13.31	19.69	27.44	46.54	24.46	18.68	32.40	51.40	97.31	47.26

Note: UK= Uttarakhand, CG= Chattisgarh, MH= Maharastra, RJ= Rajasthan, TN= Tamil Nadu, KA= Karnataka, JH= Jharkhand, ML= Meghalaya

Apart from these two states, it was found that only Karnataka and Haryana have MPCE closer to Kerala. On the other hand, states like Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Jharkhand, Bihar and Manipur has low MPCE which is below the national average across all income groups. The result showed that Chhattisgarh having lowest in case of rural areas with MPCE of ₹6.45, ₹9.75, ₹14.66, and ₹31.43 for LIG, LMIG, UMIG and HIG and Manipur having lowest MPCE in urban areas with ₹6.95, ₹13.68, ₹17.54, and ₹37 for LIG, LMIG, UMIG and HIG, respectively. In the northern region and north hills region of India, Haryana has the highest per capita expenditure pattern on fruits in both rural and urban sectors. Haryana recorded a rural MPCE of ₹19, ₹34, ₹45, and ₹62 and urban MPCE of ₹25, ₹47, ₹71, and ₹149 for LIG, LMIG, UMIG and HIG respectively.

Different states were aggregated into 6 regions containing the respective states as follows:

(i) Hills: Jammu & Kashmir, Himachal Pradesh, and Uttarakhand
(ii) North: Punjab, Chandigarh, Haryana, Delhi, and Uttar Pradesh
(iii) East: West Bengal, Bihar, Odisha, Jharkhand, and Chhattisgarh
(iv) West: Rajasthan, Gujarat, Maharashtra, -Madhya Pradesh, Goa, Daman & Diu, and D & N Haveli
(v) South: Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Lakshadweep, Pudducherry, and Andaman & Nicobar Islands
(vi) North-East (NE): Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, and Assam

The region with the highest MPCE on fruits was the southern region with average MPCE of ₹14 to ₹15 overall income group in both rural and urban areas. Comparing with the other regions in the country,

it was seen that all the other regions have low average MPCE on fruits which was below the national average of ₹4 to ₹5 per person per month (Table 2).

Table 2: MPCE on fruits across income groups in different regions (At 2011-12 Prices) (in Rs.)

	Rural					Urban				
Region	LIG	LMIG	UMIG	HIG	Overall	LIG	LMIG	UMIG	HIG	Overall
Hills	14.00	19.73	27.23	49.19	26.29	18.39	32.21	50.01	98.59	47.27
North	9.78	15.34	22.40	39.27	20.51	14.53	25.22	41.33	95.08	41.10
East	8.17	13.28	19.86	38.37	17.69	11.73	25.00	38.52	82.09	37.44
West	11.62	16.60	24.96	38.43	20.98	17.94	32.87	55.08	98.30	47.20
South	22.47	35.60	46.96	73.06	39.65	26.01	41.63	61.50	106.32	56.83
NE	9.20	13.94	20.32	40.02	18.03	10.88	21.28	39.57	81.49	38.69
All-India	13.32	19.68	27.39	46.52	24.41	18.68	32.45	51.42	97.51	47.25

The compound annual growth rate (CAGR) of MPCE on fruits for different states in India is shown in Table 3. The base year for the growth rate is the year 1999-2000 (NSSO 55th round data). A perusal of the table showed that in both rural and urban sectors of Delhi, Jammu and Kashmir as well as all the North Eastern states showed a rapidly decreasing expenditure on fruits across all income groups. In case of Goa, Himachal Pradesh, Uttar Pradesh and Punjab the decreasing trend of MPCE was observed only in the urban sector. Among all the states, Andhra Pradesh has the highest growth rate across all income groups with 6-7 per cent growth rate in rural area and 4-5 per cent in urban area. The other states with increasing growth rate were Uttrakhand, Maharashtra, Haryana, Rajasthan, Tamil nadu. It was surprising to see that Chhattisgarh which has the lowest MPCE on fruits during 2011-12 has a rapidly increasing growth rate when compared to the year 1999-2000. Comparatively, rural sector of India has a higher growth rate in fruit expenditure than that of urban sectors across all income groups in almost all the states.

The results from region wise MPCE on major fruits showed that in banana, watermelon, guava, orange, papaya, mango, muskmelon, apple and grapes the high income group (HIG) has the highest MPCE and the low income group (LIG) and lower middle income group (LMIG) has the lowest MPCE with the exception of coconut and green coconut in all the regions of India. The average amount spend per person per month in rural areas was highest in case of banana (₹5-6) followed by coconut, apple and mango which was around ₹3-5 per person per month. The average expenditure on other fruits like watermelon, muskmelon, guava, green coconut, orange, papaya and grapes was only around ₹1 per person per month in rural India. In the urban areas, the monthly per person expenditure on fruits was similar to that of rural areas but with a slightly higher average expenditure. Among all the different types of fruits, the Indian household spent the highest amount on apple (₹12 all India average), then followed by banana. It was also observed that in urban areas the range was also very high in case of apple with LIG on an average spending only ₹2 per person and HIG spending ₹32 per person per month. In the rural areas, the average for LIG is around ₹1 per person and the HIG spend around ₹9 per person per month. On the other hand, in case of banana there was not much difference across the income groups of both

rural and urban areas, with LIG spending on an average ₹3 and ₹5 per person in rural and urban areas respectively and the average expenditure of the HIG was around ₹10 in rural and ₹17 per person per month in urban areas.

In order to assess the inequality in consumption of fruits across different income groups in India we examined the Gini coefficient produced by the Gini concentration ratio. The inequality in MPCE during 2011-12 is shown in table 4 (state-wise) and table 5 (region-wise). The results showed that in both rural and urban sectors, the states with the highest MPCE i.e., Goa and Kerala have the lowest inequality in consumption of fruits. The Gini co-efficient for Goa were 0.25, 0.24, 0.17, 0.29 for LIG, LMIG, UMIG and HIG in rural area, and 0.22, 0.20, 0.26, 0.24 for LIG, LMIG, UMIG and HIG in urban area. Goa is then followed by Kerala, Meghalaya, Karnataka, Tamil Nadu, Andhra Pradesh and Delhi which have low inequality across all income groups compared to others in both the rural and urban areas. The state where high inequality was observed in Jharkhand, Bihar, UP, WB, Rajasthan and NE states except Meghalaya. In both rural and urban Haryana there is low inequality in fruit expenditure in almost all the income groups which ranges from 0.35-0.47. except for the LIG which showed a gini ration value of 0.60.

Table 3: CAGR of MPCE on fruits across the income groups in different states (At 2011-12 Prices) (in Rs.)

	Rural					Urban				
States	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**
JK	-1.35	-2.24	-1.56	-1.26	-1.25	-4.43	-4.53	-3.83	-2.49	-2.87
HP	1.41	0.86	1.95	0.62	0.61	-2.61	-1.31	-0.78	-1.03	-0.93
UK	6.48	5.29	3.05	4.13	3.97	3.30	2.80	2.08	4.08	3.35
Punjab	2.86	1.03	1.88	-0.09	0.45	-0.90	-0.32	-0.20	-2.76	-0.94
Haryana	4.04	5.28	3.96	2.39	3.80	2.79	3.39	3.62	2.85	3.88
Delhi	-6.19	-1.26	-5.85	-8.47	-4.27	-3.88	-5.22	-3.12	-3.78	-5.05
UP	0.51	0.75	0.87	0.21	0.28	-2.48	-0.67	-1.65	-0.30	-0.40
WB	2.92	2.74	3.77	2.77	2.28	0.93	1.58	0.22	1.22	0.73
Bihar	1.23	3.42	2.10	2.82	1.40	-1.80	1.42	0.88	-0.61	0.89
JH	0.32	1.14	2.75	2.97	1.79	5.71	2.82	0.38	-2.08	0.07
Odisha	3.20	3.74	2.73	2.67	1.96	1.39	1.66	0.86	-0.66	1.68
CG	3.42	3.29	4.53	5.04	3.06	-0.10	1.34	-1.01	2.19	0.39
Gujarat	1.48	1.55	2.10	0.44	0.74	0.22	1.73	0.57	-1.19	-0.18
MH	5.40	4.28	4.27	1.81	2.92	3.43	2.02	2.12	-0.04	1.56
MP	0.82	2.13	2.87	2.40	2.05	0.58	0.81	-0.60	-0.20	0.72
RJ	3.38	2.85	4.66	3.39	3.75	2.58	1.58	2.36	0.88	1.42
Goa	3.09	1.55	0.89	0.97	1.95	-1.89	-0.20	-1.41	-2.44	-0.89
AP	6.76	7.96	6.91	6.70	6.97	5.47	4.89	4.92	3.90	4.87
KA	3.58	2.40	1.55	2.22	2.00	-1.91	-0.20	1.25	3.08	2.35
Kerala	1.79	1.21	0.78	0.66	0.79	1.08	0.62	0.55	1.44	1.17
TN	4.23	3.60	2.99	3.08	3.09	1.82	2.21	1.05	0.94	1.65

ARP	-2.20	0.00	0.04	-2.54	-2.31	-7.16	-0.21	0.56	-2.44	-1.33
Assam	2.16	3.22	3.76	5.29	3.26	-3.11	0.30	0.82	1.10	1.68
Manipur	-1.79	0.97	2.93	3.18	0.99	-2.06	-0.70	0.18	1.92	0.19
ML	-1.06	-1.46	-2.11	-1.89	-2.12	-2.66	-0.58	1.54	2.75	1.76
Mizoram	-2.73	-1.24	-1.29	-0.25	-2.62	-2.71	-2.67	-0.88	-0.95	-1.08
Nagaland	-0.75	-2.38	-5.29	-3.53	-4.88	-3.79	-2.42	-4.55	-3.50	-1.96
Sikkim	-0.15	4.14	2.12	2.11	0.51	-1.30	-1.31	-3.23	-4.21	-1.28
Tripura	1.44	-2.17	-1.02	2.41	-0.90	-4.21	-5.72	-3.35	-4.87	-3.01
All-India	2.26	2.08	2.06	2.01	1.73	0.83	1.07	0.87	0.23	0.92

Note: UK= Uttarakhand, CG= Chattisgarh, MH= Maharastra, RJ= Rajasthan, TN= Tamil Nadu, KA= Karnataka, JH= Jharkhand, ML= Meghalaya

Table 4: Gini coefficient of fruit MPCE across household groups in different states

States	Rural					Urban				
	LIG	LMIG	UMIG	HIG	Overall	LIG	LMIG	UMIG	HIG	Overall
JK	0.55	0.46	0.38	0.40	0.51	0.53	0.37	0.38	0.35	0.49
HP	0.58	0.41	0.42	0.42	0.53	0.49	0.35	0.29	0.33	0.43
UK	0.59	0.50	0.48	0.41	0.58	0.54	0.38	0.40	0.42	0.59
Punjab	0.54	0.46	0.47	0.41	0.53	0.56	0.49	0.45	0.45	0.56
Haryana	0.60	0.44	0.39	0.42	0.50	0.53	0.38	0.39	0.38	0.53
Delhi	0.44	0.28	0.55	0.50	0.51	0.47	0.35	0.45	0.39	0.53
UP	0.68	0.59	0.56	0.57	0.67	0.58	0.53	0.46	0.48	0.64
WB	0.72	0.64	0.57	0.51	0.69	0.61	0.52	0.47	0.49	0.61
Bihar	0.71	0.67	0.59	0.59	0.70	0.73	0.63	0.60	0.63	0.70
JH	0.81	0.76	0.67	0.60	0.77	0.78	0.57	0.49	0.40	0.59
Odisha	0.66	0.53	0.47	0.52	0.61	0.63	0.46	0.49	0.49	0.58
CG	0.57	0.49	0.43	0.44	0.59	0.56	0.52	0.44	0.49	0.63
Gujarat	0.56	0.49	0.48	0.42	0.56	0.51	0.42	0.43	0.53	0.54
MH	0.52	0.44	0.42	0.41	0.51	0.46	0.41	0.40	0.42	0.52
MP	0.62	0.47	0.46	0.48	0.59	0.54	0.44	0.42	0.44	0.58
RJ	0.62	0.53	0.55	0.56	0.63	0.58	0.47	0.49	0.47	0.59
Goa	0.25	0.24	0.17	0.29	0.28	0.22	0.20	0.26	0.24	0.29
AP	0.47	0.43	0.43	0.50	0.52	0.47	0.42	0.43	0.43	0.51
KA	0.37	0.33	0.37	0.37	0.45	0.41	0.36	0.32	0.37	0.48
Kerala	0.30	0.27	0.29	0.37	0.37	0.30	0.29	0.36	0.41	0.42
TN	0.42	0.39	0.40	0.36	0.45	0.37	0.36	0.35	0.38	0.44
ARP	0.64	0.67	0.56	0.53	0.67	0.70	0.58	0.50	0.45	0.64
Assam	0.63	0.55	0.49	0.51	0.63	0.70	0.51	0.43	0.46	0.62
Manipur	0.59	0.57	0.58	0.52	0.63	0.62	0.61	0.56	0.54	0.65

ML	0.35	0.35	0.38	0.35	0.40	0.41	0.41	0.34	0.36	0.46
Mizoram	0.57	0.49	0.41	0.51	0.55	0.55	0.50	0.49	0.38	0.53
Nagaland	0.56	0.43	0.52	0.43	0.55	0.60	0.47	0.33	0.33	0.54
Sikkim	0.78	0.57	0.66	0.51	0.71	0.47	0.46	0.42	0.40	0.48
Tripura	0.55	0.45	0.50	0.55	0.58	0.54	0.53	0.41	0.49	0.58
All-India	0.65	0.58	0.55	0.52	0.62	0.55	0.47	0.46	0.46	0.56

The region-wise analysis showed that the Southern region have the least inequality with Gini ration ranges 0.43-0.47 followed by the Hill states of north India with ranges of 0.42-0.58 across all income groups. The Eastern and NE region show very high inequality in term of fruit consumption expenditure especially in LIG with Gini value of 0.71 in rural and 0.65 in urban areas of eastern region. Across the income groups, it was observed that as we move from LIG to HIG the inequality seem to decrease in almost all the states and regions.

Table 5: Gini coefficient of fruit MPCE across household groups in different regions

Region	**Rural**					**Urban**				
	LIG	**LMIG**	**UMIG**	**HIG**	**Overall**	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**
Hills	0.58	0.46	0.44	0.42	0.54	0.53	0.39	0.39	0.41	0.53
North	0.68	0.60	0.57	0.54	0.65	0.58	0.51	0.49	0.46	0.60
East	0.71	0.64	0.58	0.55	0.69	0.65	0.54	0.51	0.52	0.63
West	0.60	0.52	0.50	0.48	0.58	0.52	0.45	0.45	0.47	0.55
South	0.47	0.43	0.45	0.46	0.51	0.44	0.40	0.40	0.41	0.48
NE	0.61	0.54	0.49	0.51	0.61	0.65	0.53	0.45	0.47	0.61
All-India	0.65	0.58	0.55	0.52	0.62	0.55	0.47	0.46	0.46	0.56

Studying the changes in inequality (table 6) , the findings showed that during 2011-12 the inequality has reduced to a very high extent in almost all income groups of the rural areas in the states like J&K, HP, Punjab, Uttrakhand, Gujarat, Rajasthan, Maharashtra, MP, Andhra Pradesh, Karnataka, Meghalaya, Assam, and Arunachal Pradesh. On the other hand the states like Goa, Kerala, Nagaland, Manipur, Mizoram, Tripura and Delhi the inequality has not reduced in rural areas. In urban areas the reduction in inequality is more in states like Goa, Haryana, Maharashtra, Meghalaya, Sikkim, Arunachal Pradesh and some eastern states like Chhattisgarh, Jharkhand, and WB.

The various factors influencing consumption pattern of fruits in India is presented in table 7 and table 8. The income and price elasticities of demand are given in table 7. Since the income elasticities for all major fruits is elastic in nature (all values positive and above 1), it shows that fruits are somewhat luxury items in the household food basket. Thus, it indicates that as income of households increases the proportions of income spend on fruits will increase. Thus as income rises there will be more demand for fruits. All own-price elasticities display appropriate negative signs for all fruits in India indicating the negative relationship between prices of a normal commodity and its demand. The results of cross-price elasticity showed that banana, coconut, guava, apple and grapes were somewhat complimentary to each

other and also to other fruits. In contrary, watermelon, green coconut, orange, papaya, mango, muskmelon were somewhat substitutes of other fruits which indicates that when prices of any of these fruits changes there will be an increase in demand of the other fruits.

The other factors that influenced the consumption of fruits in India were captured through a regression analysis of the variables like expenditure on fruits, size of household, age of household head, number of children, gender of household head, literacy, and caste of household (table 8).

Table 6: CAGR in Gini coefficient of fruit MPCE across households groups in different states

	Rural					Urban				
States	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**
JK	-1.70	-1.53	-3.56	-2.62	-1.91	0.23	-1.15	0.91	0.53	0.52
HP	-2.26	-4.16	-3.47	-3.09	-2.54	-1.96	0.90	-3.07	-2.60	-1.47
Punjab	-2.63	-2.96	-1.59	-1.88	-2.06	-1.23	-0.84	-1.23	-0.95	-1.26
UK	-1.23	-1.71	-0.79	-2.32	-1.15	1.35	-0.51	-0.80	1.63	0.09
Haryana	0.49	-2.48	-2.43	-1.34	-1.62	-0.01	-1.86	-0.78	-2.57	-0.97
Delhi	-0.03	-2.15	1.73	3.10	0.39	-0.11	-0.31	3.84	-0.51	0.59
RJ	-1.48	-1.78	-1.49	-1.43	-1.22	-0.72	-0.84	0.40	-0.92	-0.84
UP	-0.50	-1.01	-0.37	-0.59	-0.48	-0.71	0.30	-0.93	-0.07	-0.06
Bihar	-1.19	-1.21	-1.67	-1.09	-1.01	0.49	-0.34	0.48	0.43	-0.10
Sikkim	-1.02	-3.23	-1.00	-1.36	-1.06	-3.43	-2.57	-2.35	-1.56	-2.73
ARP	-2.07	-0.94	-1.99	-3.01	-1.53	-0.36	-0.33	-1.63	-0.29	-0.30
Nagaland	-1.72	-1.56	1.48	1.31	-0.32	0.95	0.62	-3.42	-2.81	-0.86
Manipur	-1.41	0.06	3.05	2.30	1.25	0.99	2.55	2.05	2.86	1.80
Mizoram	-1.06	-0.33	-0.69	1.17	0.30	-0.56	0.33	1.73	-0.94	0.47
Tripura	-1.98	-1.10	0.30	1.69	0.10	1.39	3.66	0.95	3.10	0.72
ML	-1.66	-2.23	-2.13	-4.29	-2.36	-3.77	-4.28	-3.54	-3.95	-2.87
Assam	-1.27	-1.47	-1.62	-1.11	-0.71	0.78	-1.62	-2.07	-1.96	-1.02
WB	-1.35	-1.57	-1.85	-2.20	-1.23	-1.33	-1.55	-1.31	0.25	-0.89
JH	-0.38	-0.53	-1.48	-1.20	-0.44	-0.63	-1.58	-1.81	-1.44	-2.03
Orissa	-1.24	-2.18	-2.35	-1.25	-1.53	-0.51	-0.86	0.58	0.04	-0.92
CG	-1.73	-2.86	-3.02	-2.29	-1.47	-2.29	-0.63	-0.46	0.58	-0.22
MP	-0.99	-1.37	-1.66	-1.15	-0.85	0.13	-0.61	-0.89	-1.01	-0.73
Gujarat	-2.15	-1.59	-1.42	-3.12	-1.63	-0.45	-0.70	0.03	1.37	-0.77
MH	-0.99	-1.32	-0.87	-0.92	-1.10	-0.85	-0.61	-0.57	-1.16	-1.05
AP	-1.57	-1.96	-1.47	-0.47	-1.34	-1.15	-1.13	0.65	-0.44	-0.98
KA	-1.71	-1.35	-0.33	-0.66	-0.81	-1.17	-0.11	-0.46	0.42	0.50
Goa	0.72	0.31	-2.18	-3.38	-2.18	-2.67	-1.65	-0.42	-2.37	-1.54
Kerala	-0.15	0.14	1.92	1.12	0.30	0.33	1.37	1.78	0.23	0.67

TN	-1.21	-0.33	0.01	-0.71	-0.70	-0.95	0.39	-0.24	-0.55	-0.50
All-India	-0.94	-1.14	-1.18	-1.14	-0.91	-0.82	-0.77	-0.39	-0.44	-0.69

These variables were regressed on the weighted budget share of each fruit to find out the effect of these demographic variables on the consumption pattern of fruits in India. The result showed that as the income increases there will be increased consumption of various fruits. As the household size increases, the consumption of banana, green coconut, orange, papaya, apple and grapes decreases. As the age of the household head increase there will be more affinity towards consumption of fruits. Also, literacy of the household head is one factor that is significant in almost all major fruits which indicates that there will be more expenditure on fruits as literacy improves. Household that belongs to general or OBC category were seen to consume more fruits as compared to SC/ST category. It is interesting to note that female headed family tends to increase their consumption of fruits like banana, coconut, orange, mango, apple and grapes.

Table 7: Income and price elasticities of fruit

	Banana	**WM**	**Coconut**	**GC**	**Guava**	**Orang**	**Papaya**	**Mango**	**MM**	**Apple**	**Grape**
Income elasticity											
	1.786	20.662	2.255	5.442	5.698	5.748	15.225	5.602	19.128	3.199	5.165
Price elasticity											
Banana	-0.013	0.009	-0.004	0.001	0.005	0.005	0.015	0.001	0.001	0.000	0.004
WM	-0.466	-0.020	-0.297	-0.023	-0.127	-0.098	-0.014	-0.014	0.023	-0.128	-0.135
Coconut	-0.007	0.005	-0.008	0.000	0.002	0.002	0.008	0.000	0.001	0.000	0.000
GC	-0.130	0.069	-0.081	-0.056	-0.004	0.002	0.099	0.008	0.030	-0.022	-0.013
Guava	-0.046	0.017	-0.026	-0.001	-0.016	0.002	0.024	-0.003	0.006	-0.011	-0.002
Orange	-0.049	0.023	-0.029	0.001	0.005	-0.014	0.027	0.002	0.007	-0.010	-0.001
Papaya	-0.104	0.011	-0.066	-0.001	-0.022	-0.020	-0.019	0.001	0.012	-0.031	-0.027
Mango	-0.522	0.274	-0.307	0.018	-0.068	0.013	0.379	-0.215	0.072	-0.091	0.006
MM	-7.687	0.692	-4.311	-0.021	-1.628	-1.372	1.381	-0.425	-1.048	-1.807	-1.757
Apple	-0.078	0.040	-0.025	0.004	-0.002	0.012	0.043	0.003	0.008	-0.078	0.017
Grape	-0.039	0.015	-0.031	-0.001	0.002	0.002	0.020	0.003	0.005	-0.006	-0.022

Note: WM = watermelon, GC= green coconut, MM= Musk melon/Kharbooza

Table 8: Factors influencing consumption pattern of fruits

Variables	Mango	Guava	Papaya	WM	MM	Banana	Coconut	GC	Orang	Apple	Grape
Ln MPCE	1.716***	3.763***	7.705***	5.836***	1.856***	1.670***	1.505***	1.377***	2.854***	1.102***	2.748***
Ln hh size	0.152***	1.511***	-0.009	0.824***	0.597***	-0.385***	0.206*	-0.521***	-0.781***	-0.339***	-0.609***
Age	0.002***	-0.029***	0.033***	-0.026***	-0.019***	0.008***	0.025**	0.001	0.007***	0.004***	0.0002
Children no.	-0.272***	0.166***	-0.379***	-0.010	0.340***	-0.041**	-0.402**	-0.258***	-0.067***	-0.024***	-0.156***
Gender	0.187***	-0.374**	-0.757***	-0.461***	-0.602***	0.173***	0.571**	-0.078**	0.671***	0.055***	0.354***
Literate	0.353***	-0.153*	2.615***	0.427***	-0.431***	0.312***	0.624***	0.052**	0.534***	0.235***	0.385***
Caste	0.071***	0.632***	-0.720***	1.054***	-0.180***	0.107***	0.296***	0.234**	0.129***	0.064***	0.405***
Constant	-25.91***	-58.44***	-105.6***	-98.67***	-37.84***	-12.73***	-18.06***	-16.30***	-30.78***	-9.793***	-31.87***
R^2	0.476	0.352	0.314	0.392	0.455	0.49	0.457	0.335	0.391	0.412	0.422
Obs. (hh)	101589	101589	101589	101589	101589	101589	101589	101589	101589	101589	101589

*Note: Dependent variable= weighted budget share of fruit, MPCE= monthly per capita expenditure (proxy for income), hh = household, Obs. (hh) = observations, *** = significant at 1%, **= significant at 5% and *= significant at 10%*

Table 9: State-wise household income group based on total MPCE **(Value in Rupees)**

	Rural				Urban			
States	**LIG**	**LMIG**	**UMIG**	**HIG**	**LIG**	**LMIG**	**UMIG**	**HIG**
JK	323–1113	1113–1462	1463–1995	1996–23528	368–1355	1358–1882	1883–2874	2881–12218
HP	556–1212	1213–1646	1648–2334	2339–203091	544–1705	1706–2729	2737–3977	3980–612089
UK	543–1055	1055–1403	1404–1904	1907–13266	538–1402	1410–2196	2197–3304	3308–50521
Punjab	485–1399	1402–1900	1904–2762	2764–39922	561–1462	1463–2258	2261–3390	3396–119069
Haryana	390–1294	1295–1741	1743–2381	2381–167462	484–1572	1573–2554	2560–3981	3981–34068

Delhi	701–1491	1571–2101	2139–3096	3135–6163.25	568–1687	1687–2817	2817–4327	4331–31526
UP	92–744	745–980	980–1385	1386–34518	329–893	893–1365	1366–2232	2233–53455
WB	171–858	859–1145	1145–1628	1629–15660	352–1165	1166–1980	1981–3301	3314–47325
Bihar	252–792	793–1039	1039–1421	1422–12820	370–853	854–1278	1279–1914	1924–26472
JH	272–691	691–912	912–1219	1219–11041	296–923	926–1549	1553–2644	2644–17794
Odisha	148–650	650–874	874–1229	1230–16875	328–870	870–1445	1449–2465	2470–19117
CG	224 –672	672–919	920–1381	1383–22058	166–918	918–1483	1484–2407	2417–25492
MP	196–741	741–1003	1004–1417	1417–36114	342–961	962–1421	1422–2310	2319–44424
Gujarat	40–1051	1051–1390	1391–1921	1924–58235	447–1446	1447–2198	2200–3264	3266–41307
MH	211–1037	1038–1372	1372–1871	1871–52361	348–1489	1490–2210	2211–3528	3529–71299
RJ	303–1037	1038–1386	1386–1848	1848–68911	370–1292	1292–1954	1954–3013	3018–79528
Goa	735–1749	1753–2369	2390–3475	3487–10055	518–1900	1938–2703	2707–3510	3512–30717
AP	231–1076	1076–1413	1413–1975	1976–30521	53–1306	1306–2085	2088–3312	3314–69068
KA	409–961	961–1264	1265–1692	1694–206427	309–1213	1221–1812	1817–3117	3118–65752
Kerala	363–1362	1362–1969	1970–2955	2970–413310	50–1440	1441–2367	2369–3947	3950–301386
TN	275–1052	1052–1417	1417–1999	2000–46301	247–1287	1288–2017	2019–3015	3017–101834
ARP	40–935	937–1466	1467–2419	2421–15285	296–1360	1360–2259	2263–3356	3359–16871
Assam	320–816	816–1065	1066–1463	1464–9783	392–1021	1023–1640	1640–2770	2797–10948
Manipur	546–1000	1000–1253	1254–1610	1610–7422	491–1037	1038–1328	1329–1666	1670–6750
ML	520–1059	1063–1329	1329–1695	1698–28759	707–1412	1417–2054	2058–2747	2760–9626
Mizoram	452–1119	1121–1501	1501–2044	2062–8660	597–1500	1502–2116	2122–2841	2842–9616
Nagaland	684–1539	1542–1974	1979–2466	2469–10017	773–1531	1533–2218	2240–3056	3071–9179
Sikkim	581–1176	1177–1511	1513–2055	2058–8161	792–1576	1589–2005	2035–2631	2637–6896
Tripura	363–870	870–1140	1142–1560	1560–5978	462–1019	1019–1567	1577–2616	2633–8141

Note: UK= Uttarakhand, CG= Chattisgarh, MH= Maharastra, RJ= Rajasthan, TN= Tamil Nadu, KA= Karnataka, JH= Jharkhand, ML= Meghalaya

In rural sector, highest MPCE class for all the income groups were observed for Delhi and Goa among all the states while Jharkhand, Odisha, and Chhattisgarh were observed to have lowest MPCE intervals across the income groups. Similarly, in urban sector, Delhi and Goa have highest MPCE intervals in LMIG and UMIG while in HIG Delhi, Kerala, and Himachal Pradesh are the states with highest MPCE intervals. In LIG of urban sector, the highest MPCE intervals were observed for NE states of Sikkim and Nagaland. Again, in urban sector, Jharkhand, Odisha, and Chhattisgarh were observed to have lowest MPCE intervals across the income groups(Table 9).

x. Programme of work for 2021-22: Experiment to be continued for session 2021-22.

Salient findings:

- The monthly per capita expenditure (MPCE) on fruits was more in the southern region with an overall average of ₹40 and ₹57 per person per month in rural and urban areas, respectively. The regions with the least MPCE are the eastern and north eastern regions with around ₹18 per person in rural areas and ₹38-39 in the urban areas of both regions.
- State wise monthly expenditure it was observed that Goa has the highest MPCE with overall average of ₹81 in rural and ₹117 in urban area followed by Kerala and Haryana with overall average of ₹121 and ₹102 in rural and urban area Kerala and ₹40 in rural and ₹70 per person in urban Haryana.
- It was observed that, Haryana is the only state in northern region that has a high MPCE on fruits which is around ₹10-₹15 higher than the MPCE of any northern states.
- Andhra Pradesh has the highest growth rate of MPCE across all income groups overall compound annual growth rate (CAGR) of 6.97 and 4.87 per cent in rural and urban areas, respectively. It is followed by Uttarakhand (3.97% and 3.35% in rural and urban), and Haryana (3.80% and 3.88% in rural and urban). The state where there lowest growth rate is Delhi (-4.27% and -5.05% in rural and urban areas respectively).
- The inequality on fruit expenditure showed that states with high MPCE i.e., Goa and Kerala have low inequality with Goa gini coefficient of 0.28 in rural and 0.29 in urban, and Kerala gini coefficient of 0.37 in rural and 0.42 in urban. The states where highest inequality in expenditure on fruits was in Bihar (0.70 gini coefficient in both urban and rural areas) and Jharkhand (0.77 and 0.59 gini coefficient in rural and urban area respectively)
- The factors like income, own price and price of other fruits affect the proportion of income given to each fruit. The demographic factors that increase the expenditure on fruits are literacy which has a positive and significant effect on banana, watermelon, coconut, green coconut, orange, papaya, mango, apple and grape. The other demographic factors that has a positive effect on most fruits were age, caste and gender of household. On the other hand, it was observed that as th household size and number of children per household increases then the share of fruits/ the proportion of income dedicated to fruit expenditure in the total food basket decrease except for guava, watermelon and musk melon.

Conclusions:

The findings showed that fruits are high value products; the inequality overtime has decreased especially in the northern and eastern states. This is shown by the negative value of CAGR in Gini co-efficient with an overall value of -2.54, -2.06, -1.91, -1.62 and -1.15 in rural Himachal Pradesh, Punjab, Jammu and Kashmir, Haryana and Uttarakhand, respectively. In the urban area, the decrease in inequality on consumption of fruits was more prominent in the states of Himachal Pradesh, Punjab and Haryana with values of -1.47, -1.26 and -0.97 CAGR of Gini coefficients for the respective states. In the eastern region, the inequality has also reduced over time with -1.53, -1.47, -1.23 and -0.44 value of CAGR of Gini coefficient in rural areas and -0.92, -0.22, -2.03 and -0.89 in urban areas of Orissa, Chhattisgarh, West Bengal and Jharkhand, respectively. On the other hand, in states with high MPCE it was seen that the inequality has not decrease much since these states were already on low inequality in fruit consumption, this was observed in the southern region. Income and price are the major factors that affect the level of budget share given to each fruit. The other factors that affect the consumption expenditure are the demographic parameters. It should be noted that if education and awareness on importance of fruits in our diet is popularize, it will help the household to consume more fruits. This will directly lead to a shift in cropping pattern from field crops to perennial fruit crops.

i	**Experiment 9**: **Statistical evaluation of agricultural development of the different districts in Haryana**	
ii	Objectives of the experiment	• To categorize the districts based on socio-economic development • To categorize the districts based on agricultural development
iii	Name(s) of the Investigator	• Dr. Monika Devi Planning, analysis of data and report writing • Dr. Joginder Data collection, compilation, and analysis of data
iv	Name(s) of the collaborator(s) with activity profile	• Dr. DP Malik Planning and finalization of the report
v	Year of start	• 2020-21
vi	Duration of study	• One year
vii	Treatment details	• Locale of the experiment: All districts of Haryana • Statistical design/methods: Composite Index, Normalized Index and principal component analysis (PCA) were used.
viii	Observations recorded	• The present study was based on secondary data. • Data on various 25 socio-economic development indicators and 27 agricultural development indicators were collected.

ix. Results achieved during 2020-21:

The present study was planned to study the dynamics of inter-district development in Haryana.

Table 1: Selected socio-economic indicators

Section	Indicator	Notation
Population	Percentage of rural population male to total population	X1
	Percentage of rural population female to total population	X2
	Percentage of urban population male to total population	X3
	Percentage of urban population female to total population	X4
	Population density	X5
	Rural sex ratio of births (male per 100 female)	X6
	Urban sex ratio of births (male per 100 female)	X7
	Decennial population growth 2001-11	X8
Transport and other	Number of registered factories per lakh population	X9
	Road length per lakh population	X10
	Number of non-transport vehicle registered total per lakh population	X11
	Total transport per lakh population	X12
	Number of medical institutions allopathic per lakh population	X13
Educational services and Infrastructure	Literacy percentage male	X14
	Literacy percentage female	X15
	Total senior secondary/high schools per lakh population	X16
	Total recognised middle schools per lakh population	X17
	Total recognised primary schools per lakh population	X18
	Teacher pupil ratio primary	X19
	Teacher pupil ratio middle	X20
	Teacher pupil ratio senior sec/high school	X21
Financial	Total cooperative societies and banks per lakh population	X22
	Credit deposits ratio (%)	X23
Labour	Percentage of workers employed in working factories to total population	X24
	Main workers as percentage to total population	X25

As development is a multidimensional phenomenon and cannot be measured by one or two development indicators so data on 27 agricultural and 25 socio-economic development indicators was collected for all the districts of Haryana. Details of these indicators are given in table-1 and table-4. Triennium average of area and yield related agricultural variables have been used in the study.

Table 2: Socio-economic development status

Rank	District	Composite Index (↓)	Normalized Index (↑)	PC Value (↑)	District	Rank
1	Gurugram	0.583	1.000	9.115	Gurugram	1
2	Faridabad	0.654	0.787	9.080	Faridabad	2
3	Panchkula	0.743	0.523	2.419	Panipat	3
4	Panipat	0.761	0.471	1.906	Panchkula	4
5	Rewari	0.808	0.332	0.710	Ambala	5
6	Jhajhar	0.824	0.282	0.646	Rohtak	6
7	Yamunanagar	0.827	0.275	0.593	Yamunanagar	7
8	Rohtak	0.828	0.272	0.164	Sonipat	8
9	Ambala	0.852	0.199	-0.532	Rewari	9
10	Sonipat	0.855	0.190	-0.547	Karnal	10
11	Karnal	0.858	0.181	-0.767	Palwal	11
12	Palwal	0.863	0.166	-0.887	Jhajhar	12
13	Hisar	0.865	0.160	-1.207	Hisar	13
14	Mahendergarh	0.878	0.122	-1.396	Kurukshetra	14
15	Kurukshetra	0.883	0.106	-1.919	Jind	15
16	Bhiwani*	0.884	0.104	-2.411	Mahendergarh	16
17	Kaithal	0.885	0.102	-2.564	Sirsa	17
18	Fatehabad	0.900	0.058	-2.654	Kaithal	18
19	Jind	0.903	0.048	-3.058	Nuh	19
20	Sirsa	0.919	0.000	-3.117	Bhiwani*	20
21	Nuh	0.919	0.000	-3.574	Fatehabad	21

*Bhiwani includes the values of Charkhi Dadri.

The Composite indices, normalized indices and PC Values along with the district ranks are given in Table 2. According to Narian et al. (1991) the value of composite index lies between 0 and 1. Also, a lower value indicates the higher level of development while the value closer to 1 indicates the lower level of development. The Normalized composite index increase or decrease in the direction of development. Gurugram occupied first position in socio-economic development, according to both the methodologies. Faridabad, Panchkula, Panipat and Rewari were following districts after Gurugram. Nuh and Fatehabad were the least developed districts according to CI and PCA, respectively. Jind, Sirsa, Bhiwani and Kaithal were other least developed districts according to socio-economic sector.

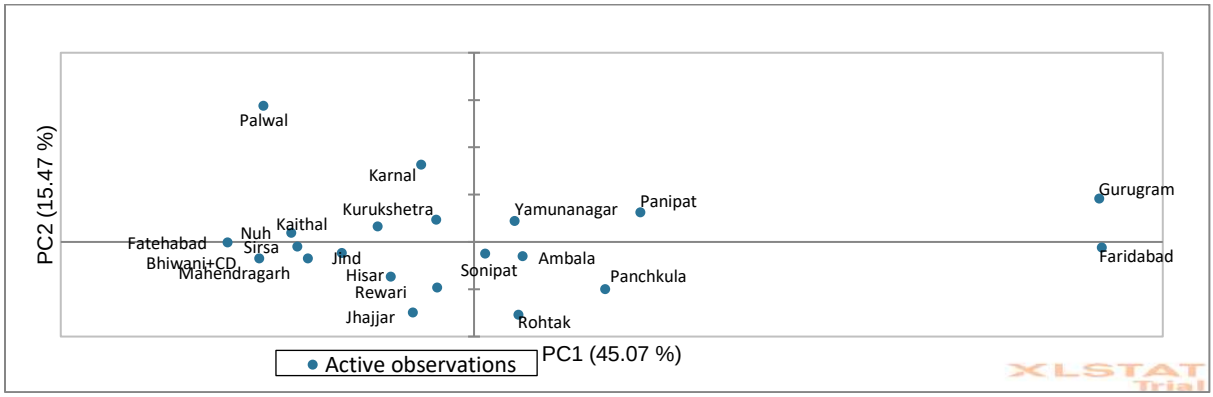


Fig.1.Socio-economic Sector Principal Component plot

Scatter plot for first two principal components of socio-economic development indicators is presented in Fig.1. The first principal component for socio-economic sector explained 45.07 per cent of the total variance and up to 5 PC's nearly 85 per cent of total variation was captured. It indicates that the districts Gurugram, Faridabad, Panchkula, and Panipat have high principal component values for PC1 and PC2. On the other hand, the districts Nuh, Sirsa, Mahendergarh, Bhiwani and Fatehabad have low scores for both of the principal components of agricultural sector indicators.

Loadings for socio-economic sector are given in table 3. It was observed that indicators X3, X4 (Percentage of urban population male and female to total population), X5 (Population density), X9 (Number of registered factories per lakh population), X11, X12 (Number of non-transport vehicle and total transport per lakh population), X19 (Teacher Pupil Ratio Primary) and X24 (Percentage of workers employed in working factories to total population) were the most important variables for first principal component from the socio-economic sector. The other indicators X14 (Literacy percentage male) and X15 (Literacy percentage female) were also having higher values.

Table: 3 Important indicators in socio-economic development:

Indicator		PC1	PC2	PC3	PC4	PC5
X1	Percentage of rural population male to total population	-0.950	0.102	-0.217	-0.041	0.116
X2	Percentage of rural population female to total population	-0.948	0.131	-0.201	-0.053	0.139
X3	Percentage of urban population male to total	0.952	-0.116	0.206	0.046	-0.117
X4	Percentage of urban population female to total	0.946	-0.116	0.214	0.048	-0.138
X5	Population density	0.848	0.314	-0.159	0.030	-0.280
X6	Rural sex ratio of births (male per 100 female)	0.127	-0.338	-0.471	0.437	0.014
X7	Urban sex ratio of births (male per 100 female)	-0.172	-0.094	-0.556	-0.260	0.283

X8	Decennial population growth	0.666	0.396	-0.010	-0.062	0.599
X9	Number of registered factories per lakh population	0.911	0.000	-0.121	0.096	0.092
X10	Road length per lakh population	-0.777	-0.311	0.154	0.205	0.173
X11	Number of non-transport vehicle registered total per lakh population	0.775	-0.176	-0.015	-0.105	0.498
X12	Total transport per lakh population	0.844	-0.023	-0.135	-0.085	0.468
X13	Number of medical institutions allopathic total per lakh population	-0.906	-0.326	-0.036	-0.058	0.113
X14	Literacy percentage male	0.535	-0.608	-0.219	-0.322	-0.135
X15	Literacy percentage female	0.637	-0.589	0.173	-0.098	-0.164
X16	Total senior secondary/high schools per lakh population	-0.179	-0.634	-0.597	0.077	-0.211
X17	Total recognised middle schools per lakh population	0.205	0.838	0.085	-0.270	-0.230
X18	Total recognised primary schools per lakh population	-0.522	0.000	0.459	-0.452	0.188
X19	Teacher pupil ratio primary	0.769	-0.113	-0.480	0.023	-0.269
X20	Teacher pupil ratio middle	-0.453	-0.526	-0.344	-0.155	0.154
X21	Teacher pupil ratio senior sec/high school	0.055	0.824	-0.286	0.324	0.033
X22	Total cooperative societies and banks per lakh population	0.083	-0.273	0.769	-0.228	-0.062
X23	Credit deposits ratio (%)	-0.325	0.015	0.313	0.796	0.127
X24	Percentage of workers employed in working factories to total population	0.918	-0.023	-0.153	0.041	0.325
X25	Main workers as percentage to total population	0.307	-0.579	0.535	0.368	0.166

Table 4: Selected agricultural indicators

Section	Indicator	Notation
Area	Percentage of forest area to total geographical area	X1
	Percentage of net area sown to total cultivable area	X2
	Percentage of area sown more than once to total cultivable area	X3
	Net area irrigated percentage to net area sown	X4
	Percentage of total cereals area to total cropped area	X5
	Percentage of total pulses area to total cropped area	X6
	Percentage of total food-grains area to total cropped area	X7
	Percentage of total oilseeds area to total cropped area	X8
	Average land holding size	X9
Yield	Total cereals yield	X10

	Total pulses yield	X11
	Total food-grains yield	X12
	Total oilseeds yield	X13
Mechanization	Number of tractors per 000 ha of total cropped area	X14
	Number of tube-wells and pumping sets	X15
Human Labour	Percentage of cultivator worker to total workers	X16
	Percentage of agriculture worker to total workers	X17
Other Inputs	Irrigation intensity (gross irrigated area x 100/net irrigated area)	X18
	Fertilizer consumption kg per ha	X19
	Regulated markets	X20
	Rainfall annual (cm)	X21
Livestock	Number of cattle per lakh population	X22
	Number of buffaloes per lakh population	X23
	Number of sheep per lakh population	X24
	Number of goats per lakh population	X25
	Number of poultry per lakh population	X26
	Number of veterinary institutions in the state	X27

Table 5: Agricultural development status

Rank	District	Composite Index (↓)	Normalized Index (↑)	PC Value (↑)	District	Rank
1	Karnal	0.768	1.000	1.822	Yamunanagar	1
2	Kurukshetra	0.780	0.943	1.080	Karnal	2
3	Yamunanagar	0.788	0.902	1.070	Kurukshetra	3
4	Jind	0.815	0.773	1.016	Jind	4
5	Kaithal	0.816	0.769	0.963	Sirsa	5
6	Sirsa	0.825	0.727	0.781	Ambala	6
7	Hisar	0.825	0.726	0.563	Kaithal	7
8	Bhiwani*	0.830	0.703	0.325	Fatehabad	8
9	Ambala	0.851	0.600	0.267	Sonipat	9
10	Fatehabad	0.865	0.533	0.202	Panipat	10
11	Palwal	0.865	0.530	0.057	Palwal	11
12	Sonipat	0.892	0.399	0.050	Hisar	12
13	Mahendragarh	0.900	0.361	-0.421	Rohtak	13
14	Rohtak	0.903	0.351	-0.464	Bhiwani*	14
15	Jhajjar	0.931	0.214	-0.471	Mahendragarh	15
16	Panipat	0.931	0.214	-0.525	Panchkula	16
17	Panchkula	0.933	0.204	-0.968	Faridabad	17
18	Rewari	0.936	0.192	-1.099	Nuh	18
19	Faridabad	0.961	0.069	-1.222	Gurugram	19
20	Gurugram	0.964	0.055	-1.370	Rewari	20

21	Nuh	0.975	0.000	-1.656	Jhajjar	21

*Bhiwan includes the values of Charkhi Dadri.

Karnal, Kurukshetra, Yamaunangar, Jind, Kaithal and Sirsa were found highly developed districts in agricultural sector. Nuh, Gurugram, Faridabad, Rewari and Jhajjar were among the least developed districts in agricultural sector. Results of both methodologies are in accordance.

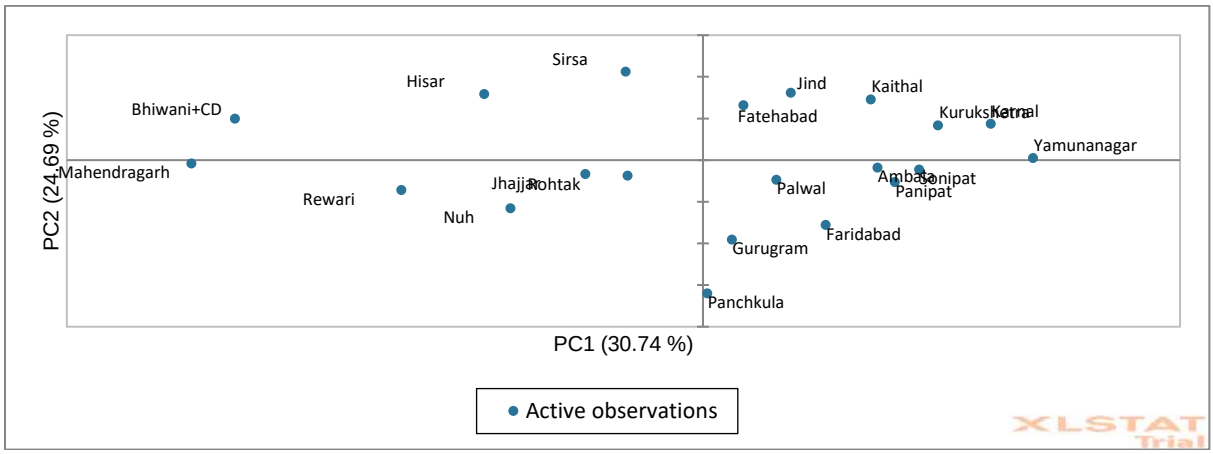


Fig.2. Agricultural Sector Principal Components plot

Scatter plot for first two principal components of agricultural development indicators is presented in Fig.2. The first principal component for agriculture sector explained 30.74 per cent of the total variance and up to 5 PC's nearly 80 per cent of total variation was captured. Fig.2 indicates that the districts Yamunanagar, Karnal, Kurukshetra, Kaithal and Jind have high principal component scores for PC1 and PC2. On the other hand, the districts Nuh, Rewari, Mahendergarh and Jhajjar have low scores for both of the principal components of agricultural sector indicators. Panchkula, Faridabad, Gurugram have lower values for PC2. The developmental disparities indicated by PC1 and PC2 in Fig.2 are in accordance with the disparities reflected by Normalized index of development.

Table 6: Important indicators in agricultural development

Indicator		Component				
		PC1	PC2	PC3	PC4	PC5
X1	Percentage of forest area to total geographical area				-.827	
X2	Percentage of net area sown to total cultivable area					
X3	Percentage of area sown more than once to total cultivable area					.786
X4	Net area irrigated percentage to net area sown					
X5	Percentage of total cereals area to total cropped area	.918				
X6	Percentage of total pulses area to total cropped area	-.781				
X7	Percentage of total food-grains area to total cropped area	.914				

X8	Percentage of total oilseeds area to total cropped area	-.755				
X9	Average land holding size					
X10	Total cereals yield		.928			
X11	Total pulses yield					
X12	Total food-grains yield		.907			
X13	Total oilseeds yield					
X14	Number of tractors per 000 ha of total cropped area					
X15	Number of tube-wells and pumping sets	.821				
X16	Percentage of cultivator worker to total workers					
X17	Percentage of agriculture worker to total workers			.835		
X18	Irrigation intensity (gross irrigated area x 100/net irrigated area)					
X19	Fertilizer consumption kg per ha					
X20	Regulated markets					
X21	Rainfall annual (cm) 2019			-.774		
X22	No. of cattle per lakh population		.822			
X23	No. of buffaloes per lakh population			.846		
X24	No. of sheep per lakh population					
X25	No. of goats per lakh population					
X26	No. of poultry per lakh population				-.903	
X27	Number of veterinary institutions in the state gvh					

Loadings for agricultural sector are presented in table 6. It was observed that Indicators X5, X7 (Percentage of total cereals and food-grains area to total cropped area) and X15 (Number of tube-wells and pumping sets) are the most important variables for first PC from the agricultural sector. The other five indicators from PC2 and PC3 with higher loadings were X10, X12 (Total cereals yield), X12 (Total food-grains yield), and X17 (Percentage of agriculture worker to total workers), X22 (Number of cattle per lakh population) and X23 (Number of buffaloes per lakh population).

ix. Programme of work for 2020-21: Experiment concluded

Salient findings of the study:

- Gurugram, Faridabad, Panchkula and Panipat were found highly developed districts in socio-economic sector based on both the methods and Nuh, Fatehabad, Bhiwani, Jind and Kaithal were among the least developed districts.
- It was observed that percentage of urban population to total, population density, number of registered factories and percentage of work force in factories, transport related facilities and teacher pupil ratio primary were important variables for the socio-economic development.
- Karnal, Kurukshetra, Yamunanagar, Jind, Kaithal and Sirsa have been found highly developed districts in agricultural sector according to Composite index and Principal Component method. Nuh, Gurugram, Faridabad, Rewari and Jhajhar were in least developed districts according to agricultural sector.

- Percentage of total cereals and food-grains area to total cropped area, irrigation facilities, total cereals and food-grains yield, number of cattle per lakh population and percentage of agriculture workers contributed highly in agricultural sector development.

Conclusion

Study indicates the inter-district disparities in Haryana in both the sectors. Gurugram, Faridabad and Panchkula were among the highly developed districts in socio-economic sector. Nuh was found lagging behind in both the sectors. It was observed that percentage of urban population to total, population density, number of registered factories, working force in factories and transport related indicators were the important variables in the socio-economic sector development. Karnal, Kurukshetra, Yamunanagar, Jind, Kaithal and Sirsa were among the highly developed districts in agricultural sector. Nuh, Gurugram, Faridabad, Rewari and Jhajhar were least developed districts according to agricultural sector. It was observed that percentage of cereals and food-grains area to total cropped area, irrigation facilities, cereals yield, number of cattle per lakh population and percentage of agriculture worker were main contributing factors in agricultural sector development.

i	**Experiment 10: An application of explanatory variables to model and forecast sugarcane yield**	
ii	**Objectives of the experiment**	• To develop forecast models for sugarcane yield • To compare the accuracy of developed models • To identify the model for forecasting sugarcane yield
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning, compilation, tabulation and analysis of data • Dr. Joginder Data collection, compilation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Planning and report writing
v	**Year of start**	• 2020-21
vi	**Duration of study**	• **One year**
vii	**Treatment details**	• **Locale of experiment:** Yamunanagar district • **Crop:** Sugarcane • **Period:** 1981-2019 • **Statistical design/methods:** Descriptive and explorative data analysis, ARIMA, ARIMAX, principal component analysis and discriminant function analysis were applied.

viii	**Observations recorded**	• The present study was based on secondary data. • Data of sugarcane yield was collected. • Data on weather parameters: maximum temperature, minimum temperature and rainfall were also collected.

ix. Results achieved during 2020-21:

The following results have been obtained based on secondary data of sugarcane yield and weather variables for the period 1980-2018 of Yamunanagar district of Haryana:

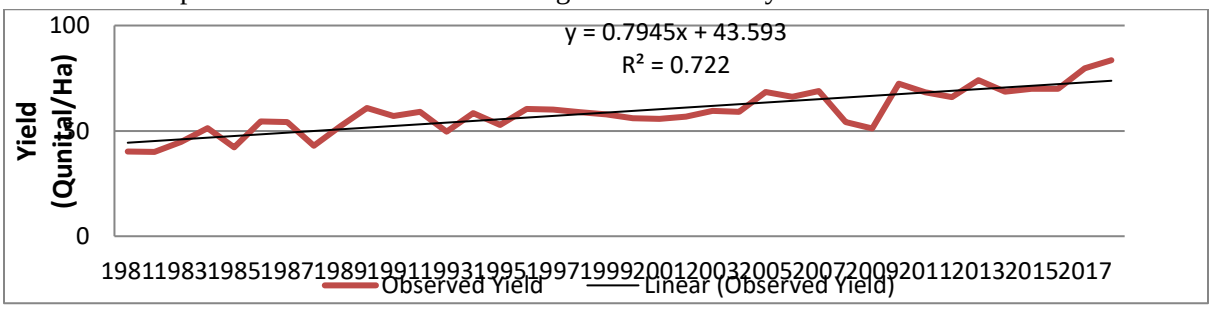


Fig. 1: Trend line of sugarcane yield in Yamunanagar district

Fig. 1 shows the trend line for yield of sugarcane crop of Yamunanagar district. The trend of sugarcane yield was found almost linear with 0.722 value of R^2.

Table 1: Summary statistics of sugarcane yield of Yamunanagar:

Statistic	Mean	Standard Deviation	Range	Minimum	Maximum	CV
Yield (Quintal/Ha)	59.08	10.39	43.51	40.02	83.53	17.59

Table 1 provides the summary statistics and shows that mean yield was 59.08 Quintal/ha for the study period with a variability of 17.59 per cent.

Table 2: Forecast for next five years from selected models:

Year	ARIMA (0,1,1)	ARIMA (0,1,1) tmn2	ARIMA (0,1,1) tmn8	ARIMA (0,1,1) rf6	ARIMA (0,1,1) rf6, tmn2	PCA*	DFA*
2014	71.11	71.11	76.35	70.74	70.38	70.35	70.27
2015	69.61	69.58	74.71	71.37	70.68	71.41	71.09
2016	71.33	71.33	74.04	69.77	69.40	74.15	71.56
2017	71.07	71.09	75.68	71.28	71.34	73.71	78.04
2018	70.58	70.61	74.83	73.58	74.14	74.34	78.52

*PCA-Principal component analysis, DFA-Discriminant function analysis

Various combinations of ARIMA have been tried and with lower AIC, BIC value ARIMA (0,1,1) was selected for forecasting sugarcane yield. ARIMA with weather parameter (exogenous parameters)

(ARIMAX) was also used with several exogenous parameters combination and selected models alongwith their forecast values are presented in the table 2. Further Principal component analysis and discriminant function analysis was also performed. Table 2 gives the forecast figures for last five years obtained from various applied models.

Table 3: Accuracy measures of selected models

Model	ARIMA (0,1,1)	ARIMA (0,1,1) tmn2	ARIMA (0,1,1) tmn8	ARIMA (0,1,1) rf6	ARIMA (0,1,1) rf6, tmn2	PCA	DFA
RMSE	7.07	7.05	6.18	5.93	5.68	5.35	2.62
MAD	5.14	5.14	5.86	4.40	4.14	4.52	2.22

A comparison of accuracy measures of all models revealed that Root mean square error (RMSE) and Mean absolute deviation (MAD) were less in Discriminant function analysis (DFA). Also, RMSE and MAD were found least in all tried fortnights in Discriminant function analysis in comparison to other applied models.

Table 4: Fitted model using discriminant function analysis (DFA) for Sugarcane yield

Fortnight of forecast	Fitted Regression Model	P-value
20th fortnight (16th Oct-31th Oct)	Yield = -1441.653+0.751**T+0.510**Z_1-0.417*Z_2	< 0.01

Note: *Significant at 5 % level of significance, **Significant at 1 % level of significance

Above table provides the model summary of selected model and overall model was found significant along-with individual scores. Thus, 20th fortnight is the best time for forecasting the yield. The comparison of observed and forecasted yield of subsequent years using selected model are shown in the figure 2 given below.

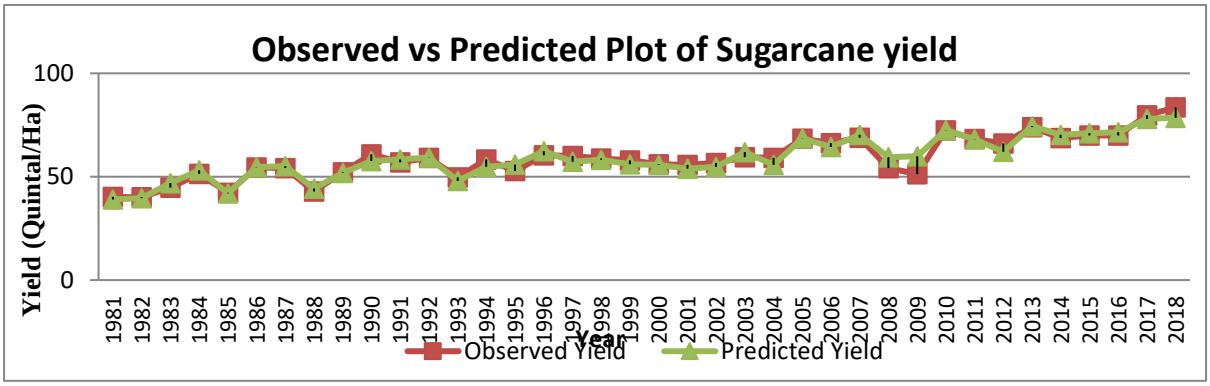


Fig. 2 Comparison of observed and forecasted yield

ix. Programme of work for 2020-21: Experiment concluded

Salient findings of the study:

- The trend of sugarcane yield is found almost linear with 0.722 value of coefficient of determination (R^2). Also variability in sugarcane yield was about 17.59 per cent.
- Discriminant function analysis has outperformed the other applied models with least values of RMSE (2.62 per cent) and MAD (2.22 per cent).
- It was observed that 20th fortnight (16th Oct-31th Oct) is the appropriate time for forecasting sugarcane yield.
- Inclusion of exogenous parameters contributed positively in forecast of yield.

Conclusion:

Accuracy results revealed that univariate models have lesser accuracy as compared to the models with weather parameters. Discriminant function analysis has the higher level of accuracy in sugarcane yield forecasting and found best among all tried models. Also, selected model was found significant along-with individual scores. In discriminant function analysis 20th fortnight (16th Oct-31th Oct) is the best time for forecasting the sugarcane yield. Hence, use of weather parameters was found contributing positively towards the yield forecasting of sugarcane crop.

i	**Experiment 11 : Estimation of wheat yield using ordinal logistic regression model**	
ii	**Objectives of the experiment**	• To develop the forecast model for estimation of wheat yield • To check the accuracy of the model in estimation of wheat yield • To compare the results with existing models
iii	**Name(s) of the Investigator**	• **Dr. Joginder** Planning, compilation and analysis of data • **Dr. Monika Devi** Data compilation and tabulation
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2020-21
vi	**Duration of study**	One year

vii	**Treatment details**	• **Locale of experiment:** Haryana **Northern Region:** Karnal district **Western Region:** Hisar district • **Crop:** wheat • **Period: 1980-2019** • **Statistical design/methods:** Ordinal logistic for two/three groups and stepwise linear regressions were used.
viii	**Observations recorded**	• Time series data of wheat yield for Hisar and Karnal was collected. • Fortnightly data of weather parameters such as temperature, relative humidity, rainfall and sunshine hours was also collected.

Results achieved during 2020-21:

The following results have been obtained based on secondary data of wheat crop based on weather variables for the period 1980-2019 of Karnal and Hisar districts of Haryana:

Western Region: Hisar District

Table 1: Fitted models using ordinal logistic regression (OLR) for different fortnights- three groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
5th Fortnight (2nd March to 16th March)	Yield = -1081.31+0.537**T+4.801**P_1+8.372**P_2 (0.029) (0.940) (0.730)	<0.01
6th Fortnight (17th March to 31st March)	Yield = -1067.97+0.557**T+4.864**P_1+8.063**P_2 (0.031) (0.884) (0.805)	<0.01
7th Fortnight (1st April to 15th April)	Yield = -1087.369+0.565**T+4.045**P_1+8.030**P_2 (0.027) (0.850) (0.841)	<0.01

Note: Figures in brackets represent standard errors, ****** Significant at 1% level of significance

Table 2: Fitted models using ordinal logistic regression (OLR) for different fortnights- two groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
5th Fortnight (2nd March to 16th March)	Yield= -1061.617+0.550**T+6.519**P_1 (0.037) (0.664)	<0.01
6th Fortnight (17th March to 31st March)	Yield = -1107.26+0.573**T+6.055**P_1 (0.039) (0.677)	<0.01
7th Fortnight (1st April to 15th April)	Yield =-1118.786+0.583**T+5.662**P_1 (0.035) (0.744)	<0.01

Note: Figures in brackets represent standard errors, ****** Significant at 1% level of significance

From the above Table 1 & 2, it is observed that all the fitted regression models and their coefficients are significant at 1 per cent level of significance ($p<0.01$).

Table 3: Comparative measures of forecast at different fortnights using OLR

Fortnight of forecast acc. to SMW	RMSE		MAPE		MAD	
	Three groups	**Two groups**	**Three groups**	**Two groups**	**Three groups**	**Two groups**
5th Fortnight (2nd March to 16th March)	**2.65**	**2.36**	**3.09**	**2.84**	**1.67**	**1.40**
6th Fortnight (17th March to 31st March)	2.71	**2.52**	5.28	**5.01**	2.56	**2.45**
7th Fortnight (1st April to 15th April)	4.30	**3.26**	5.99	**4.42**	2.87	**2.12**

Table 3 reveals that the values of all comparative measures like root mean square error (RMSE), mean absolute percentage error (MAPE) and mean absolute deviation (MAD) are minimum in 5th fortnight. It is also observed that in case of two groups the values of these measures are lowest as compared to three groups.

Northern Region: Karnal District

Table 4: Fitted models using ordinal logistic regression (OLR) for different fortnights- three groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
5th Fortnight (2nd March to 16th March)	Yield = -1379.420+0.713**T +1.465**P_1 +5.933**P_2 (0.022) (0.768) (0.654)	<0.01
6th Fortnight (17th March to 31st March)	Yield = -1369.088+0.703**T +2.614**P_1 +6.724**P_2 (0.023) (0.635) (0.601)	<0.01
7th Fortnight (1st April to 15th April)	Yield = -1413.566+0.726**T +2.855**P_1 +7.650**P_2 (0.032) (0.746) (0.698)	<0.01

Table 5: Fitted models using ordinal logistic regression (OLR) for different fortnights- two groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
5th Fortnight (2nd March to 16th March)	Yield = -1374.298+0.710**T+4.483**P_1 (0.026) (0.573)	<0.01
6th Fortnight (17th March to 31st March)	Yield = -1364.690+0.702**T+5.022**P_1 (0.027) (0.548)	<0.01
7th Fortnight (1st April to 15th April)	Yield = -1335.041+0.684**T+5.167**P_1 (0.034) (0.601)	<0.01

Note: Figures in brackets represent standard errors, ****** Significant at 1% level of significance

From the above Table 4 & 5, it is observed that all the fitted regression models and their coefficients are significant at 1 per cent level of significance ($p<0.01$).

Table 6: Comparative measures of forecast at different fortnights using OLR

Fortnight of forecast acc. to SMW	RMSE		MAPE		MAD	
	Three groups	**Two groups**	**Three groups**	**Two groups**	**Three groups**	**Two groups**
5th Fortnight (2nd March to 16th March)	**2.60**	**4.38**	**7.33**	**7.78**	**2.97**	**3.39**
6th Fortnight (17th March to 31st March)	**2.79**	5.72	**8.50**	10.28	**3.62**	4.44
7th Fortnight (1st April to 15th April)	**3.64**	6.05	**8.53**	10.79	**4.51**	4.65

Table 6 reveals that the values of all comparative measures are minimum in 5th fortnight. It is also observed that in case of three groups the values of these measures are lowest as compared to two groups.

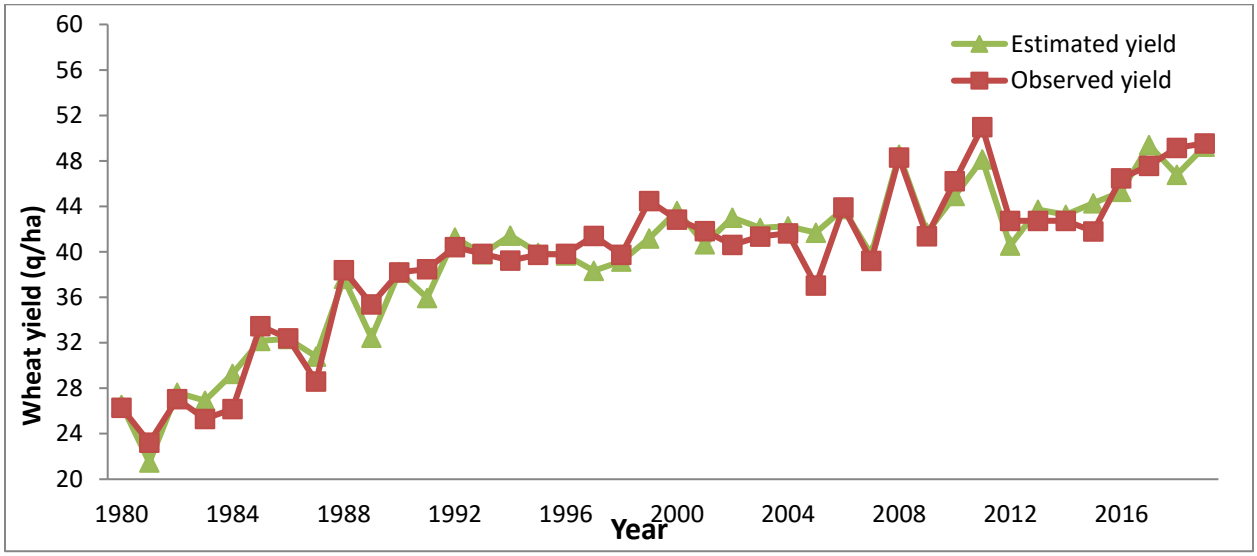


Fig. 1: Comparison of observed and estimated wheat yield

Salient findings of the study:

- All the fitted regression models for estimating wheat yield (Karnal and Hisar) are significant at one per cent level of significance.
- Parameters of fitted models are significant at 5 per cent level of significance.
- For Hisar and Karnal district, OLR model with two and three groups has minimum value of all comparative measures, respectively.

- It is also observed that 5th Fortnight (2nd March to 16th March) i.e. approximately one month before harvesting is the appropriate time for forecasting wheat yield.

Conclusion

All the fitted models for both groups (two and three) are significant at 1% level of significance. The values of RMSE, MAPE and MAD were found minimum in 5th fortnight according to standard meteorological week in both groups. Also, in two group case RMSE, MAPE and MAD give the minimum value as compare to three group cases. Hence, based on present study, forecast of wheat yield using ordinal logistic regression using weather variables may be done in 5th fortnight (2nd March to 16th March) i.e. one month before harvest by dividing the yield in two and three groups for Hisar and Karnal districts, respectively.

i	**Experiment 12: Estimation of paddy yield using Bayesian discriminant function analysis**	
ii	**Objectives of the experiment**	• To develop forecast models for estimation of the paddy yield • To check the accuracy of the selected model • To compare the results with other methods
iii	**Name(s) of the Investigator**	• **Dr. Joginder** Planning, data analysis and report writing • **Dr. Monika Devi** Data compilation and tabulation
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	2020-21
vi	**Duration of study**	One year
vii	**Treatment details**	• **Locale of experiment:** Haryana **Northern Region:** Karnal district **Western Region:** Hisar district • **Crop**: Paddy • **Period:** 1980-2019 • **Statistical design/methods:** Bayesian discriminant function analysis, logistic regression and stepwise linear regression techniques were used.

viii	**Observations recorded**	• Time series data of paddy yield was collected. • Fortnightly weather data on temperature, relative humidity, rainfall and sunshine hours was also collected.

ix Results achieved during 2020-21:

The following results have been obtained based on secondary data of paddy yield based on weather variables for the period 1980-2019 of Karnal and Hisar districts of Haryana:

Western Region: Hisar District

Table 1: Fitted models using discriminant function analysis (DFA) for different fortnights- three groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
21st Fortnight (29 Sept. to 13 Oct.)	Yield = 367.594-0.176**T+4.556**P_1+9.668**P_2 (0.082) (1.412) (1.363)	<0.01
22nd Fortnight (14Oct. to 28 Oct.)	Yield = 499.393-0.238**T+3.922**P_1+9.904**P_2 (0.069) (1.460) (1.392)	<0.01
23rd Fortnight (29 Oct. to 12 Nov.)	Yield = 389.194-0.179**T+4.222**P_1+9.822**P_2 (0.065) (1.399) (1.413)	<0.01

Note: Figures in brackets represent standard errors, ****** Significant at 1% level of significance

Table 2: Fitted models using ordinal logistic regression (OLR) for different fortnights- three groups

Fortnight of forecast acc. to SMW	Fitted Regression Model	P-value
21st Fortnight (29 Sept. to 13 Oct.)	Yield = 435.082-0.207*T+6.907*P_1+10.296*P_2 (0.072) (2.799) (1.424)	<0.01
22nd Fortnight (14 Oct. to 28 Oct.)	Yield = 504.416-0.237*T+6.473*P_1+10.241*P_2 (0.071) (2.905) (1.488)	<0.01
23rd Fortnight (29 Oct. to 12 Nov.)	Yield = 515.549-0.249*T+7.372*P_1+10.645*P_2 (0.048) (1.955) (1.324)	<0.01

Note: Figures in brackets represent standard errors, ***** Significant at 5% level of significance

From the above Table 1&2, it is observed that all the fitted regression models and their coefficients are significant at 1 & 5 per cent level of significance ($p<0.01$), respectively.

Table 3: Comparative measures of forecast at different fortnights using DFA & OLR

Fortnight of forecast acc. to SMW	RMSE		MAPE		MAD	
	DFA	OLR	DFA	OLR	DFA	OLR

21st Fortnight (29 Sept. to 13 Oct.)	**0.90**	**3.90**	**0.99**	**3.91**	**0.24**	**0.39**
22nd Fortnight (14 Oct. to 28 Oct.)	**1.33**	3.95	**1.80**	6.95	**0.25**	1.18
23rd Fortnight (29 Oct. to 12 Nov.)	**1.86**	4.51	**2.84**	7.78	**1.02**	1.28

Table 3 reveals that the values of all comparative measures (RMSE, MAPE and MAD) were found minimum in 21st fortnight. It is also observed that in case of DFA, values of these measures are lowest as compared to OLR technique.

Northern Region: Karnal District

Table 4: Fitted models using ordinal logistic regression (OLR) for different fortnights- three groups

Fortnight of forecast acc. to SMW	**Fitted Regression Model**	**P-value**
21st Fortnight (29 Sept. to 13 Oct.)	Yield = -397.751+0.224**T- 0.266*P_1 + 5.221*P_2 (0.049) (2.831) (1.646)	<0.01
22nd Fortnight (14 Oct. to 28 Oct.)	Yield = -351.559+0.180**T-1.662*P_1 + 4.385*P_2 (0.073) (2.925) (1.671)	<0.01
23rd Fortnight (29 Oct. to 12 Nov.)	Yield = -411.931+0.232*T- 2.264*P_1 + 4.297*P_2 (0.093) (2.931) (1.579)	<0.01

Note: Figures in brackets represent standard errors, ***** Significant at 5 % level of significance
****** Significant at 1% level of significance

Table 5: Fitted models using discriminant function analysis (DFA) for different fortnights- Three groups

Fortnight of forecast acc. to SMW	**Fitted Regression Model**	**P-value**
21st Fortnight (29 Sept. to 13 Oct.)	Yield = -398.332+0.229**T+1.673*P_1 +3.303*P_2 (0.053) (1.438) (1.596)	<0.01
22nd Fortnight (14 Oct. to 28 Oct.)	Yield = -316.532+0.155*T+1.876*P_1 +3.222*P_2 (0.073) (1.337) (1.464)	<0.01
23rd Fortnight (29 Oct. to 12 Nov.)	Yield = -456.228+0.250*T+1.524*P_1 +2.684*P_2 (0.105) (1.401) (1.614)	<0.01

Note: Figures in brackets represent standard errors, ***** Significant at 5 % level of significance
****** Significant at 1% level of significance

From the above Table 4 & 5, it is observed that all the fitted regression models and their coefficients are significant at 1 & 5 per cent level of significance ($p<0.01$), respectively.

Table 6: Comparative measures of forecast at different fortnights using DFA and OLR

Fortnight of forecast acc. to SMW	RMSE		MAPE		MAD	
	DFA	OLR	DFA	OLR	DFA	OLR
21st Fortnight (29 Sept. to 13 Oct.)	**0.74**	**0.90**	**0.39**	**2.82**	**0.11**	**0.89**
22nd Fortnight (14 Oct. to 28 Oct.)	**1.30**	1.33	**2.63**	3.53	**0.82**	1.10
23rd Fortnight (29 Oct. to 12 Nov.)	**1.36**	1.86	**4.21**	5.81	**1.33**	1.83

Table 6 reveals that the values of all comparative measures are minimum in 21st fortnight. It is also observed that in case of DFA, the values of these measures are lowest as compared to OLR.

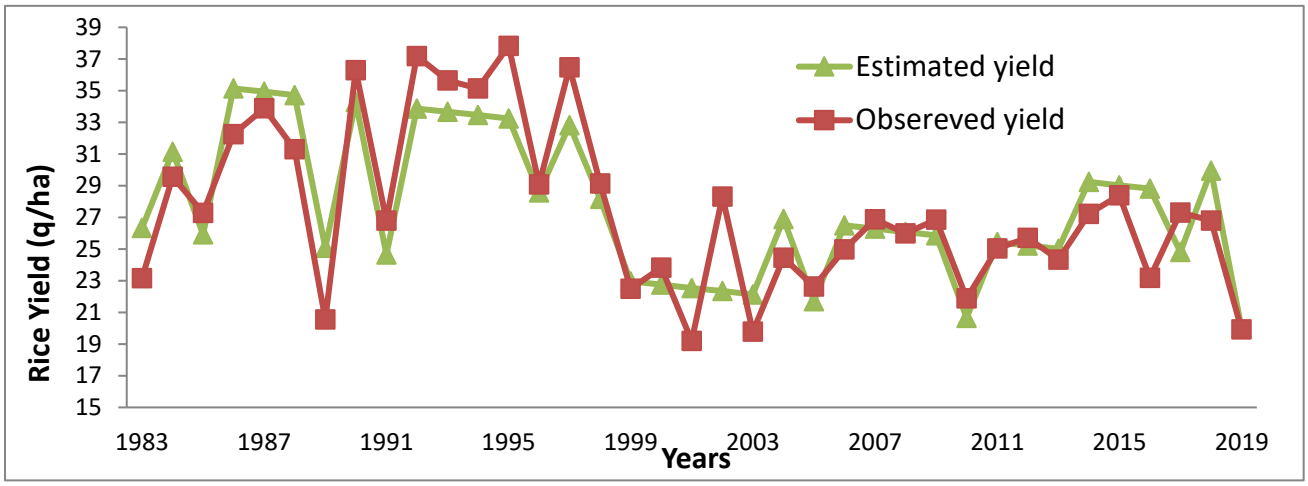


Fig. 1: Comparison of observed and estimated rice yield

ix. Programme of work for 2020-21: Experiment concluded

Salient findings of the study:

- All the fitted regression models for estimating rice yield (Karnal and Hisar) are significant at 1 per cent level of significance.
- Parameters of fitted models are significant at 5 per cent level of significance.
- For both Hisar and Karnal districts, DFA model has minimum values of all comparative measures.
- It is also observed that 21st fortnight (29 Sept. to 13 Oct.) *i.e.* approximately one month before harvesting is the appropriate time for forecasting the rice yield.

Conclusion

The results reveal that the fitted models using DFA and OLR based on weather parameters are significant at 1 per cent level of significance. In both models, the values of RMSE, MAPE and MAD are minimum in 21st fortnight. Also, the values of RMSE, MAPE and MAD were found minimum in DFA technique as compared to OLR technique. Thus, based on present study, forecast of rice yield using DFA may be done in 21st fortnight (29 Sept. to 13 Oct.) *i.e.* one month before harvest for both Hisar and Karnal districts.

i	**Experiment No. 13: Analysis of fertilizer application in different *Kharif* & *Rabi* crops in Haryana**	
ii	**Objectives of the experiment**	• To analyze the pattern of fertilizer use in principal crops in Haryana • To work out the marginal productivity of the fertilizer application for major crops • To find out the reasons for imbalance use of fertilizers
iii	**Name(s) of the investigators**	• Dr. Vijay Kumar Finalization of data, Analysis and report writing • Dr. Veer Sain Collection and compilation of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Preparation of schedule, monitoring and planning
v	**Year of start**	**2019-20**
vi	**Duration of study**	Two years
vii	**Treatment details**	• **Locale of experiment:** Eastern and western zone of Haryana. • **Eastern Zone:** Yamuna nagar & Karnal was selected for the study. • **Western Zone:** Bhiwani & Mewat will be selected for the study. • **Data Collection:** In first year the data for Rabi crops was collected and in second year the data for Kharif crops will be collected. • **Statistical design/methods:** Production function and descriptive statistics like mean, per cent were used.
viii	**Observations recorded**	• Information related to the fertilizer application in various crops, information regarding land holding, reasons to not applying recommended doses of fertilizer to the crops was collected from the farmers.

ix. Results achieved during 2020-21

Fertilizer use pattern in *Rabi* season eastern and western zone of Haryana in 2019-20

In Haryana urea was the major source of Nitrogen (N) and all the farmers used N on their crops. Top-dressing was the most common method of application in the crops. The survey results showed the fertilizers use pattern for wheat, mustard, maize and sugarcane in Karnal and Yamunanagar districts (Table 1). Nitrogen, phosphate and potash applications in wheat, mustard, maize and sugarcane was 62.30, 50.29, 60.80 and 80.39 kg/acre, 22.99, 22.55, 27.51 and 36.35 kg/acre and 9.84, 8.64, 18.50 and 33.57 kg/acre in overall eastern zone, respectively. In Sugarcane crop maximum fertilizer was used followed by Maize, Wheat and Mustard crop. The results showed that farmers of Karnal districts use more fertilizer then Yamunanagar farmers.

Table 1: Fertilizer use pattern for *Rabi* crops in eastern zone of Haryana (Kg/acre)

District: Karnal						
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**S**	**Ca**
Wheat	65.48	22.64	6.13	2.85	1.09	0.00
Mustard	55.58	23.91	10.00	0.38	1.31	1.31
Maize	67.06	35.16	25.00	6.11	2.94	4.67
Sugarcane	80.86	36.68	39.00	7.00	2.55	3.15
District: Yamuna Nagar						
Wheat	59.12	23.34	13.56	4.02	1.99	0.49
Mustard	44.99	21.18	7.27	3.64	2.00	1.91
Maize	54.54	19.85	12.00	2.00	2.70	2.10
Sugarcane	79.91	36.01	28.13	5.83	4.31	3.94
Overall Eastern Zone						
Wheat	62.30	22.99	9.84	3.44	1.54	0.24
Mustard	50.29	22.55	8.64	2.01	1.66	1.61
Maize	60.80	27.51	18.50	4.06	2.82	3.39
Sugarcane	80.39	36.35	33.57	6.42	3.43	3.55

The survey results showed the fertilizers use pattern for wheat and mustard in Bhiwani and Mewat districts (Table 2). Nitrogen, phosphate and potash applications in wheat and mustard were 60.2 and 50.5 kg/acre, 26.7 and 19.6 kg/acre and 7.1 and 10.8 kg/acre in overall eastern zone, respectively. In wheat crop more fertilizer was used then in mustard crop. The results showed that farmers of Mewat districts use more fertilizer then Bhiwani farmers.

Table 2: Fertilizer use pattern for *Rabi* crops in western zone of Haryana (Kg/acre)

District: Bhiwani					
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**S**
Wheat	55.6	24.9	8.5	0.6	1.9
Mustard	45.2	22.1	11.8	0.6	1.6
Gram	6.8	17.73	0.13	0	0
District: Mewat					

Wheat	64.8	28.6	5.7	0.6	1.4
Mustard	55.8	17.06	9.83	0.51	0.29
Barley	42.2	16.23	0	0.64	0.64
Overall Western Zone					
Wheat	60.2	26.7	7.1	0.6	1.7
Mustard	50.5	19.6	10.8	0.6	1.0

Cost incurred on various fertilizers for *Rabi* crops in eastern zone of Haryana

Cost incurred on fertilizer use pattern for Rabi crops in Haryana are presented in Table 3. Total cost incurred on fertilizers in Wheat, Mustard, Maize and Sugarcane was Rs. 2449.40, 2136.57, 2903.17 and Rs. 4163.39 in overall, respectively. The results showed that in Karnal district, the farmers of Maize, Mustard and Sugarcane growers expended more on fertilizers than Yamunanagar, however in case of Wheat, the farmers of Yamunanagar district expended more on fertilizer.

Table 3: Cost incurred on fertilizer use for Rabi crops in Eastern Zone of Haryana (Rs./acre)

District: Karnal						
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**S**	**Total Expenditure**
Wheat	853.89	1066.15	183.75	82.33	120.31	2306.43
Mustard	724.70	1100.57	300.00	10.13	82.00	2242.89
Maize	874.40	1566.48	750.00	165.00	102.11	3548.67
Sugarcane	1054.41	1666.61	1170.00	189.00	130.80	4272.02
District: Yamuna Nagar						
Wheat	770.86	1089.58	406.74	120.19	195.51	2592.37
Mustard	586.68	960.83	218.18	98.18	129.27	2030.24
Maize	711.20	894.46	360.00	54.00	197.20	2257.66
Sugarcane	1042.06	1620.20	843.75	157.50	314.75	4054.76
Overall Eastern Zone						
Wheat	812.38	1077.87	295.25	101.26	157.91	2449.40
Mustard	655.69	1030.70	259.09	54.16	105.64	2136.57
Maize	792.80	1230.47	555.00	109.50	149.66	2903.17
Sugarcane	1048.24	1643.41	1006.88	173.25	222.78	4163.39

Total cost incurred on fertilizers in Wheat and Mustard was Rs. 2501 and Rs. 2048 in overall, respectively. The results showed that in Mewat district, the farmers of wheat growers expended more on fertilizers than Bhiwani, however in case of mustard, the farmers of Bhiwani district expended more on fertilizer. (Table-4)

Table 4: Cost incurred on fertilizer use for *Rabi* crops in western zone of Haryana (Rs./acre)

District: Bhiwani						
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**S**	**Total Expenditure**
Wheat	726	1170	255	48	206	2439
Mustard	590	1042	353	51	170	2206
Gram	87	835	4	0	0	926

District: Mewat						
Wheat	844	1348	170	44	157	2563
Mustard	728	803	294	33	32	1891
Barley	551	764	0	46	70	1431
Overall Western Zone						
Wheat	785	1259	212	46	182	2501
Mustard	659	923	324	42	101	2048

Fertilizer expenditure on sampled farms in different *Rabi* crops

In eastern zone the expenditure on fertilizer to the total variable cost was found highest *i.e.* 21.40 per cent for Mustard crop, followed by Wheat 19.39 per cent and Maize 15.18 per cent in Karnal district and found least in Sugarcane *i.e.* 7.53 per cent. Same pattern was observed in Yamunanagar district, highest expenditure on fertilizer to the total variable cost was found in Mustard *i.e.*23.66 per cent, followed by Wheat 16.96, Maize 10.4 per cent and Sugarcane 7.03 per cent. Overall in Eastern Zone of Haryana the maximum parentage expenditure was found in Mustard followed by Wheat, Maize and Sugarcane crop.

Table 5: Fertilizer expenditure on sampled farms in eastern zone of Haryana (Rs./acre)

District: Karnal					
Crops	**Total Variable Cost (TVC)**	**Total Cost (TC)**	**Total Fertilizer Expenditure**	**% of fertilizer expenditure to TVC**	**% of fertilizer expenditure to TC**
Wheat	11896.00	39672.00	2306.43	19.39	0.05
Mustard	10480.00	38132.00	2242.89	21.40	0.06
Maize	23379.00	53517.00	3548.67	15.18	0.03
Sugarcane	56770.00	95250.00	4272.02	7.53	0.01
District: Yamunanagar					
Wheat	15281.00	39526.00	2592.37	16.96	0.04
Mustard	8581.00	32525.00	2030.24	23.66	0.07
Maize	21708.00	73029.00	2257.66	10.40	0.01
Sugarcane	57654.00	96593.00	4054.76	7.03	0.01
Overall Eastern Zone					
Wheat	13588.50	39599.00	2449.40	18.03	0.05
Mustard	9530.50	35328.50	2136.57	22.42	0.06
Maize	22543.50	63273.00	2903.17	12.88	0.02

Sugarcane	57212.00	95921.50	4163.39	7.28	0.01

Table 6: Fertilizer expenditure on sampled farms in western zone of Haryana (Rs./acre)

District: Bhiwani					
Crops	**Total Variable Cost (TVC)**	**Total Cost (TC)**	**Total Fertilizer Expenditure**	**% of fertilizer expenditure to TVC**	**% of fertilizer expenditure to TC**
Wheat	18404	29263	2439	13.25	8.33
Mustard	11094	19757	2206	19.88	11.16
Gram	9672	18811	926	9.57	4.92
District: Mewat					
Wheat	17438	41295	2563	14.69	6.20
Mustard	10316	30273	1891	18.33	6.24
Barley	10854	26363	1431	13.18	5.42
Overall Western Zone					
Wheat	17921	35279	2501	13.95	7.08
Mustard	10705	25015	2048	19.13	8.18

In western zone the expenditure on fertilizer to the total variable cost was found highest i.e. 19.88 per cent for Mustard crop, followed by Wheat 13.25 per cent and Gram 9.57 per cent in Bhiwani district. Same pattern was observed in Mewat district, highest expenditure on fertilizer to the total variable cost was found in Mustard i.e.18.33 per cent, followed by Wheat 14.69 and Barley 13.18 per cent. Overall in Western Zone of Haryana the maximum parentage expenditure was found in Mustard followed by Wheat crop.

Marginal value productivity

Based on data collected from wheat, mustard, maize and sugarcane growers in Karnal and Yamunanagar districts Cobb Douglas production function was employed to determine the efficiency level of individual resource used. The resources like nitrogen and phosphate were the major contributing exogenous variables in cultivation of these crops. The production function analysis fitted for resource use in Karnal district reveals that the regression co-efficient of nitrogen and phosphate were positive in wheat and phosphate in mustard and maize (Table 7). In Yamunanagar district regression co-efficient of nitrogen and phosphate fertilizers were positive in wheat and sugarcane and phosphate in mustard and maize. Similarly in overall both the resources were positive in all the selected crops. In overall Eastern Zone every five per cent increase in nitrogen would increase gross return by 0.075, 0.100, 0.523 and 0.041 per cent for wheat, mustard, maize and sugarcane and phosphate would increase 0.027, 0.026, 0.036 and 0.044 per cent for wheat, mustard, maize and sugarcane, respectively.

The MVP value of nitrogen and phosphate fertilizer under selected crops greater than unity indicates that all these inputs were underutilized in the respective districts and overall. On the other side, the value MVP were less than unity for the selected crops reflects that nitrogen and phosphate were over utilized and use of these inputs needs to be curtailed to higher returns. There was ample scope for exploitation the use of these resources to maximize the production and to increase the gross returns. It is imperative from the study that use of underutilized resources in the cultivation of selected crops resulted into higher yield while reduce the use of over utilized inputs caused in reduction of expenses incurred.

Table 7: Marginal value productivity of fertilizers use (N and P) in eastern zone of Haryana

District: Karnal								
Crops	**Wheat**		**Mustard**		**Maize**		**Sugarcane**	
Statistical Indicators	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**
GM	841.53	1059.86	716.26	1083.07	807.45	1287.99	1059.33	1531.69
Coefficient	0.004	0.339	-0.152	0.114	-0.147	0.624	-0.159	-0.062
MVP	**0.21**	**14.31**	**-7.49**	**3.76**	**-10.61**	**27.46**	**-20.13**	**-5.32**
District : Yamuna Nagar								
GM	758.30	938.15	571.37	538.78	704.04	1083.07	1018.16	1472.00
Coefficient	0.109	0.024	-0.213	0.005	-0.155	1.077	0.059	0.038
MVP	**6.15**	**0.96**	**-9.99**	**0.15**	**-11.22**	**51.17**	**6.91**	**3.08**
Overall Eastern Zone								
GM	792.75	988.27	628.41	722.93	748.25	538.17	1023.94	1480.38
Coefficient	0.075	0.027	0.100	0.026	0.523	0.036	0.041	0.044
MVP	**4.09**	**1.10**	**4.80**	**0.81**	**37.79**	**1.83**	**4.81**	**3.44**

The production function analysis fitted for resource use in Bhiwani district reveals that the regression co-efficient of nitrogen was positive in wheat, mustard and in phosphate was positive in wheat and gram (Table 8). In Mewat district regression co-efficient of nitrogen was positive in mustard and barley and in phosphate fertilizers was positive in wheat only. Similarly in overall Nitrogen was found positive in wheat and mustard crop and phosphorous was positive in wheat crop. In overall Western Zone every five per cent increase in nitrogen would increase gross return by 9.71 and 16.72 per cent for wheat & mustard and phosphate would increase 0.83 per cent for wheat.

Table 8: Marginal value productivity of fertilizers use (N and P) in western zone of Haryana

District: Bhiwani						
Crops	**Wheat**		**Mustard**		**Gram**	
Statistical Indicators	**N**	**P**	**N**	**P**	**N**	**P**
GM	712.99	1155.11	552.94	1028.20	81.75	776.80
Coefficient	0.29	0.04	0.15	-0.38	-0.23	0.28
MVP	14.63	1.18	6.80	-9.75	-92.41	11.79
District : Mewat					**Barley**	
GM	722.39	1156.66	723.33	695.08	709.19	991.21
Coefficient	-0.01	0.02	0.16	-0.03	0.25	-0.16
MVP	-0.76	0.69	9.01	-1.30	13.28	-6.00
Overall Western Zone						
GM	718.01	1155.94	632.42	845.39		
Coefficient	0.16	0.02	0.33	-0.22		
MVP	9.71	0.83	16.72	-8.05		

Reasons for imbalance uses of fertilizers

It is clear from the table 9, that in Eastern zone, about 78 per cent of the sample farmers did not use recommended doses of fertilizers due to 'non-availability of funds. About 68 per cent of the sampled farmers were at all not aware about the recommended doses of fertilizers. About 51 per cent farmers were not aware about their soil status. Surprisingly about 49 per cent of sample farmers expressed the view that the use of fertilizers was not economical. Lack of irrigation facilities on time was told by 45 per cent farmers. Twenty five per cent farmers were found health conscious and use their produce at their own, therefore, they didn't apply the fertilizers at the most. About 21 per cent respondents expressed the view that non-availability of fertilizers in desired quantity and in time is the reason for not using the recommended doses of fertilizer by them. Near about 10 per cent farmers compliant regarding under standards of fertilizers as Zinc etc, therefore, they have to apply more. Six per cent apply more fertilizers due to the desire of more production especially in rented land farmers.

However in western zone, about 74 per cent of the sample farmers did not use recommended doses of fertilizers due to non-availability of timely irrigation and 73 per cent of farmers reported 'non-availability of funds'. About 60 per cent of the sampled farmers were at all 'not aware about the recommended doses of fertilizers'. About 49 per cent farmers were not aware about their soil status. Surprisingly about 43 per cent of sample farmers expressed the view that the use of fertilizers was not economical. Twenty per cent farmers were found health conscious and use their produce at their own, therefore, they didn't apply the fertilizers at the most. About 19 per cent respondents expressed the view that non-availability of fertilizers in desired quantity and in time is the reason for not using the recommended doses of fertilizer by them. Near about 14 per cent farmers compliant regarding under

standards of fertilizers as Zinc etc, therefore, they have to apply more. Four per cent apply more fertilizers due to the desire of more production especially in rented land farmers.

Table 9: Reasons for imbalance uses of fertilizers by the eastern zone sample farmers

		Total number of farmers & Rank					
Sr. No.	**Reasons**	**Eastern Zone (Knl + Yngr)**	**Rank**	**Western Zone (Bhw + Mwt)**	**Rank**	**Joint**	**Rank**
1	Inadequate availability of funds	62 (78)	I	58 (73)	II	120 (75)	I
2	Higher Price of fertilizers	39 (49)	IV	34 (43)	V	73 (46)	V
3	Erratic supply of timely irrigation	36 (45)	V	59 (74)	I	95(59)	III
4	Imperfect knowledge about fertilizers	54 (68)	II	48 (60)	III	102(64)	II
5	Ill effects of fertilizers on health	20 (25)	VI	16 (20)	VI	36(23)	VI
6	Excessive use of fertilizers especially in rented land	5 (6)	VIII	3 (4)	VIII	8(5)	VIII
7	Unawareness about soil fertility/Least use of soil health card	41 (51)	III	39 (49)	IV	80(50)	IV
8	Non-availability of quantity fertilizers especially in cooperative societies in peak season.	17 (21)	VII	15 (19)	VII	32 (20)	VII

In eastern zone for *Rabi* crops maximum number of farmers reported inadequate availability of funds the main reason to not adopting recommended doses of fertilizers to their crops, however in western zone the most ranked reason is erratic supply of electricity for timely irrigation and in overall it comes the inadequate availability of funds as of eastern zone. In overall inadequate availability of funds is followed by imperfect knowledge about fertilizers, erratic supply of electricity for timely irrigation, unawareness about soil fertility/least use of soil heath card, high price of fertilizers, ill effects of fertilizers on health, non-availability of quantity fertilizers especially in cooperative societies in time. The least affected reason among the list found was excessive use of fertilizers especially in rented land for overall in both zones.

Fertilizer use pattern in *Kharif* season eastern and western zone of Haryana in 2020-21

In Haryana urea was the major source of Nitrogen (N) and all the farmers used N on their crops. Top-dressing was the most common method of application in the crops. The survey results showed the fertilizers use pattern for Coarse Rice, Fine Rice, Very Fine Rice and Jowar in Karnal and Yamunanagar districts (Table 10). Nitrogen, phosphate and potash applications in Coarse Rice, Fine Rice, Very Fine Rice and Jowar was 67, 64.47, 46.5 and 47.27 kg/acre, 22.2, 21.17, 18.73 and 14.03 kg/acre and 14.48, 14.10, 10.81 and 0.46 kg/acre in overall eastern zone, respectively. In Paddy PR crop maximum fertilizer was used followed by Fine Rice, Very Fine Rice and Jowar crop. The results showed that farmers of Karnal districts use more nitrogenous fertilizer then Yamunanagar farmers.

Table 10: Fertilizer use pattern for *Kharif* crops in eastern zone of Haryana (Kg/acre)

District: Karnal					
Crops↓ Fertilizer→	**N**	**P**	**K**	**Zn**	**S**
Coarse Rice	72.3	21.56	12.5	1.44	2.58
Fine Rice	74.38	20.32	11.0	1.61	2.59
Very Fine Rice	45.15	17.55	10.26	1.48	1.36
Jowar	54.33	15.52	0	0	0
District: Yamuna nagar					
Coarse Rice	61.7	22.8	16.5	1.5	3.0
Fine Rice	61.32	24.33	18.71	1.69	3.23
Very Fine Rice	48.82	20.76	11.75	1.32	0.66
Jowar	40.0	12.50	0.94	0.08	0.04
Overall Eastern Zone					
Coarse Rice	67.0	22.20	14.48	1.45	2.77
Fine Rice	64.47	21.17	14.10	1.58	2.83
Very Fine Rice	46.5	18.73	10.81	1.48	1.13
Jowar	47.27	14.03	0.46	0.04	0.02

The survey results showed that in western zone fertilizers use pattern for cotton, bajra, and jowar in Bhiwani and Mewat districts (Table 11). Nitrogen and phosphate applications in cotton, bajra and jowar was 52.21 and 26.61 kg/acre, 19 and 7.4 kg/acre and 46.37 and 21.93 kg/acre in overall eastern zone, respectively. In cotton crop maximum fertilizer was used followed by jowar and bajra crop. The results showed that farmers of Mewat districts use more fertilizer then Bhiwani farmers.

Table 11: Fertilizer use pattern for *Kharif* crops in western zone of Haryana (Kg/acre)

District: Bhiwani				
Crops↓ Fertilizer→	**N**	**P**	**K**	**Zn**
Cotton	42.92	27.94	32.76	3.23
Bajra	19.0	6.7	0	0
Jowar	46.7	21.9	0	0
Guar	4.03	6.93	0	0
District: Mewat				
Cotton	61.5	25.3	14.0	6.3
Bajra	19.0	8.1	0	0
Jowar	46.1	21.9	0	0
Fine Rice	57.9	21.6	11.2	7.2
Overall Western Zone				
Cotton	52.21	26.61	23.36	4.78
Bajra	19.0	7.4	0	0
Jowar	46.37	21.93	0	0

Cost incurred on various fertilizers for *Kharif* crops in eastern zone of Haryana

Cost incurred on fertilizer use pattern for Kharif crops in Haryana are presented in Table 12. Total cost incurred on fertilizers in Paddy PR, Fine Rice, Very Fine Rice and Jowar was Rs. 2710, 2610, 1996 and Rs. 1225 in overall, respectively. The results showed that in Yamuna Nagar district, the farmers of Paddy growers expended more on fertilizers than Karnal, however in case of Jowar, the farmers of Karnal district expended more on fertilizer.

Table 12: Cost incurred on fertilizer use pattern for *Kharif* crops in eastern zone of Haryana

(Rs./acre)

District: Karnal						
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**S**	**Total Expenditure**
Coarse Rice	943	1015	377	185	278	2520
Fine Rice	970	957	328	204	279	2458
Very Fine Rice	589	826	304	185	145	1904
Jowar	708	730	0	0	0	1439
District: Yamuna Nagar						
Coarse Rice	805	1075	485	185	321	2901
Fine Rice	800	1145	523	204	350	3022
Very Fine Rice	637	977	354	184	66	2088
Jowar	522	589	25	12	4	1147
Overall Eastern Zone						
Coarse Rice	874	1045	431	185	299	2710
Fine Rice	841	997	403	195	306	2610
Very Fine Rice	606	882	323	185	90	1996
Jowar	616	661	12	6	2	1295

In western zone, the costs incurred on fertilizer use pattern for *Rabi* crops in Haryana are presented in Table 13. Total cost incurred on fertilizers in cotton, bajra and jowar was Rs. 2974, 596 and Rs. 1637 in overall, respectively. The results showed that in Bhiwani district, the farmers of cotton and jowar growers expended more on fertilizers than Mewat, however in case of bajra, the farmers of Mewat district expended more on fertilizer.

Table 13: Cost incurred on fertilizer use pattern for *Kharif* crops in western zone of Haryana (Rs./acre)

District: Bhiwani					
Crops↓ Fertlizer→	**N**	**P**	**K**	**Zn**	**Total Expenditure**
Cotton	559.7	1315.3	873.8	282.4	3031.2
Bajra	247.6	316.5	0	0	564.1
Jowar	608.4	1032.7	0	0	1641.1
District: Mewat					
Cotton	802.1	1190.0	372.2	553.9	2918.10
Bajra	247.6	380.1	0	0	627.70
Jowar	600.9	1032.7	0	0	1633.60
Overall Western Zone					
Cotton	680.87	1252.63	623.02	418.14	2974.67
Bajra	248	348	0	0	596
Jowar	605	1033	0	0	1637

Fertilizer expenditure on sample farms in different *Kharif* crops

The expenditure on fertilizer to the total variable cost was found highest *i.e.* 13.83 per cent for Jowar crop, followed by coarse rice 11.26 per cent and Fine Rice 9.27 per cent in Karnal district and found least in very fine rice i.e. 8.08 per cent. In Yamunanagar district, highest expenditure on fertilizer to the total variable cost was found in Coarse Rice i.e.13.33 per cent, followed by fine rice 11.44 per cent, jowar 10.42 per cent and 1121 Paddy 8.82 per cent. Overall in eastern zone of Haryana the maximum parentage expenditure was found in coarse rice followed by jowar, fine rice and very fine rice crop (Table14).

The expenditure on fertilizer to the total variable cost was found highest *i.e.* 16.59 per cent for Jowar crop, followed by cotton 15.03 per cent Bhiwani district and found least in bajra i.e. 5.62 per cent. In Mewat district, highest expenditure on fertilizer to the total variable cost was also found in Jowar i.e.16.04 per cent, followed by Cotton 13.99 per cent and bajra 6.07 per cent. Overall in eastern zone of Haryana the maximum parentage expenditure was found in Jowar followed by cotton and bajra crop.

Table 14: Fertilizer expenditure on sample farms in different *Kharif* crops in eastern zone of Haryana **(Rs./acre)**

District: Karnal					
Crops	**Total Variable Cost (TVC)**	**Total Cost (TC)**	**Total Fertilizer Expenditure**	**% of fertilizer expenditure to TVC**	**% of fertilizer expenditure to TC**

Coarse Rice	22381	49922	2520	11.26	5.05
Fine Rice	26527	56442	2458	9.27	4.35
Very Fine Rice	23578	51375	1904	8.08	3.71
Jowar	10402	31453	1439	13.83	4.58
District: Yamuna Nagar					
Coarse Rice	21766	46724	2901	13.33	6.21
Fine Rice	26407	49488	3022	11.44	6.11
Very Fine Rice	23680	48038	2088	8.82	4.35
Jowar	11010	32961	1147	10.42	3.48
Overall Eastern Zone					
Coarse Rice	22073	48323	2710	12.28	5.61
Fine Rice	25199	52392	2610	10.36	4.98
Very Fine Rice	23640	50182	1996	8.44	3.98
Jowar	10701	32195	1295	12.10	4.02

Table 15: Fertilizer expenditure on sample farms in different *Kharif* crops in western zone of Haryana **(Rs./acre)**

District: Bhiwani					
Crops	**Total Variable Cost (TVC)**	**Total Cost (TC)**	**Total Fertilizer Expenditure**	**% of fertilizer expenditure to TVC**	**% of fertilizer expenditure to TC**
Cotton	20169	31420	3031	15.03	9.65
Bajra	10038	18475	564	5.62	3.05
Jowar	9893	31273	1641	16.59	5.25
District: Mewat					
Cotton	20843	42767	2918	13.99	6.82
Bajra	10342	20989	628	6.07	2.99
Jowar	10185	31623	1634	16.04	5.17
Overall Western Zone					
Cotton	20506	37093	2974	14.50	8.01
Bajra	10190	19732	596	5.84	3.02
Jowar	10039	31448	1637	16.30	5.20

Marginal value productivity

Cobb Douglas production function on coarse rice, fine rice, very fine rice and jowar growers in Karnal and Yamunanagar districts was employed to determine the efficiency level of individual resource used. The resources like nitrogen and phosphate were the major contributing exogenous variables in cultivation of these crops.

The production function analysis fitted for resource use in Karnal district reveals that the regression co-efficient of nitrogen were positive in coarse rice and very fine rice and phosphate in jowar (Table 16). While, in Yamunanagar district, regression co-efficient of nitrogen fertilizers were estimated to be positive in case of coarse rice, fine rice and jowar and phosphate in all the selected crops.

Similarly in overall nitrogen was positive in paddy and phosphate positive in fine rice, very fine rice and jowar crops. In overall eastern zone every five per cent increase in nitrogen would increase gross return by 16.05, 2.37 and 0.96 per cent for coarse rice, fine rice and very fine rice and phosphate would increase 0.11, 1.68 and 5.76 per cent for fine rice, very fine rice and jowar, respectively.

The MVP value of nitrogen and phosphate fertilizer under selected crops greater than unity indicates that all these inputs were underutilized in the respective districts and overall. On the other side, the value MVP were less than unity for the selected crops reflects that nitrogen and phosphate were over utilized and use of these inputs needs to be curtailed to higher returns. There was ample scope for exploitation the use of these resources to maximize the production and to increase the gross returns. It is imperative from the study that use of underutilized resources in the cultivation of selected crops resulted into higher yield while reduce the use of over utilized inputs caused in reduction of expenses incurred.

Table 16: Marginal value productivity of fertilizers use (N and P) in eastern zone of Haryana

District: Karnal								
Crops	**Coarse Rice**		**Fine Rice**		**Very Fine Rice**		**Jowar**	
Statistical Indicators	**N**	**P**	**N**	**P**	**N**	**P**	**N**	**P**
GM	939.82	992.97	874.66	801.90	577.84	779.78	703.64	683.03
Coefficient	0.14	-0.11	-0.28	-0.02	0.04	-0.02	-0.02	0.10
MVP	8.06	-5.93	-16.86	-1.36	3.09	-1.01	-0.88	4.65
District : Yamuna nagar								
GM	795.45	1075.24	718.74	1026.32	633.78	948.27	485.13	566.45
Coefficient	0.17	0.10	0.16	0.03	-0.03	0.21	0.22	0.03
MVP	10.93	4.99	10.93	1.45	-2.40	11.51	14.41	1.74
Overall Eastern Zone								
GM	864.63	1033.29	792.88	907.19	597.76	837.77	527.23	591.31
Coefficient	0.26	-0.12	0.04	0.002	0.0	0.0	-0.01	0.10
MVP	16.05	-6.11	2.37	0.11	0.96	1.68	-0.30	5.76

The production function analysis fitted for resource use in Bhiwani district reveals that the regression co-efficient of nitrogen was positive in cotton only and phosphate in cotton and bajra (Table 17). In Mewat district regression co-efficient of nitrogen fertilizers was positive in Cotton and Bajra and phosphate in all the selected crops.

Similarly in overall nitrogen was positive in all selected crops. In overall eastern zone every five per cent increase in nitrogen would increase gross return by 6.27, 587.46 and 1386.44 per cent for cotton, bajra and jowar and phosphate would increase 0.85, 1135.40 and -566.36 per cent for cotton, bajra and jowar, respectively.

Table 17: Marginal Value Productivity of fertilizers use (N and P) in Western Zone of Haryana

District: Bhiwani						
Crops	**Cotton**		**Bajra**		**Jowar**	
Statistical Indicators	**N**	**P**	**N**	**P**	**N**	**P**
GM	558.60	1311.42	247.47	314.58	607.76	1030.75
Coefficient	0.535	0.52	-0.10	0.008	-0.04	-0.38
MVP	26.04	10.83	-7.89	0.48	-2.43	-12.63
District: Mewat						
GM	796.14	1188.88	247.47	377.77	599.83	1030.75
Coefficient	0.069	0.72	0.00	0.028	-0.53	0.01
MVP	2.72	19.10	0.34	1.55	-30.13	0.43
Overall Western Zone						
GM	666.87	1248.65	247.47	344.73	603.78	1030.75
Coefficient	0.13	0.03	0.091	0.245	-0.30	-0.21
MVP	15.95	3.69	13.08	33.22	-39.67	-25.53

Reasons for imbalance uses of fertilizers

It is clear from the table 18, that in Eastern zone about 74 per cent of the sample farmers did not use recommended doses of fertilizers due to ‘non-availability of funds’.About 60 per cent of the sample farmers were at all ‘not aware about the recommended doses of fertilizers’. About 54 per cent farmers were not aware about their soil status. Surprisingly about 51 per cent of sample farmers expressed the view that the use of fertilizers was not economical. Lack of irrigation facilities on time was told by 40 per cent farmers. Twenty eight per cent farmers were found health conscious and use their produce at their own, therefore, they didn’t apply the fertilizers at the most. About 19 per cent respondents expressed the view that non-availability of fertilizers in desired quantity and in time is the reason for not using the recommended doses of fertilizer by them. Near about 11 per cent farmers compliant regarding under standards of fertilizers as Zinc etc, therefore, they have to apply more. Eight per cent apply more fertilizers due to the desire of more production especially in rented land farmers. None of the sample farmers reported about the quality of fertilizer responsible for not using the recommended doses of fertilizers.

In western zone, about 74 per cent of the sample farmers did not use recommended doses of fertilizers due to ‘non-availability of timely irrigation’. Whereas about 60 per cent of the sample farmers reported about insufficient funds available with them. 63 per cent farmers were ‘not aware about the recommended doses of fertilizers’. About 45 per cent farmers reported the higher amount of fertilizers. 23

per cent farmers also reported the non-availability of sufficient amount of fertilizers to use. 19 per cent farmers were found health conscious and use their produce at their own, therefore, they didn't apply the fertilizers at the most. Near about 13 per cent farmers compliant regarding under standards of fertilizers as Zinc etc, therefore, they have to apply more. Four per cent apply more fertilizers due to the desire of more production especially in rented land farmers. None of the sample farmers reported about the quality of fertilizer responsible for not using the recommended doses of fertilizers.

Table 18: Reasons for imbalance uses of fertilizers by the sample farmers

Sr. No.	Reasons	Total number of farmers & Rank					
		Eastern Zone	Rank	Western Zone	Rank	Joint	Rank
1	Inadequate availability of funds	59 (74)	I	55 (69)	II	114 (71)	I
2	Higher Price of fertilizers	41 (51)	IV	36 (45)	V	77 (48)	V
3	Erratic supply of electricity for timely irrigation	32 (40)	V	59 (74)	I	91(57)	III
4	Imperfect knowledge about fertilizers	48 (60)	II	50 (63)	III	98(61)	II
5	Ill effects of fertilizers on health	22 (28)	VI	15 (19)	VII	37(23)	VI
6	Excessive use of fertlizers especially in rented land	6 (8)	VIII	3 (4)	VIII	9(6)	VIII
7	Unawareness about soil fertility/Least use of soil health card	43 (54)	III	45 (6)	IV	88(55)	IV
8	Non-availability of quantity fertilizers especially in cooperative societies in peak season.	15 (19)	VII	18 (23)	VI	33 (21)	VII

(Figures in parentheses indicate the percentage to total number of sample farmers)

In eastern zone maximum number of farmers reported inadequate availability of funds the main reason to not adopting recommended doses of fertilizers to their crops, however in western zone the most ranked reason is erratic supply of electricity for timely irrigation and in overall it comes the inadequate availability of funds as of eastern zone. In overall inadequate availability of funds is followed by imperfect knowledge about fertilizers, erratic supply of electricity for timely irrigation, unawareness about soil fertility/least use of soil health card, higher price of fertilizers, ill effects of fertilizers on health, non-availability of quantity fertilizers especially in cooperative societies in peak season. The least affected reason among the list found was excessive use fertilizers especially in rented land for overall in both zones.

x. Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

***Rabi* 2019-20**

- In the eastern zone, more fertilizers have been used in Karnal than Yamunanagar district. In overall a maximum of Rs. 4163.39 is expended on fertilizer in sugarcane followed by 2903, 2449 & 2136 in maize, wheat & mustard respectively. However in western zone more fertilizers have been used in Mewat than Bhiwani district. Maximum expenditure on fertilizer was made in wheat crop (2501) followed by mustard crop (2048).
- The share of fertilizers to the total variable cost in eastern zone is maximum in mustard *i.e.* 22.42 per cent followed by wheat (18.03%), maize (12.88%) and sugarcane (7.28%) but in western Zone it was found maximum in mustard crop (19.13%) followed by wheat crop (13.95%).
- In eastern zone, in overall this implies that every five per cent increase in nitrogen would increase gross return by 0.075, 0.10, 0.52 and 0.04 per cent for wheat, mustard, maize and sugarcane respectively.
- In western zone, every five per cent increase in nitrogen would increase gross return by 9.71 and 16.72 per cent for wheat & mustard and phosphate would increase 0.83 per cent for wheat.
- The MVP analysis for eastern zone in overall reveals that MVP in nitrogen was found 4.09 in wheat, 4.8 in mustard, 37.79 in maize and 4.81 in sugarcane and MVP of phosphate in wheat was 1.10, 1.83 in maize and 3.44 in sugarcane. The MVP analysis for western zone in overall reveals that MVP in nitrogen was found 9.71 in wheat and 16.72 in mustard and MVP of phosphate in wheat was 0.83, -8.5 in mustard.
- The MVP value of nitrogen and phosphorus fertilizers under selected crops greater than unity indicate that all these inputs were underutilized and if MVP is less than unity then it reflects that N & P were over utilized and the use of these inputs need to be curtailed to higher returns.
- In overall inadequate availability of funds is followed by imperfect knowledge about fertilizers, erratic supply of electricity for timely irrigation, unawareness about soil fertility/least use of soil heath card, high price of fertilizers, ill effects of fertilizers on health, non-availability of quantity fertilizers especially in cooperative societies in time.

Kharif-2020

- In the eastern zone for Kharif crops, more fertilizers have been used in Karnal compared to Yamunanagar district. The share of fertilizers to the total variable cost is maximum in jowar *i.e.* 13.83 per cent followed by coarse rice (11.26%), fine rice (9.27%) and very fine rice (8.08%).
- In western zone for Kharif crops, more fertilizers have been used in Mewat compared to Bhiwani district. The share of fertilizers to the total variable cost is maximum in jowar *i.e.* 16.3 per cent followed by cotton (14.5%) and bajra (5.24%).
- In overall eastern zone every five per cent increase in nitrogen would increase gross return by 16.05, 2.37 and 0.96 per cent for coarse rice, fine rice and very fine rice and phosphate would increase 0.11, 1.68 and 5.76 per cent for fine rice, very fine rice and jowar, respectively.
- In overall eastern zone every five per cent increase in nitrogen would increase gross return by 15.95, 13.08 and -39.67 per cent for cotton, bajra and jowar and phosphate would increase 3.69, 33.22 and -25.53 per cent for cotton, bajra and jowar, respectively.

- The MVP analysis in overall eastern zone reveals that MVP in nitrogen was found 16.05 in Coarse Rice, 2.37 in Fine Rice, 0.96 in very fine rice and -0.3 in jowar and MVP of phosphate in p-pr was -6.11, 0.11 in Fine Rice, 1.68 in very fine rice and 5.76 in jowar. whereas in overall western zone reveals that MVP in nitrogen was found 15.95 in cotton, 13.08 in bajra and -39.67 in jowar and MVP of phosphate in cotton was 3.69, 33.22 in bajra, -25.53 in jowar.
- In eastern zone maximum number of farmers reported inadequate availability of funds the main reason to not adopting recommended doses of fertilizers to their crops, however in western zone the most ranked reason is erratic supply of electricity for timely irrigation and in overall it comes the inadequate availability of funds as of eastern zone. The least affected reason among the list found was excessive use fertilizers especially in rented land for overall in both zones.

Conclusion

In the eastern zone for Kharif crops, the share of fertilizers to the total variable cost was estimated to be maximum in jowar i.e. 13.83 per cent followed by coarse rice (11.26%), fine rice (9.27%) and very fine rice (8.08%). Whereas, in Rabi crops, share of fertilizers to the total variable cost, was maximum in mustard i.e. 22.42 per cent followed by wheat (18.03%), maize (12.88%) and sugarcane (7.28%). Similarly, in western zone, in case of Kharif crops, share of fertilizers to the total variable cost were found to be maximum in jowar i.e. 16.3 per cent followed by cotton (14.5%) and bajra (5.24%). While, in Rabi season, it was found maximum in mustard crop (19.13%) followed by wheat crop (13.95%). The use of every five per cent increase in nitrogen would increase gross return for *rabi* crops like wheat, mustard, maize and sugarcane in eastern zone and would increase gross return for wheat, mustard & phosphate for wheat crop in western zone. In *kharif* crops in eastern zone increase in nitrogen would increase gross return for paddy (coarse rice, fine rice & very fine rice) and phosphorous would increase paddy (fine rice, very fine rice) and jowar. However in western zone the certain increase in nitrogen and phosphate would increase gross return for cotton & bajra crops. MVP analysis revealed that in *rabi* crops the MVP in nitrogen was more than unity for wheat, mustard, maize & sugarcane (eastern zone) and for wheat & mustard (Western zone) and MVP in phosphate was more than unity in wheat, maize, sugarcane (eastern zone) and for wheat crop (Western zone) indicated the overutilization of resources. In overall for both *rabi* & *kharif* season the outmost reason reported by farmers for not using recommended dose of fertilizers was imperfect knowledge of fertilizers followed by erratic supply of electricity for timely irrigation, unawareness about soil fertility, higher price of fertilizers, ill effects of fertilizers on health.

i	**Experiment No. 14: Comparative analysis of cost, returns and labour hours impact on production of major crops in Haryana with highest producing state in India.**	
ii	**Objectives of the experiment**	• Comparison of input use pattern of major crops in Haryana along with major producing state • To analysis the growth in costs and returns of major crops in Haryana viz a viz major producing state • To study the pattern of labour hours used in the production of major crops in Haryana and highest producing state • To suggest policy measure for sustainability in production

		of major crops in Haryana
iii	**Name(s) of the investigators**	• Dr. Vijay Kumar Planning, monitoring, data Collection and report writing • Dr. Sumit Analysis and report writing.
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Joginder Interview schedule and statistical analysis
v	**Year of start**	**2020-21**
vi	**Duration of study**	One year
vii	**Treatment details**	• **Locale of experiment:** Haryana and India. • **Data Collection:** The data were collected from the all possible secondary sources as DES-DoACFW, Statistical Abstracts, MOSPI, CACP and other reports and journal. • **Statistical design/methods:** The descriptive statistics mean, percentage and suitable analytical model were used for the comparative analysis.
viii	**Observations recorded**	• Information related to inputs used in production of crops in Haryana and major producing state in India. • The cost and returns data were collected from various sources for comparative analysis. • All kind of labour hours detail was analysed to find impact on production of crops. • For trend of growth in cost and return, at least 10 years data will be analysed.

ix. Results achieved during 2020-21

Comparison of input use pattern of major crops in Haryana with highest producing state

The compound growth rate was calculated for all the six crops of Haryana State along with highest producing state. In bajra crop the CAGR for human labour, bullock labour, seed and irrigation charges is higher but the CAGR of Haryana is higher for machine labour and fertilizer & manure then Gujarat. In overall look the CAGR of bullock labour is decreasing in Haryana then its competitive producing states. The CAGR of Haryana state is higher for machine labour and fertilizer & manure then Gujarat for bajra, Punjab for paddy, wheat and cotton, Tamilnadu for sugarcane & MP for gram.

Table 1: Comparison of Haryana's average input use pattern of bajra, paddy, wheat, cotton, sugarcane & gram crop with highest producing states.

States	Inputs	CAGR (%)	States	CAGR (%)			States	CAGR (%)	States	CAGR (%)
		Bajra		Paddy	Wheat	Cotton		Sugarcane		Gram
HRY	**Human Labour**	9.97	**HRY**	8.82	8.72	9.77	**HRY**	9.53	**HRY**	22.26
GUJ		10.41	**PUN**	9.84	5.52	9.97	**TND**	9.87	**MP**	15.61
HRY	**Bullock**	-10.97	**HRY**	-	-	-2.73	**HRY**	-	**HRY**	-

GUJ	**Labour**	2.52	**PUN**	2.38	-1.68	3.01	**TND**	-	**MP**	0.33
HRY	**Machine labour**	12.40	**HRY**	8.10	8.81	11.69	**HRY**	9.36	**HRY**	12.36
GUJ		9.49	**PUN**	6.12	8.06	6.07	**TND**	5.13	**MP**	12.51
HRY	**Seed**	9.34	**HRY**	7.73	6.87	17.81	**HRY**	12.10	**HRY**	9.37
GUJ		12.56	**PUN**	8.52	7.73	15.71	**TND**	1.99	**MP**	11.88
HRY	**Fertilizer & Manure**	11.62	**HRY**	4.74	5.09	11.05	**HRY**	9.35	**HRY**	-
GUJ		8.27	**PUN**	3.92	5.14	10.97	**TND**	5.14	**MP**	14.62
HRY	**Insecticides**	-	**HRY**	7.75	4.94	2.64	**HRY**	7.58	**HRY**	-
GUJ		-	**PUN**	9.50	4.85	1.44	**TND**	8.84	**MP**	20.34
HRY	**Irrigation Charges**	5.53	**HRY**	7.52	8.64	10.65	**HRY**	3.60	**HRY**	-
GUJ		13.87	**PUN**	2.10	3.07	3.92	**TND**	4.73	**MP**	15.50

Table 1(i): Comparison of quinquennium average input use patter of bajra crop with Gujarat

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Human Labour	4060.94	4159.03	8942.32	15188.92	**9.97**
Gujarat		3867.68	4510.75	8391.44	16728.22	**10.41**
Haryana	Bullock Labour	406.30	418.95	541.96	89.75	**-10.97**
Gujarat		399.37	352.97	519.48	487.74	**2.52**
Haryana	Machine labour	1094.62	1728.77	3441.76	6010.58	**12.40**
Gujarat		1246.46	2013.02	3223.01	4902.58	**9.49**
Haryana	Seed	243.28	365.36	651.07	866.69	**9.34**
Gujarat		336.13	554.81	1113.63	1882.66	**12.56**
Haryana	Fertilizer & Manure	347.46	437.58	956.84	1688.26	**11.62**
Gujarat		1224.40	1559.61	2519.64	4065.75	**8.27**
Haryana	Insecticides	1.14	4.78	9.63	71.63	**-**
Gujarat		1.36	3.61	36.12	52.17	**-**
Haryana	Irrigation Charges	411.98	406.33	337.02	882.31	**5.53**
Gujarat		715.25	815.68	1843.46	4897.35	**13.87**

The use of inputs as Human labour, bullock labour, seed and irrigation is more in Gujarat then of Haryana but Machine labour and fertilizers are used in Haryana at higher side.

Table 1 (ii): Comparison of quinquennium average input use patter of paddy crop with Punjab

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Human Labour	6447.68	8211.46	15245.16	22215.09	**8.82**
Punjab		4108.77	4987.06	10868.32	15493.29	**9.84**

Haryana	Bullock Labour	74.43	94.30	126.04	36.69	**#NUM!**
Punjab		40.27	66.25	117.38	37.21	**2.38**
Haryana	Machine labour	1711.54	2866.58	3785.18	5802.55	**8.10**
Punjab		2620.30	3270.01	4698.56	6295.31	**6.12**
Haryana	Seed	461.36	583.29	958.85	1322.40	**7.73**
Punjab		524.20	639.73	1222.38	1702.77	**8.52**
Haryana	Fertilizer & Manure	2248.56	2708.22	3067.62	4655.12	**4.74**
Punjab		2138.96	2495.04	3305.26	3748.68	**3.92**
Haryana	Insecticides	798.07	1424.16	1729.67	2601.38	**7.75**
Punjab		1054.03	1415.94	2438.66	4135.14	**9.50**
Haryana	Irrigation Charges	2354.95	2997.93	4820.43	6528.90	**7.52**
Punjab		1969.76	2483.90	1904.16	2612.96	**2.10**

The use of inputs in Paddy as Human labour, bullock labour, seed and insecticides are more in Punjab then of Haryana but Machine labour, fertilizers and irrigation are used in Haryana at higher side.

Table 1 (iii): Comparison of quinquennium average input use patter of wheat crop with Punjab

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Human Labour	3648.73	4504.94	8897.56	12191.05	**8.72**
Punjab		2771.60	2654.50	4602.67	5704.97	**5.52**
Haryana	Bullock Labour	205.80	313.39	205.74	67.88	**-**
Punjab		76.38	76.60	76.05	48.41	**-1.68**
Haryana	Machine labour	2584.18	4071.53	6143.61	9042.33	**8.81**
Punjab		2867.76	4205.93	6235.42	8844.37	**8.06**
Haryana	Seed	915.70	1177.25	1784.46	2438.62	**6.87**
Punjab		736.09	984.31	1689.08	2179.65	**7.73**
Haryana	Fertilizer & Manure	2072.88	2500.41	3203.31	4351.78	**5.09**
Punjab		2467.55	2863.82	3786.71	5199.86	**5.14**
Haryana	Insecticides	498.63	663.82	684.87	1035.81	**4.94**
Punjab		846.94	1087.18	1317.03	1693.68	**4.85**
Haryana	Irrigation Charges	1328.73	1890.28	3104.25	4303.83	**8.64**
Punjab		350.66	500.59	403.32	527.95	**3.07**

The use of inputs in wheat as seed and fertilizers is more in Punjab then of Haryana but Human labour, machine labour, insecticide and irrigation are used in Haryana at higher side.

Table 1 (iv): Comparison of quinquennium average input use patter of cotton crop with Punjab

	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Human Labour	6735.398	9067.844	19424.62	25652.392	**9.77**
Punjab		5649.316	8810.104	16534.492	22963.428	**9.97**

Haryana	Bullock Labour	770.788	1105.128	1031.78	507.348	**-2.73**
Punjab		165.83	171.05	219.156	195.728	**3.01**
Haryana	Machine labour	844.584	1829.234	2833.954	4691.474	**11.69**
Punjab		2587.142	2854.734	4258.178	5855.224	**6.07**
Haryana	Seed	415.404	1061.11	3895.882	4287.242	**17.81**
Punjab		603.356	2675.698	4770.912	5419.204	**15.71**
Haryana	Fertilizer & Manure	636.956	1171.566	2119.016	3189.494	**11.05**
Punjab		783.308	1671.932	2970.804	3602.508	**10.97**
Haryana	Insecticides	1322.55	2080.144	1786.324	2295.024	**2.64**
Punjab		5290.662	3781.358	3880.17	6158.684	**1.44**
Haryana	Irrigation Charges	751.75	1691.34	2675.456	3326.996	**10.65**
Punjab		381.824	765.678	354.998	615.504	**3.92**

The costs incurred on use of inputs in Cotton crops as Human labour, bullock labour is more in Gujarat then of Haryana but Machine labour, seed, fertilizers, insecticide and irrigation are used in Haryana at higher side.

Table 1 (v): Comparison of quadrennial average input use patter of sugarcane crop with Tamilnadu

State	Particulars	1998-99 to 2001-02	2002-03 to 2005-06	2006-07 to 2009-10	2010-11 to 2013-14	CAGR (%)
Haryana	Human Labour	10234.31	12386.18	24370.23	27644.21	9.53
Tamilnadu		24615.02	24586.36	38304.19	78313.14	9.87
Haryana	Bullock Labour	67.98	446.22	342.10	241.89	-
Tamilnadu		250.64	365.46	189.21	665.85	-
Haryana	Machine labour	1071.47	2319.35	1348.96	3713.11	9.36
Tamilnadu		736.83	1154.59	1091.65	1686.21	5.13
Haryana	Seed	2056.98	3524.00	2639.87	8611.36	12.10
Tamilnadu		4100.67	4579.52	3276.68	7026.63	1.99
Haryana	Fertilizer & Manure	1599.40	2550.22	3698.37	4273.66	9.35
Tamilnadu		5561.88	6045.13	5871.74	11355.44	5.14
Haryana	Insecticides	544.20	852.03	644.90	1777.00	7.58
Tamilnadu		171.97	209.28	356.90	432.13	8.84
Haryana	Irrigation Charges	1904.39	2175.85	2417.21	2931.40	3.60
Tamilnadu		1924.46	3441.40	3166.31	4016.69	4.73

The costs incurred on use of inputs in Sugarcane crops as Human labour, insecticides and irrigation is more in Tamilnadu then of Haryana but Machine labour, seed and fertilizers are used in Haryana at higher side.

Table 1 (vi): Comparison of triennium average input use patter of gram crop with MP

State	Particulars	2006-07 to	2009-10 to	2012-13 to	2015-16 to	CAGR

		2008-09	2011-12	2014-15	2017-18	(%)
Haryana	Human Labour	2230.43	12464.92	10642.95	14033.84	22.26
MP		2262.96	3934.20	6317.69	8272.47	15.61
Haryana	Bullock Labour	286.14	267.58	19.94	3.63	-
MP		518.64	439.31	491.53	572.59	0.33
Haryana	Machine labour	1722.51	3140.44	3380.68	4943.58	12.36
MP		1797.87	2735.92	3965.12	5158.81	12.51
Haryana	Seed	1118.15	4999.72	1569.32	2895.57	9.37
MP		2428.02	2854.71	4390.80	6888.03	11.88
Haryana	Fertilizer & Manure	48.67	1354.96	164.14	72.46	-
MP		534.41	834.70	1641.87	1710.99	14.62
Haryana	Insecticides	0.00	479.99	38.33	162.49	-
MP		215.70	566.02	797.74	1282.23	20.34
Haryana	Irrigation Charges	100.25	1068.33	358.63	437.26	-
MP		685.68	784.91	1606.47	2170.82	15.50

The CAGR of inputs in gram crops as bullock labour, machine Labour, seed, fertilizers, insecticide and irrigation are more in Madhya Pradesh then of Haryana but Human labour is used in Haryana at higher side.

II. To analysis the growth in costs and returns of major crops in Haryana viz-a-viz highest producing state

The CAGR in total cost of paddy, wheat, cotton, sugarcane and gram crop is higher in Haryana, than Punjab (paddy, wheat, cotton), Tamil Nadu and Madhya Pradesh respectively however it is more in Gujarat for bajra crop.

Table 2: Growth in costs and returns of bajra, paddy, wheat, cotton, sugarcane & gram crop in Haryana and Gujarat

State	Inputs	CAGR (%)	State	CAGR (%)			State	CAGR (%)	State	CAGR (%)
		Bajra		Paddy	Wheat	Cotton		Sugarcane		Gram
HRY	Total Cost (Rs./ha)	10.22	HRY	8.55	8.22	9.61	HRY	8.35	HRY	17.16
GUJ		10.33	PUN	8.37	7.04	8.72	TND	7.28	MP	11.79
HRY	Cost of Production (Rs./qtl)	6.56	HRY	6.74	7.16	6.46	HRY	7.68	HRY	5.28
GUJ		6.01	PUN	6.92	6.48	4.62	TND	8.20	MP	8.57
HRY	Value of Main	10.56	HRY	10.02	7.60	9.55	HRY	8.87	HRY	19.79

GUJ	**Production (Rs./ha)**	10.36	**PUN**	9.21	7.42	10.32	**TND**	8.53	**MP**	11.36
HRY	**Value of By-Product (Rs./ha)**	9.89	**HRY**	10.59	9.85	12.34	**HRY**	11.46	**HRY**	8.55
GUJ		12.58	**PUN**	9.40	7.23	12.76	**TND**	7.38	**MP**	10.73

The CAGR in total cost is higher in Gujarat then Haryana state {Table-2 (i)}.

Table 2 (i) : Growth in costs and returns of bajra crop in Haryana and Gujarat

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Total Cost (Rs./ha)	9845.52	11600.28	23536.52	38677.49	**10.22**
Gujarat		10769.82	13452.02	25623.12	45705.87	**10.33**
Haryana	Cost of Production (Rs./qtl)	604.10	677.87	1039.62	1504.49	**6.56**
Gujarat		504.28	570.74	783.33	1197.08	**6.01**
Haryana	Value of Main Production (Rs./ha)	5405.46	7619.45	16416.92	22776.97	**10.56**
Gujarat		8788.80	11415.75	24460.58	36548.48	**10.36**
Haryana	Value of By-Product (Rs./ha)	1963.24	2054.90	3881.82	7793.50	**9.89**
Gujarat		3289.89	3885.76	10390.60	17662.22	**12.58**

The CAGR in total cost for paddy crop is higher in Haryana then Punjab state {Table-2 (ii)}.

Table 2 (ii): Growth in costs and returns of paddy crop in Haryana and Punjab

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Total Cost (Rs./ha)	23184.65	32172.23	51937.00	78935.48	**8.55**
Punjab		23095.50	31173.88	53155.59	74743.28	**8.37**
Haryana	Cost of Production (Rs./qtl)	589.55	660.35	1195.10	1498.88	**6.74**
Punjab		413.94	472.36	825.70	1074.18	**6.92**
Haryana	Value of Main Production (Rs./ha)	26260.06	41965.99	70371.66	110226.52	**10.02**
Punjab		29417.96	43174.19	72743.96	108086.89	**9.21**
Haryana	Value of By-Product (Rs./ha)	425.05	708.59	1072.36	1933.76	**10.59**
Punjab		188.94	313.89	751.88	615.97	**9.40**

The CAGR in total cost for Wheat crop is higher in Haryana then Punjab state {Table-2 (iii)}.

Table 2(iii): Growth in costs and returns of wheat crop in Haryana and Punjab

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Total Cost (Rs./ha)	20876.87	27180.06	45269.61	66112.21	**8.22**
Punjab		21851.30	27217.20	43011.88	58217.55	**7.04**
Haryana	Cost of Production (Rs./qtl)	434.15	573.83	842.70	1211.71	**7.16**
Punjab		435.24	563.98	870.85	1080.31	**6.48**
Haryana	Value of Main	24901.94	30671.05	53695.52	70126.36	**7.60**

Punjab	Production (Rs./ha)	26879.96	32836.91	53022.83	74429.16	**7.42**
Haryana	Value of By-Product (Rs./ha)	3862.62	5587.10	10756.75	14968.73	**9.85**
Punjab		3175.71	4078.30	6401.24	8882.12	**7.23**

The CAGR in total cost for Cotton crop is higher in Haryana then Punjab state {Table-2 (iv)}.

Table 2(iv): Growth in costs and returns of cotton crop in Haryana and Punjab

State	Years	1998-99 to 2002-03	2003-04 to 2007-08	2008-09 to 2012-13	2013-14 to 2017-18	CAGR (%)
Haryana	Total Cost (Rs./ha)	17640.44	28570.36	53842.63	68408.38	**9.61**
Punjab		22797.27	35702.06	60671.08	76821.65	**8.72**
Haryana	Cost of Production (Rs./qtl)	2312.40	1890.50	2873.39	5228.85	**6.46**
Punjab		2505.52	1760.74	2961.87	4700.83	**4.62**
Haryana	Value of Main Production (Rs./ha)	16745.67	30644.63	66799.54	59973.87	**9.55**
Punjab		17531.13	40931.65	71691.83	79336.22	**10.32**
Haryana	Value of By-Product (Rs./ha)	695.59	869.60	2446.95	3540.44	**12.34**
Punjab		842.91	1619.11	3463.93	4959.42	**12.76**

The CAGR in total cost for Sugarcane crop is higher in Haryana then Tamilnadu state {Table-2 (v)}.

Table 2(v): Growth in costs and returns of sugarcane crop in Haryana and Tamilnadu

State	Years	1998-99 to 2001-02	2002-03 to 2005-06	2006-07 to 2009-10	2010-11 to 2013-14	CAGR (%)
Haryana	Total Cost (Rs./ha)	40467.43	49488.23	64335.09	104856.36	**8.35**
Tamilnadu		60926.48	62713.70	84874.74	140537.50	**7.28**
Haryana	Cost of Production (Rs./qtl)	66.56	79.26	95.32	169.46	**7.68**
Tamilnadu		53.31	69.04	92.68	137.46	**8.20**
Haryana	Value of Main Production (Rs./ha)	57131.22	63544.06	96174.79	148569.25	**8.87**
Tamilnadu		86335.44	77899.78	128735.60	216257.18	**8.53**
Haryana	Value of By-Product (Rs./ha)	1713.19	2468.12	3295.14	7991.80	**11.46**
Tamilnadu		1538.93	1541.92	2647.20	3239.78	**7.38**

The CAGR in total cost for Gram crop is higher in Haryana then Madhya Pradesh {Table-2 (vi)}.

Table 2(vi): Growth in costs and returns of gram crop in Haryana and MP

State	Years	2006-07 to 2008-09	2009-10 to 2011-12	2012-13 to 2014-15	2015-16 to 2017-18	CAGR (%)
Haryana	Total Cost (Rs./ha)	10714.92	16359.96	29629.26	43368.97	**17.16**
MP		15901.22	22357.99	31230.54	43797.57	**11.79**
Haryana	Cost of Production (Rs./qtl)	2348.19	2892.10	3138.25	3549.40	**5.28**
MP		1572.14	1898.00	2851.01	3171.90	**8.57**

Haryana	Value of Main Production (Rs./ha)	11527.56	14994.55	31538.15	59394.16	**19.79**
MP		21091.15	29558.84	35013.27	60910.20	**11.36**
Haryana	Value of By-Product (Rs./ha)	1154.99	1637.62	3277.10	2417.11	**8.55**
MP		1135.54	1427.41	1859.30	2903.71	**10.73**

II. To study the impact of labour hours to the production of major crops in Haryana and highest producing state

The impact of labour hours used in the production of major crops in Haryana and highest producing state is presented in Table 3 and 4. The production of paddy, wheat and cotton crops compare with highest producing state i.e. Punjab, shows negative and significant behaviour in paddy crop with human labour (-0.044 and -0.12) in both the state and animal labour also shows negative and significant behaviour in Haryana but positive and significant in Punjab, which indicating 2.975 per cent increase in labour hour increases one per cent in production. Almost 36 per cent and 48.19 per cent variation could be explained by these variables in Haryana and Punjab state in paddy crop, respectively. In wheat crop human and animal labour shows negative and non-significant behaviour in both the states. In cotton crop human labour shows significant behaviour in both the states, which indicating that 0.037 per cent in Haryana and 0.054 per cent in Punjab increases one per cent of production and animal labour in both the states shows negative and non-significant behaviour. Nearly 78 per cent and 64.20 per cent variation could be explained by these variables in Haryana and Punjab state in cotton crop, respectively (Table 3). The production of bajra in Haryana and Gujarat shows negative and significant behaviour with animal labour (-0.337 and -0.314) and non-significant behaviour with human labour (0.006 and 0.016) in both the state, respectively. Almost 36.47 per cent and 72.15 per cent variation could be explained by these variables in Haryana and Gujarat state in bajra crop, respectively. The production of sugarcane crop compare with Tamilnadu state shows significant with human labour (0.344 and 0.414) and non-significant with animal labour (-3.24 and -1.8) in both the states, respectively. Almost 83.74 per cent and 71.46 per cent variation could be explained by these variables in Haryana and Tamilnadu state in sugarcane crop, respectively The production of gram crop compare with MP state shows non-significant human labour in Haryana but significant in MP i.e. (0.087) and animal labour shows non-significant in both the state (Table 4).

Table 3: Impact of labour hours to the production of paddy, wheat and cotton in Haryana with highest producing states

Variables	PADDY				WHEAT				Cotton			
	HRY		PUN		HRY		PUN		HRY		PUN	
	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
Constant	72.427		108.679		50.402		47.966		-6.973		-11.67	
Human Labour (Man hours)	-0.044* (0.02)	-2.604	-0.12* (0.03)	-4.193	-0.021^{NS} (0.02)	-853	-0.006^{NS} (0.02)	-383	0.037* (0.01)	7.803	0.054* (0.01)	5.051
Animal Labour (Pair Hours)	-0.57* (0.29)	-1.953	2.975* (1.49)	2.001	-0.278^{NS} (0.16)	-1.724	-1.614^{NS} (1.32)	-1.219	-0.152* (0.03)	-4.849	-2.67* (0.54)	-4.936
R^2	**0.3561**		**0.4819**		**0.3410**		**0.2063**		**0.7762**		**0.6420**	

Note: * denote significance at 5 per cent levels, respectively.

NS means non-significant. Figures within the parentheses indicate the standard error.

Table 4: Impact of labour hours to the production of bajra, sugarcane and gram in Haryana with highest producing states

Variables	BAJRA				SUGARCANE				GRAM			
	Haryana		Gujarat		HRY		Tamilnadu		HRY		MP	
	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
Constant	**16.993**		**17.427**		**253.513**		**69.888**		**9.092**		**-10.428**	
Human Labour (Man hours)	**0.006NS (0.02)**	**0.285**	**0.016NS (0.02)**	**1.029**	**0.344* (0.05)**	**7.623**	**0.414* (0.07)**	**0.344 (0.05)**	**0NS (0.004)**	**0.023**	**0.087* (0.03)**	**3.355**
Animal Labour (Pair Hours)	**-0.337* (0.11)**	**-3.024**	**-0.314* (0.05)**	**6.608**	**-3.24NS (1.88)**	**-1.728**	**-1.8NS (2.39)**	**-3.24 (1.88)**	**-0.549NS (0.258)**	**-2.126**	**-0.015NS (0.06)**	**-0.256**
R2	**0.3647**		**0.7215**		**0.8374**		**0.7146**		**0.3369**		**0.7163**	

Note: * denote significance at 5 per cent levels, respectively.

NS means non-significant. Figures within the parentheses indicate the standard error.

Suggestions regarding policy measure for sustainability in production of major crops in Haryana:-

The major yield gaps are due to lack of proper management practices. These shall be narrowed down by undertaking appropriate interventions and evolving strategic Road Map as we move forward to implement this agriculture policy. In this context, some action points are proposed as under: Action Points

- To follow scientific land use planning taking into account competing uses, climate change, cropping system, soil health, water availability, declining TFP, etc.
- Encourage public-private partnership in hybrid/quality seed production and formation of seed villages with proper technical knowhow/backup.
- Production, testing and distribution/sale of improved seeds, tools, small farm implements and machinery, by involving private sector for greater participation through creation of enabling environment.
- Support for viable units of integrated farming systems (IFS), with emphasis on greater diversification. Also to promote inter-cropping/ multiple cropping to harness spatial and temporal advantages of different crops and to encourage organic agriculture in selected areas to reduce and stabilize cost of cultivation.
- Promoting lab to land and land to lab activities at quick pace and Organize farmer field schools (with emphasis on women farmers) and impart training on various aspects of IFS, value addition, in the use of best production practices involving champion farmers. Organize exposure visits of farmers and development workers for cross learning to the sites of success stories.
- Strengthening of research on climate smart agriculture would increase the productivity of agriculture in the state.
- Initiation of State Insurance Scheme for major agricultural enterprises, besides availing of provisions under centrally sponsored scheme would be a welcome move.
- Adequate and timely supply of credit with easy terms and conditions to farmers would enhance production by masses.

x. Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

- In overall view the CAGR of bullock labour is decreasing in Haryana then its competitive producing states. the CAGR of Haryana state is higher for machine labour and fertilizer & manure then Gujarat for bajra, Punjab for paddy, wheat & cotton, Tamil nadu for sugarcane & MP for gram.
- The use of inputs in bajra crop as human labour, bullock labour, seed and irrigation is more in Gujarat then of Haryana but Machine labour and fertilizers was used in Haryana at higher side.
- The use of inputs as human labour, bullock labour, seed and insecticides in paddy, seed and fertilizers in wheat, human labour, bullock labour in cotton was more in Punjab state than Haryana but machine labour, fertilizers and irrigation in paddy, human labour, machine labour, insecticide and irrigation in wheat, machine labour, seed, fertilizers, insecticide and irrigation in cotton was used at higher amount in Haryana State.
- The costs incurred on use of inputs in Sugarcane crops as Human labour, insecticides and irrigation were more in Tamilnadu than Haryana but Machine labour, seed and fertilizers used in

Haryana was at higher side. The CAGR of inputs in Gram crops as bullock labour, Machine Labour, seed, fertilizers, insecticide and irrigation were more in MP then of Haryana but Human labour used in Haryana was at higher side.

- The cost analysis shows that the CAGR in total cost of paddy, wheat, cotton, Sugarcane and Gram crop was higher in Haryana, than Punjab (paddy, wheat, and cotton), Tamil Nadu and Madhya Pradesh respectively however it was more in Gujarat for bajra crop.
- The production of paddy, wheat and cotton crops compare with highest producing state *i.e.* Punjab, shows negative and significant behavior in paddy crop with human labour in both the state and animal labour also shows negative and significant behavior in Haryana but positive and significant in Punjab, which indicating 2.975 per cent increase in labour hour increases one per cent in production. Almost 36 per cent and 48.19 per cent variation could be explained by these variables in Haryana and Punjab state in paddy crop, respectively.
- In wheat crop human and animal labour shows negative and non-significant behavior in both the states and in cotton crop human labour shows significant behavior in both the states, which indicating that 0.037 per cent in Haryana and 0.054 per cent in Punjab increases one per cent of production and animal labour in both the states shows negative and non-significant behavior. Nearly 78 per cent and 64.20 per cent variation could be explained by these variables in Haryana and Punjab state in cotton crop, respectively.
- The production of bajra in Haryana and Gujarat shows negative and significant behavior with animal labour and non-significant behavior with human labour in both the state, respectively. Almost 36.47 per cent and 72.15 per cent variation could be explained by these variables in Haryana and Gujarat state in bajra crop, respectively.
- The production of sugarcane crop compare with Tamilnadu state shows significant with human labour and non-significant with animal labour in both the states, respectively. Almost 83.74 per cent and 71.46 per cent variation could be explained by these variables in Haryana and Tamilnadu state in sugarcane crop, respectively.
- The production of gram crop compare with MP state shows non-significant human labour in Haryana but significant in MP i.e. (0.087) and animal labour shows non-significant in both the state.
- The major yield gaps are due to lack of proper management practices. By adopting the under given policies Haryana State probably be stabilize their production level upto mark, these policies may be, - To follow scientific land use planning taking into account competing uses, climate change, cropping system, soil health, water availability, declining TFP, etc., encourage public-private partnership in hybrid/quality seed production and formation of seed villages with proper technical knowhow/backup and Strengthening of research on climate smart agriculture would increase the productivity of agriculture in the state.

Conclusion

The CAGR of Bullock labour is decreasing in Haryana then its competitive producing states. As we compare paddy, wheat, cotton, bajra, sugarcane and gram crops with highest producing states and found that most of the inputs like machine labour, irrigation, insecticides were higher in Haryana. So, Haryana should adopt cultivation practice from these states for those inputs which were higher side in Haryana. The cost analysis shows that the CAGR in total cost of Paddy, Wheat, Cotton, Sugarcane and Gram crop was higher in Haryana except bajra crop. The production of paddy, wheat and cotton, bajra,

sugarcane and gram crops compare with highest producing state shows that human labour observed significant behaviour in cotton, sugarcane and gram and negative significant in paddy. Non-significant found in wheat, bajra and gram. Similarly in animal labour found negative significant in bajra, cotton and paddy and non-significant in wheat, sugarcane and gram. The major yield gaps are due to lack of proper management practices.

i	**Experiment No.15 : Economic Analysis of Harvesting and Transportation Interventions of Sugarcane in Haryana**	
ii	**Objectives of the experiment**	• To study various methods of harvesting of sugarcane, labour requirement and costs involved. • To examine costs involved in various modes of transportation of cane from field to mill gate. • To ascertain incentives/support provided by sugar mills for sugarcane cultivation in the state.
iii	**Name(s) of the investigators**	• **Dr. Vijay Kumar** Planning, monitoring, finalization of interview schedule and report writing • **Dr. Neeraj Panwar** Data Collection • **Dr. Sumit** Compilation and analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Preparation of Schedule, planning and report writing
v	**Year of start**	**2020-21**
vi	**Duration of study**	**One year**
vii	**Treatment details**	**Locale of experiment:** 1. HAFED Sugar Mill, Assandh (Karnal) (HAFED) 2. The Haryana Co-op. Sugar Mills Ltd. Rohtak (Co-operative) 3. The Saraswati Sugar Mills Ltd. Yamuna Nagar (Private) • **Statistical design/methods:** The descriptive statistics like mean, percentage were used.
viii	**Observations recorded**	• Information related to area coverage, production and protection technologies, expenses incurred in harvesting operation both manual and mechanical. • Different mode of transportation of produce to mill. • Various incentives provided by sugar mills for enhancing sugarcane area coverage in the state.

Results achieved during 2020-21:-

Sugarcane crop is raised in about 4.2-5.0 million ha area and about 50 per cent of this crop remains as ratoon crop, in general, being a long-duration crop of 12 months and its sowing spreading from October to May, sugarcane is a labour-intensive crop, which requires about 166-325 labour days per hectare (Sharma and Prakash, 2011). Intercultural operation is the single largest consumer of labour in

sugarcane cultivation in India. The main components of labour-use in sugarcane cultivation are inter-culture, harvesting and planting operations. Harvesting requires about 85-100 labour days/ha for a normal sugarcane crop. However, the labour-use for harvesting depends upon the yield and condition of the crop at harvesting time, the labour demand per ha for harvesting the cane is higher, if the yield of the crop is higher or the crop has lodged and the canes are not erect. Most of the operations in cane cultivation are carried out manually and the use of machinery is limited to field preparation. Further manual harvesting was divided into cutting, detopping, detrashing, bundle making and loading. The overall average labour-use in manual harvesting was 91.58 man days/ha. The average highest labour-use was used in cutting *i.e.* 26.66 per cent followed by detopping (21.70%), bundle making (19.65%), detrashing (18.24%) and loading (13.74%) of the total labour-use. The highest total labour-use was 96.63 man days/ha in Karnal followed by 92.38 man days/ha in Yamunanagar and 85.75 man days in Rohtak district (Table 1). The overall transportation cost of sugarcane by different mean of transportation in Haryana was found Rs. 24.77 per quintal whereas it was Rs. 24.94, 21.64 and 27.99 for Karnal, Yamunanagar and Rohtak respectively. In incentive or support given by sugar mill to farmers was support for purchase of agro-chemicals, online message for supply of cane(100%), subsidized food arrangements at sugar mill (65%) and arrangement of extension services for timely dissemination of production and protection technologies (58.33%).

Table 1: Average human labour use for different activities in manual harvesting in Haryana

(Mandays/ha)

Activities	Karnal	Y/Nagar	Rohtak	Overall Average
Cutting	25.50 (26.39)	25.00 (27.06)	22.75 (26.53)	**24.42 (26.66)**
Detopping	20.38 (21.09)	19.75 (21.38)	19.50 (22.74)	**19.88 (21.70)**
Detrashing	16.88 (17.46)	17.50 (18.94)	15.75 (18.37)	**16.71 (18.24)**
Bundle making	20.75 (21.47)	17.00 (18.40)	16.25 (18.95)	**18.00 (19.65)**
Loading	13.13 (13.58)	13.13 (14.21)	11.50 (13.41)	**12.58 (13.74)**
Total	**96.63 (100.00)**	**92.38 (100.00)**	**85.75 (100.00)**	**91.58 (100.00)**

Figures in parentheses represent per cent to total

Table 2 shows that labour costs of different activities in manual harvesting. Cutting and detrashing costs represent the highest portion of the manual harvesting. The overall average labour cost in manual harvesting was 48.78 Rs./qtl. The average highest labour cost was used in cutting *i.e.* 27.88 per cent followed by detrashing (20.97%) detopping (20.44%), bundle making (19.68%) and loading (11.03%) of the total cost. The highest total labour cost was Rs. 52.10/qtl in Yamunanagar district followed by Rs. 47.75/qtl in Karnal district and Rs. 46.50/qtl in Rohtak district.

Table 2: Cost of different activities in manual harvesting in Haryana **(Rs./qtl.)**

Activities	Karnal	Y/Nagar	Rohtak	Overall Average
Cutting	13.65 (28.59)	14.25 (27.35)	13.40 (28.82)	**13.60 (27.88)**
Detopping	10.00 (20.94)	11.10 (21.31)	9.30 (20.00)	**9.97 (20.44)**
Detrashing	10.00 (20.94)	10.70 (20.54)	9.60 (20.65)	**10.23 (20.97)**
Bundle making	9.10 (19.06)	9.90 (19.00)	9.40 (20.22)	**9.60 (19.68)**
Loading	5.00 (10.47)	6.15 (11.80)	4.80 (10.32)	**5.38 (11.03)**
Total	**47.75 (100.00)**	**52.10 (100.00)**	**46.50 (100.00)**	**48.78 (100.00)**

Figures in parentheses represent per cent to total

After harvesting of sugarcane bundles are piled up by head loading to the end points of the field and again loaded in the carts, tractors trailers, trucks by manual loading, which is common practice. In the study area selected sample farmers used only 4-wheel trolley for transportation of sugarcane. There was slip system for the purchase of sugarcane by the sugar mill. The cost of transportation of sugarcane depends on distance from farm gate to sugar mill. The overall average of total cost of transportation was Rs. 8550/ha. Highest transportation cost was in Karnal district (Rs. 9100/ha.) followed by Rohtak (Rs. 8650/ha) and Yamunanagar district (Rs. 7900/ha) (Table 3).

Table 3: Transportation cost of sugarcane by different mean of transportation in Haryana

Activities		Karnal	Y/Nagar	Rohtak	Overall Average
Yield (Qtls.)		364.8	364.9	309.0	346.2
4-wheel trailer/trolley	**Capacity (Qtls.)**	86.75	89.00	78.00	**84.58**
Distance (Km)	**From farm gate to sugar mill**	17.55	14.70	15.48	**15.91**
Total Cost of Transportation	**From farm gate to sugar mill**	**9100.00**	**7900.00**	**8650.00**	**8550.00**
Per Qtl. Cost of Transportation	**From farm gate to sugar mill**	**24.94**	**21.64**	**27.99**	**24.77**

Incentive or support for farmers from sugar mills

It can be observed from Table 4 that subsidy given by sugar mills to sugarcane farmers were support for purchase of agro-chemicals (corozen insecticide), bonus/dividend to sugarcane cultivators particularly to the members or shareholders and online message for supply of cane to sugar mills (100.00%), subsidized stay and food arrangement at sugar mill (65.00%) and arrangement of extension services for timely dissemination of production and protection technologies (58.33%).

Table 4: Incentive or support for farmers from sugar mills in Haryana

Particulars	Karnal (20)		Y/Nagar (20)		Rohtak (20)		Overall (60)	
	Sum	%	Sum	%	Sum	%	Sum	%
Support for purchase of agro-chemicals (Corozen insecticide) at subsidized rate.	20.00	100.00	20.00	100.00	20.00	100.00	60.00	100.00
Bonus/dividend to sugarcane cultivators which are members or share holders	20.00	100.00	20.00	100.00	20.00	100.00	60.00	100.00
Online message for supply of cane to sugar mills	20.00	100.00	20.00	100.00	20.00	100.00	60.00	100.00
Subsidized stay and food arrangement at sugar mill	16.00	80.00	13.00	65.00	10.00	50.00	39.00	65.00
Arrangement of extension services for timely dissemination of production and protection technologies.	11.00	55.00	12.00	60.00	12.00	60.00	35.00	58.33

Programme of work for 2020-21: Experiment concluded

Salient Features of the Study:-

- Most of the operations in cane cultivation are carried out manually and the use of machinery is limited to field preparation. Further manual harvesting was divided into cutting, detopping, detrashing, bundle making and loading.
- The overall average labour-use and labour cost in manual harvesting was 91.58 man days/ha and 48.78 Rs./qtl, respectively.
- In the study area sampled farmers used only 4-wheel trolley for transportation of sugarcane.
- Subsidy given by sugar mills to sugarcane farmers were Support for purchase of agro-chemicals (corozen insecticide), Bonus/dividend to sugarcane cultivators particularly to the members or shareholders and Online message for supply of cane to sugar mills (100.00%), Subsidized stay and food arrangement at sugar mill (65.00%) and Arrangement of extension services for timely dissemination of production and protection technologies (58.33%).
- It was observed that among harvesting and transportation selected problems, in harvesting major problem was timely availability of mechanical harvester first (100%) which was followed by Availability/ scarcity of labour during harvesting period; Dependence on migratory labour; Higher charges of harvesting by labour and Non-availability of village labour.
- Similarly in transportation major problem were Long waiting period for disposal of cane at sugar mills followed by Higher labour charges for loading; Timely non-availability of vehicle and Not availability of labour for Loading of cane.

Conclusion

The major operations require mechanisation in sugarcane cultivation are planting, harvesting and de-trashing. Most of the operations in cane cultivation are carried out manually and the use of machinery is limited to field preparation. Further, manual harvesting was divided into cutting, de-topping, de-trashing, bundle making and loading. The overall average labour-use and labour cost in manual harvesting was 91.58 man days/ha and 48.78 Rs./qtl, respectively. In the study area selected sampled farmers used only 4-wheel trolley for transportation of sugarcane. Higher charges of harvesting and non-availability of labour were the major constraints while in case of transportation were long waiting period for disposal of cane at sugar mills. The overall transportation cost of sugarcane by different mean of transportation in Haryana was found Rs. 24.77 per quintal whereas it was Rs. 24.94, 21.64 and 27.99 for Karnal, Yamunanagar and Rohtak respectively. In incentive or support given by sugar mill to farmers was support for purchase of agro-chemicals, online message for supply of cane (100%), subsidized food arrangements at sugar mill (65%) and arrangement of extension services for timely dissemination of production and protection technologies (58.33%).

II. New Experiments planned for the 2021-22

i	**Experiment No. 1: Economic evaluation of production and marketing of normal and mid-cauliflower in Hisar district of Haryana.**	
ii	**Objectives of the Experiment**	• To work out cost and returns of cauliflower cultivation • To study the marketing pattern of cauliflower • To identify the production and marketing constraints in cauliflower cultivation
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Data collection and report writing • Dr. DP Malik Planning, finalization of interview schedule
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• **2021-22**
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of the experiment**: Hisar • **Blocks and villages to be covered:** One block from Hisar district and further two villages will be selected • **Number and types of respondents:** Ten cauliflower growers (10) from each selected village and five (5) market intermediaries from Hansi market will be surveyed randomly. • **Statistical design/methods:** The statistical tools like mean, percentage, price spread, Acharya approach etc. will be used
viii	**Observations to be recorded**	• Data related seed, agro-chemicals, human labour, inputs and output prices will be collected. • Information related to price received by producer, price spread and marketing constraints of cauliflower will be recorded.
ix	**Work timeline**	• Finalization of interview schedule : Up to August, 2021 • Data collection: December, 2021 • Compilation of data: January to April, 2022 • Analysis and tabulation of data: May to June ,2022
x	**Expected outcome**	• Returns and constraints from cauliflower cultivations will be ascertained

i	**Experiment No. 2 : Economic analysis of value addition of cane in Haryana**	
ii	**Objectives of the Experiment**	• To study the marketing pattern of cane • To work out the processing cost for value addition of cane • To identify constraints of various stakeholders in the identified value chains
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Planning, Finalization of interview schedule and report writing • Dr. Sumit data collection
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One Year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Number and type of respondents:** Three sugar mill (one public sector, one cooperative sector and one from private sector) and appropriate number of related value chain actors will be interviewed • **Statistical design/methods:** The statistical tools like mean, percentage, price spread etc. will be used
viii	**Observations to be recorded**	• Information related to raw materials (cane), cane price, sugar processing expenses, cane quantity, margins, prices of finished products etc. will be collected from the identified stakeholders • Information related to marketing channel, price spread and constraints regarding disposal pattern of cane will be recorded.
ix	**Work timeline**	• Finalization of interview schedule : Up to October – November, 2021 • Data collection : January- February 2022 • Tabulation and compilation of data: March to April, 2022 • Analysis and report writing: May to June, 2022
x	**Expected outcome**	• Disposal pattern of cane, estimation of its processing cost and constraints analysis of cane for value addition will be explored

i	**Experiment No. 3: Study on Price and arrivals vegetable crops in APMC markets of Haryana**	
ii	**Objectives of the experiment**	• To study volatility in price and arrivals of major vegetable crops • To develop forecast model for prices and arrivals of various vegetable crops
iii	**Name(s) of the investigators**	• Dr. Joginder Planning, compilation and analysis of data • Dr. Monika Devi Data analysis and technical writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Data compilation and report writing
v	**Year of start**	• 2021-22
vi	**Duration**	• One year
vii	**Treatment details**	• Locale of experiment: APMC markets of Haryana • Crop: Onion and Potato • Period: 2010-2020 • Statistical design/methods: Explorative data analysis, time series models and some other suitable statistical techniques subject to need of the study will be used.
viii	**Observations to be recorded**	• Monthly average wholesale prices and arrivals of vegetable crops will be collected from identified APMC markets of Haryana.
ix	**Work timeline**	• Data collection : Up to January 2022 • Compilation and tabulation of data: February to March, 2022 • Analysis and report writing: May to June , 2022
x	**Expected outcome**	• Development of forecasting models for prices and arrivals of vegetable crops.

i	**Experiment No. 4: Time series models for forecasting the prices of fruit crops in India**	
ii	**Objectives of the experiment**	• To study the status of arrival of major fruit crops in markets of India • To develop price and arrivals forecast models of selected fruit crops
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, execution and analysis of data • Dr. Monika Devi Data analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Data compilation and technical writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Major fruit markets of India (NHB) • **Crop:** Major fruit crops (Guava, Kinnow, etc.) • **Period:** 2010-2020 • **Statistical design/methods:** Explorative data analysis, time series models and some suitable statistical techniques subject to need of the study will be used.
viii	**Observations to be recorded**	• Monthly time series data of prices and arrivals of fruit crops will be collected from National Horticulture Board.
ix	**Work timeline**	• Data collection : Up to January 2022 • Compilation and tabulation of data: February to March, 2022 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• Development of forecast models for prices and arrivals of selected fruit crops.

i	**Experiment No. 5: Assessment of storage infrastructure for agri - horti products in Haryana**	
ii	**Objectives of the Experiment**	• To study the growth and capacity utilization of storage and warehouses in Haryana • To analyze the commodity profile stored in warehouses • To explore the storage of agricultural products in public-private partnership (PPP) mode
iii	**Name (s) of the investigators**	• Dr. KK Kundu Planning, finalization of interview schedule and report writing • Dr. Sumit Data collection
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• Two Years (2021-23)
vii	**Treatment details**	• **Locale of the experiment**: Haryana • **Number and types of respondents:** Appropriate number of storages will be selected for primary data • **Statistical design/methods:** The statistical tools like mean, percentage etc. will be used.
viii	**Observations to be recorded**	• In the first year (2021-22) study will be done with the secondary data only • Number and storage capacity of all warehouses for the period 1990-2020 • District and agency-wise procurement of wheat and paddy • Primary data will be collected in the second year (2022-23) to elicit the functioning of at least five private godowns and five state owned warehouses
ix	**Work timeline**	• Data collection : Up to January 2022 • Compilation and tabulation of data: February to March, 2022 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• Assessment of storage capacity of public and private warehouses for Agri-Horti products will be done

i	**Experiment No. 6 : Analysis of arrival and prices pattern of onion in Haryana**	
ii	**Objectives of the experiment**	• To study the arrival and price pattern of onion in major APMC markets of Haryana • To co-integrate prices of onion in selected markets of Haryana with prices of onion in major markets at national level
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Data collection and technical writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 year
vii	**Treatment details**	• **Locale of experiment:** APMC markets of India • **Crop:** Onion • **Period:** 2016-2020 • **Statistical design/methods:** Descriptive and explorative data analysis, Co-integration analysis, Causality test and some other suitable statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• Time series data related to onion arrival and prices will be collected.
ix	**Work timeline**	• Data collection : Up to January 2022 • Compilation and tabulation of data: February to March, 2022 • Analysis and report writing: May to June, 2022
x	**Expected outcome**	• Impact analysis of major onion markets on retail price of onion in various markets of Haryana and National level.

i	**Experiment No. 7: A study on status and forecasting of pulses production at state and national level**	
ii	**Objectives of the experiment**	• To examine the trends in area, production and productivity of pulses in various districts of Haryana • To identify major pulses producing states in India • To develop forecast models for pulses production at state and national level
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Technical report writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** India and major pulses producing states • **Crop:** Three major pulses crops • **Period:**1980-2020 • **Statistical design/methods:** Descriptive and explorative data analysis, uni-variate time series models and some other suitable statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• Time series data on pulses area, production and yield will be collected.
ix	**Work timeline**	• Data collection : Up to January 2022 • Compilation and tabulation of data: February to March, 2022 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• Development of forecast models for pulses production in Haryana and India.

i	**Experiment No. 8: Economic appraisal of sesame cultivation in Haryana**	
ii	**Objectives of the experiment**	• To work out the costs and returns of sesame cultivation • To compare the resource use efficiency in sesame cultivation with competing crops • To study the constraints in cultivation of sesame
iii	**Name (s) of the investigators**	• Dr Neeraj Pawar Finalization of schedule, compilation and analysis of data. • Dr. D.P. Malik Report writing
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2021-22
vi	**Duration of experiment**	• One Year
vii	**Treatment details**	• **Local of experiment:** Rewari and Mahendergarh • **Sampling design:** Purposive multistage sampling • **Number of respondents:** 60 farmers *i.e.* 30 from each district • **Statistical design/Method:** Descriptive statistics, Appropriate production function etc. will be used
viii	**Observations to be recorded**	• Information related to resources used *i.e.* seed, irrigation, chemical fertilizer, agro-chemicals, machinery, input, output, prices etc. • Opinion of farmers will be recorded for the constraints to be identified in cultivation of sesame
ix	**Work timeline**	• Data collection : Up to September, 2021 • Data collection: September-October, 2021 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• Estimation of returns, extent of inputs use and constraints in sesame cultivation will be ascertained

i	**Experiment No. 9: Economic appraisal of groundnut cultivation in Haryana**	
ii	**Objectives of the Experiment**	• To work out the cost and returns of groundnut cultivation. • To analyze the resource use efficiency in groundnut cultivation. • To identify the constraints in cultivation of groundnut.
iii	**Name (s) of the investigators**	• Dr. Neeraj Pawar • Finalization of interview schedule, collection of data, compilation and analysis of data. • Dr. J.S. Papang • Report writing
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• **Locate of the experiment:** Rewari, Hisar, Fatehabad and Sirsa • **Sampling design:** Purposive Multistage sampling • **Number of respondents:** 40 farmers i.e. 10 from each district • **Statistical design/methods:** Descriptive statistics, Cobb-Douglas production function etc. will be used
viii	**Observations to be recorded**	• Information related to resources used i.e. seed, irrigation, fertilizer, agro-chemicals, machinery, input, output, prices etc. • Opinion of farmers will be collated for the constraints to be identified in cultivation of groundnut
ix	**Work timeline**	• Finalization of interview schedule : Up to August, 2021 • Data collection: September-October, 2021 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• Estimation of returns, extent of inputs use and constraints in groundnut cultivation will be ascertained

i	**Experiment No. 10: Assessing the quantity and dynamics intake of fruits in India (continued)**	
ii	**Objectives of the Experiment**	• To quantity the monthly consumption of fruits across different income groups in different regions of India including Haryana • To assess the dynamics of nutrient intake from fruits
iii	**Name (s) of the investigators**	• Dr. Janailin S. Papang: Collection, extraction, compilation, processing, analysis of data, report writing • Dr D P Malik: Report writing.
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• Locale of experiment: All India • Data : NSSO data (55th round and 68th round) • Statistical design/methods: Descriptive statistics and OLS regressions will be applied.
viii	**Observations to be recorded**	• From the data, the observations for different states will be extracted separately and the food consumption (quantity) will be converted into nutrient equivalents using the conversion tables. • Then unit value of different food products will be calculated using the consumption data.
ix	**Work timeline**	• Data collection: January-February, 2022 • Analysis and report writing: May to June ,2022
x	**Expected outcome**	• The study expects to find the status of nutrient intake in different households of various states in India and Haryana in particular.

i	**Experiment No 11: Outreach and adoption determinants of micro irrigation system in Haryana (Continued)**	
ii	**Objectives of the experiment**	• To examine the extent of adoption among selected farmers in identified districts • To examine the system wise constraints in adoption of micro-irrigation technologies.
iii	**Name(s) of the investigators**	• Dr. Sanjay Planning, preparation of schedule, collection, and compilation of data • Dr. Janailin S. Papang Monitoring, analysis and report writing
iv	**Name(s) of the collaborator**	• Nil
v	**Year of start**	• 2021-22
vi	**Duration**	• 1 year
vii	**Treatment details**	• **Locale of the experiment:** Bhiwani and Mahendergarh • **Sample:** Two blocks each from Bhiwani and Mahendergarh district were selected. Further, two villages from each of the selected block picked up randomly. • **Number and type of respondents:** 60 adopter farmers. • **Statistical design/methods:** Descriptive statistics, etc.
viii	**Observations recorded**	• Data related to spread of micro irrigation among sampled farmers • Constraints faced in adoption
ix	**Work timeline**	• Finalization of interview schedule : Up to December, 2021 • Data collection: January to March, 202 • Analysis and report writing: April to June ,2022
x	**Expected outcome**	• Information regarding level of adoption among selected farmers and what are the problems related to the micro-irrigation systems that are hindering its further spread.

i	**Experiment No. 12: Carbon footprint assessment of basmati and non-basmati rice cultivation in Haryana**	
ii	**Objectives of the experiment**	• To calculate carbon footprint of basmati rice cultivation • To work out carbon footprint of non-basmati rice cultivation
iii	**Name(s) of the investigators**	• Dr. Sanjay Planning, preparation of schedule, collection, and compilation of data • Dr. Dalip Kumar Bishnoi Data collection
iv	**Name(s) of the collaborator(s) with activity profile**	• NIL
v	**Year of start**	• 2021-22
vi	**Duration**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Karnal district will be selected for basmati and non-basmati paddy will be selected • **Sampling design:** Purposive Multistage sampling • **Number of respondents:** 60 *i.e.* o 15 farmers for Basmati "DSR" 15 farmers for Basmati "Transplanted" 15 Non-basmati "DSR" 15 Non-basmati "Transplanted " • **Statistical design/methods:** Descriptive statistics and suitable techniques for carbon footprint calculation
viii	**Observations to be recorded**	• Quantity of seed/ diesel/ electricity/ agrochemicals used, power of motor, stubble management practices etc.
ix	**Work timeline**	• Finalization of interview schedule : Up to December, 2021 • Data collection: January to March, 202 • Analysis and report writing: April to June ,2022
x	**Expected outcome**	• The carbon footprint is a measure of total carbon emissions from the cultivation of a crop. As paddy is a prominent crop in Haryana, this study will help us to know the contribution of this crop towards carbon emissions. Also, this study will serve as a guiding tool for more comprehensive analysis of the carbon footprint assessment of all the crops cultivated in Haryana.

i	**Experiment No. 13: Economic evaluation of garlic and turmeric cultivation in Haryana**	
ii	**Objectives of the experiment**	• To work out the costs and returns of garlic and turmeric cultivation. • To analyze the marketing pattern of garlic and turmeric cultivation. • To study the constraints impeding the cultivation and marketing of garlic and turmeric.
iii	**Name of the investigators**	• Dr. Sumit Finalization of schedule, compilation and analysis of data. • Dr. K.K. Kundu Report writing
iv	**Name of the collaborator with activity profile**	• Nil
v	**Year of study**	• 2021-22
Vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Karnal and Yamunanagar • **Sampling design:** Purposive multistage sampling • **Number of respondents:** 60 i.e. 30 farmers for each crop • **Statistical design/Method:** Descriptive statistics, appropriate production function technique will be used.
viii	**Observations to be recorded**	• Inputs used i.e. seeds, agro-chemicals, preparatory tillage, labour used etc. • Costs and prices of inputs and output • Marketing costs, margins and price-spread • Constraints in cultivation of garlic and turmeric
ix	**Work timeline**	• Finalization of interview schedule : Up to October, 2021 • Data collection for turmeric : November – December, 2021 • For garlic Rabi season crop: May-June, 2022 • Tabulation and analysis of data: June ,2022
x	**Expected outcome**	• Estimation of returns, marketing pattern of sale and constraints of garlic and turmeric cultivation will b0e ascertained

i	**Experiment No. 14**: **Assessment of cost and returns of poplar (*populus deltoides*) based cropping system in Haryana**	
ii	**Objectives of the experiment**	• To work out the cost and returns of poplar based cropping system • To study the disposal pattern of poplar • To identify the constraints faced by the farmers in cultivation and marketing of poplar
iii	**Name(s) of the Investigator**	• Dr. Sumit Planning, finalization of interview schedule and data collection • Dr. Neeraj Pawar Data collection and Report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• NIL
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 year
vii	**Treatment details**	• **Locale of experiment:** Yamunanagar • **Sampling design:** Purposive multistage sampling • **Number and types of respondents:** 40 farmers i.e. 20 farmers each from two selected blocks of the district • **Statistical design/methods:** The statistical tools like mean, percentage will be used.
viii	**Observations to be recorded**	• Inputs used i.e. seeds, agro-chemicals, preparatory tillage, labour used etc. • Quantity and prices of inputs and output • Constraints hindering the cultivation of poplar based cropping system.
ix	**Work timeline**	• Finalization of interview schedule : October 2021 • Data collection: January – February, 2022 • Tabulation and analysis of data: June ,2022
x	**Expected outcome**	• Assessment of returns from popular based cropping system will be done

i	**Experiment No. 15: Economic evaluation of mechanical transplantation of paddy in Haryana**	
ii	**Objectives of the experiment**	• To estimate cost and returns of mechanical transplanted paddy vis-a-vis traditional transplanted paddy • To analyze the resource use efficiency of mechanical transplantation of paddy • To identify the constraints in adoption of mechanical transplantation of paddy
iii	**Name(s) of the Investigator**	• Dr Vinay Mehala Preparation of schedule, compilation of data and report writing • Dr Monika Devi Analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr Parminder Malik
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Sonipat • **Sampling design:** Purposive multistage sampling • **Sample size:** 60 farmers from Sonipat district will be interviewed • **Statistical design/methods:** Descriptive statistics, resource use efficiency and other suitable tools related to the study will be used.
viii	**Observations to be recorded**	• Cost and prices of various inputs and outputs • Perception related constraints in adoption of mechanical transplantation of paddy.
ix	**Work timeline**	• Finalization of interview schedule : October 2022 • Data collection: December- January, 2021 • Tabulation and analysis of data: March to June ,2022
x	**Expected outcome**	• Estimation of cost involved and benefit accrued from mechanical transplanting of paddy will be done

i	**Experiment No. 16: An economic analysis of arrival and price behaviour of mustard in Haryana**	
ii	**Objectives of the experiment**	• To work out trends in price and arrivals of mustard • To analyze seasonal variation of the prices and arrivals of mustard • To suggest appropriate policy measures
iii	**Name(s) of the Investigator**	• Dr Vinay Mehala Data collection and compilation • Dr. Dalip Kumar Bishnoi Report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Monika Devi Analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Hisar, Bhiwani, Mahendergarh, Rewari districts as well as State as whole. • **Time period:** 1999-00 to 2020-21 • **Statistical design/methods:** Descriptive statistics and other suitable tools related to the study will be used.
viii	**Observations to be recorded**	• Data related to annual arrivals and prices of mustard will be collected.
ix	**Work timeline**	• Data collection: January – February, 2022 • Tabulation and analysis of data: March to June ,2022
x	**Expected outcome**	• Price and arrival behaviour of mustard will be analyzed to formulate appropriate policy measures

Other Agencies

Comprehensive Scheme for studying the Cost of Cultivation of Principal Crops in India-Haryana (Funded by Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India)

1. **Scheme No:** 3066-C(c) Econ.-I.(CS)
2. **Year of start**: 1970
3. **Location** : Haryana
4. **Objectives of scheme**: To provide representative and quality data on cost of cultivation of principal crops in Haryana. The detailed objectives are as under:
   - To facilitate data entry at Tehsil / Village level, making the process of data collection, validation and compilation efficient through ICT enabled Web based System.
   - To facilitate processing of data and generation of query based report at Central level.
   - To monitor the functioning of field men, field supervisors and Field Officers at different levels through workflow based system
   - To scrutinize and validate the data entered by field men at the level of field supervisor and field officer through the envisaged workflow based system.
   - To reduce the time lag in reporting of data.
5. **Any need to modify the objective as per need of the state**: Nil
6. **Constraints, if any :** Post of Field Officer lying vacant and shortage of Agriculture Inspectors
7. **Name of investigators with activity profile:**

Name of Scientist	**Name of cluster allotted**
Dr. D.P. Malik Honorary Director	Monitoring and supervision of all 30 clusters selected in different zones of Haryana
Field Officer –Vacant	All 30 cluster selected in different zones of Haryana.
Dr. R. S. Pannu (Up to 30.10.2020) RRS Karnal Dr.Sumit (w.e.f. 01.11.2020) RRS Kaul	Dhakal, Mundhri, Bhagal, Sarsa, Amin, Harnaul, Gaduali, Gogripur, Salwan, Bhambhewa (10).
Dr.Neeraj Pawar, RRS Rohtak	Alawalpur, Dipalpur, Kheri Damkan, Samargopalpur, Sisar Khas, Silani, Naya Gaon, Mandola, Mahrana, Kinnana (10).
Dr.Nirmal Kumar (up to 19.11.2019) Dr. Vijay Kumar (From 20.11.2019) Dr. Veer Sain (w.e.f. 17.08.2020 to 28.01.2021) Dr. Vinay Mehla (from 29.01.2021)Deptt. Agril. Economics	Sawant Khera, Sarsana, Ladwi, Dhamana, Phangal, Duleri, Beeran, Sohasra, Akanwali, Khara Kher (10).
Dr. Joginder	Checking and scrutinized RT-wise data for both kharif and rabi seasons in computer lab, removal of discrepancies in data as reported by funding agency. Exporting the data in excel and checking the all outliers in online data entries and resolution of queries raised by agriculture inspectors.

8. Budget for the year 2020-21 (head wise sanction and expenditure details) (Rs.)

Sr. No.	Particulars	Allotment	Fund received	Expenditure	Over expenditure to allocation	Over expenditure to funds received
1	Pay	22800000	17500000	16120743	Nil	Nil
2	ADA	2600000	9700000	2465713	Nil	Nil
3	GPF	2200000	2900000	1841360	Nil	Nil
4	TA	565000		332455	Nil	Nil
5	Gratuity	1500000		1452671	Nil	Nil
6	Medical	900000		814056	Nil	Nil
7	LTC	500000		380005	Nil	Nil
8	OE(O)	90000		78869	Nil	Nil
9	PSS	3479000		2562630	Nil	Nil
10	Other charges	311000		272000	Nil	Nil
11	M & S	15000		9360	Nil	Nil
12	POL	40000		33306	Nil	Nil
	Sub-Total	35000000		26363168	Nil	Nil
	Deficit for 2019-20			4888406		
	Total	**35000000**	**30100000**	**31251573**	**Nil**	**1151573**

I	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
Ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
Iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data. **Dr.R.S. Pannu / Dr.Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Vijay Kumar/ Dr.Nirmal Kumar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Joginder** Validation, rectification, RT wise check list, corrections in online data.
Iv	**Names of Collaborators with activity profile**	Nil
V	**Year of start**	2020-21
Vi	**Locale of experiment**	**Haryana**
Vii	**Observations recorded**	• Information was collected on daily basis by A.I.s. • Data was recorded in schedules and data entries were done in software by agriculture inspectors. • Monthly checking of data at each cluster in physical record and software was done by supervisors/scientists.

ix. Results achieved during *Kharif* 2020-21

- The cost of cultivation data of kharif crops grown in Haryana state namely paddy, cotton, pearl millet, cluster bean, jowar, maize, mungbean, pigeon pea etc. was collected from 30 centres/clusters located in different agro-climatic zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers of thirty (30) clusters were contacted daily by agriculture inspector to extract relevant information during kharif season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	**Name of Supervisor**	**Clusters visited (No.)**	**(Farmers interacted (no.)**	**schedules checked (No.)**
July	Dr. R.S. Pannu	10	15	35
	Dr. Neeraj Pawar	07	22	42
	Dr. Vijay Kumar	02	09	15
August	Dr. R.S. Pannu	01	0	03
	Dr. Neeraj Pawar	03	15	36
	Dr. Vijay Kumar	-	-	-
September	Dr. R.S. Pannu	05	24	12
	Dr. Neeraj Pawar	08	25	30
	Dr. Veer Sain	04	15	23
October	Dr. R.S. Pannu	04	24	12
	Dr. Neeraj Pawar	08	25	30
	Dr. Veer Sain	04	15	33
November	Dr. Sumit	08	10	14
	Dr. Neeraj Pawar	09	30	25
	Dr. Veer Sain	04	10	10
December	Dr. Sumit	08	36	50
	Dr. Neeraj Pawar	05	07	45
	Dr. Veer Sain	07	20	35

- Supervisors visited regularly and check data in records as collected by AIs from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.
- The information recorded by AIs was also crossed checked from the farmers by supervisors, field officer and Hon.Director through interaction during visit at cluster.
- At the end of the season, the online data entries were forwarded to supervisor by AIs and the data was thoroughly checked in the software with physical records.
- During kharif season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- The online data entries in new software (FARMAP2.0) for kharif season of year 2020-21 have been completed in the month of January, 2021 and data were submitted to funded agency in the month of February, 2021.

I	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
Ii	**Objectives**	• Collection of data on cost of cultivation of Rabi crops. • Supervision and cross check of data. • Regular monitoring of work of agriculture inspectors. • Timely submission of data to funding agency.
Iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant** Monitoring, supervision, checking & verification and submission of data. **Dr. Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Vinay Mehla** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Joginder** Validation, rectification, RT wise check list, correction in online data.
Iv	**Names of Collaborators with activity profile**	Nil
V	**Year of start**	2020-21
Vi	**Locale of experiment**	**Haryana**
Vii	**Observations recorded**	• Information was collected on daily basis by A.I.s. • Data was recorded in schedules and a data entry was done in software by agriculture inspectors on monthly basis. • Monthly checking of data at each cluster in physical record and software was done by supervisors/scientists.

viii. Results achieved during *Rabi* 2020-21

- The cost of cultivation data of rabi crops of Haryana state namely wheat, gram, rapeseed &mustard, sugarcane, summer mungbean, onion etc. were collected from 30 centres /clusters located in different agro-climatic zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers were contacted for collection of data related cost of cultivation of crops during rabi season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	Name of supervisor	Clusters visited (No.)	(Farmers interacted (no.)	schedules checked (No.)	Remarks
January	Dr. Sumit	04	25	25	
	Dr. Neeraj Pawar	08	15	45	
	Dr. Veer Sain	06	20	40	
February	Dr. Sumit	04	25	25	
	Dr. Neeraj Pawar	06	21	35	
	Dr. Vinay Mehla	04	11	24	
March	Dr. Sumit	03	12	17	Contacted on telephone
	Dr. Neeraj Pawar	06	16	30	--do--
	Dr. VinayMehla	06	14	35	--do--
April	Dr. Sumit	08	17	45	--do--
	Dr. Neeraj Pawar	06	14	27	--do--
	Dr. Vinay Mehla	06	07	27	--do--
May	Dr. Sumit	0	08	0	--do--
	Dr. Neeraj Pawar	0	10	0	--do--
	Dr. Vinay Mehla	0	12	0	
June	Dr. Sumit	08	16	04	Contacted on telephone
	Dr. Neeraj Pawar	03	07	30	--do--
	Dr. Vinay Mehla	0	14	0	--do--

- Supervisors visited regularly and checked data in records as collected by A.I.s from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.
- The information recorded by AIs was also crossed checked supervisors, field officer and Hon. Director from the farmers through interaction during visit at cluster.
- At the end of the season, the online data entries were forwarded to supervisor by A.I.s and the data was thoroughly checked in the software with physical records.
- During rabi season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

Submission of data

- Final submission of data for rabi season will be done to funding agency in the month of July, 2021 as data for Kharif of season has already submitted to funding agency in the month of February, 2021.
- Validation of data for kharif and rabi seasons will be done in the month of July, 2020.
- Weighing diagram as required by funding agency was also prepared and will be submitted in due course of time.
- The online data entries in new software (FARMAP2.0) for rabi season of year 2020-21 is in progress for submission to the funding agency.

Trainings/Meetings proposed

- The computer trainings about online data entries in new software were imparted to Agriculture inspectors 2020-21 and resolved problems of online data entries.
- Meetings of AIs were organized by supervisors during 2020-21 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items, keeping daily operation record etc.

Work done in computer lab

- The discrepancies in unit level data for all Rabi crops as reported by funding agency in May-June, 2020 were checked, corrected and re-submitted again well in time.
- Doubtful cost items of Sugarcane crop for the year 2018-19 and 2019-20 were rechecked, corrected and re-submitted again well in time.
- Doubtful items of Irrigation cost and Insecticides cost of Gram crop for the year 2018-19 and 2019-20 were rechecked, corrected and re-submitted again well in time.
- Doubtful cost items of Rabi crops (Wheat, Gram, Rapeseed & Mustard and Sugarcane) for the year 2019-20 were rechecked, corrected and re-submitted again well in time.
- The online data entries for *Kharif* season have already submitted to the funding agency and for *Rabi* season, it will be submitted by the end of July, 2021.
- Checking and scrutinized the RT-wise data for both *Kharif* and *Rabi* seasons, data entries in new software FARMAP 2.0 and exporting the data in excel for checking the all outliers in online data entries was done regularly.
- Various queries raised by agriculture inspectors in online data entries for 2020-21 have been resolved.

9. Justification for continuation of scheme:

The scheme was started in 1970 with an objective to collect quality data from farmers for various kharif and rabi crops in each season of every year to provide basis for fixation of MSP at national Level. The scheme is to be continued taking into consideration-increased use of purchased inputs, mechanization of farm operations etc. to work out cost of cultivation of principal crops by providing farm level information for fixation of MSP to benefit farmers for sustainable production of crops in India including Haryana state.

10. Salient Achievements during 2020-21

- The cost of cultivation of nine important crops of Haryana state namely, paddy, cotton, pearl millet, sugarcane, wheat, gram, rapeseed & mustard, summer mungbean and onion were collected from clusters located in different agro-climatic zones of Haryana state by cost accounting method.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.
- The data entries in FARMAP2.0 software for the *rabi*and *kharif* seasons for the year 2019-20have been submitted in August, 2020, to Ministry of Agriculture and Farmer's Welfare, Govt. of India, New Delhi for further analysis. The result of which will be used by the Commission for Agricultural Costs and Prices (CACP) for fixing the minimum support prices of *Kharif* and *Rabi* crops at national level.

- The online data entries in new software (FARMAP2.0) for *Kharif* season of year 2020-21 have been submitted in the month of February, 2021. The submission of online data entries for rabi season is in progress and will be completed by the end of July 2021.
- The work of data entry operators, progress of online data etc. in computer lab of cost of cultivation scheme was closely monitored to ensure timely submission of data to funding agency.
- The discrepancies in data as reported by funding agency were rechecked, corrected and re-submitted again well in time.

New experiments planned for the year 2020-21

i	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Field Officer (Vacant)** Monitoring, supervision, checking & verification and submission of data **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Vinay Mehla** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Joginder** Validation, rectification, RT wise check list, correction in online data
iv	**Names of Collaborators**	Nil
v	**Year of start**	2021-22
vi	**Locale of experiment**	**Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/field officer

i	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of rabi crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Field Officer (Vacant)** Monitoring, supervision, checking & verification and submission of data **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Vinay Mehla** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO **Dr. Joginder** Validation, rectification, RT wise check list, correction in online data
iv	**Names of Collaborators**	Nil
v	**Year of start**	2021-22
vi	**Locale of experiment:**	**Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors/scientists • Random checking of data by SRO/field officer

C. LIST OF PG STUDENTS OF DEPARTMENT

S.N.	Name of Student	Adm. No.	Title of Research Problem	Major Advisor
Ph.D. students				
1.	Sadhanala Swetha	2015A02D	Dynamic of Major Oilseeds and Pulses in India	Dr. V.P. Mehta
2.	Meenu Punia	2015A06D	Agricultural Insurance in India vis-a vis in Haryana : Problems and Prospects	Dr. K.K.Kundu
3.	Swamy H.M.	2016A01D	Spatial and temporal crop diversification in India and their consequences on agriculture	Dr. U.K.Sharma
4.	Sunita	2016A02D	A study to develop optimum combination of farm enterprises in Haryana	Dr. V.P.Mehta
5.	Heena	2016A04D	An Economic Analysis of Organic Farming vis-à-vis Inorganic Farming in Haryana	Dr.D.P.Malik
6.	Davinder Pal Singh	2017A06D	Contract farming in Haryana and Punjab: An Economic prospective	Dr.K.K.Kundu
7.	Nitin Sharma	2018A04D	Economic analysis of chemical fertilizers in India.	Dr.R.S.Pannu
8.	Harshit Bansal	2019A06D	Extent of land and water degradation in Haryana- An economic analysis	Dr. Neeraj Pawar
9.	Manpreet Kaur	2019A07D	Economic Evaluation of Climate Smart Agriculture Technologies in Haryana	Dr. D.P. Malik
10.	Nisha	2019A08D	Assessment of socio-economic impact of Agro-Metrological Advisory Services in Haryana	Dr. K.K. Kundu
11.	Ritu	2019A09D	Comparative Economic Analysis of Major floricultural Crops in Sonepat and Gurgaon districts of Haryana	Dr. J.K. Bhatia
12.	Ajay Singh	2020A02D	Production Effciency and PFarming Systems in Haryana	Dr. U.K. Sharma
13.	Chenavali Karnakar	2020A03D	Production, Marketing and Value Chain Analysis of Nutri-cereals in India	Dr. D.P. Malik
14.	Dinesh Kumar	2020A04D	Production, Utilization and Value Addition in Coarse cereals and Oilseeds in Haryana	Dr. K.K. Kundu
15.	Mohit Sehal	2020A05D	An Economic Analysis of Residue Management of Paddy-Wheat in Haryana	Dr. Dalip Bishnoi
Foreign Ph.D. students				
1.	KabirAbdulaziz	2018A01D	Value chain analysis of staple foods and dairy Products in Haryana	Dr.K.K.Kundu
M.Sc. students				
1	Baljit Kaur	2018A01M	Performance and Functioning of Electronic National Agricultural Market (e-NAM) in Haryana: An economic analysis.	Dr.K.K.Kundu
2	Dinesh Kumar	2018A02M	An Economic analysis of Laser land leveling practice in Haryana.	Dr.D.K.Bishnoi

3	Mohit Sehal	2018A03M	An Economic Analysis of Integrated Pest Management (IPM) and Integrated Nutrient (INM) in Paddy (Basmati) crop in Haryana	Dr. NeerajPawar
4	Mandeep Kumar	2019A03M	An Economic Analysis of spring maize cultivation in Haryana	Dr. R.S. Pannu
5.	Manoj Kumar	2019A04M	An economic analysis of nutria-millets cultivation in India	Dr. Neeraj Pawar
6	Pooja Rani	2019A06M	Assessing the economic viability of solar photovoltaic water pumping system in agriculture in Haryana	Dr. D.K. Bishnoi
7	Raj Ratan Pandey	2019A07M	An economic analysis of production and marketing sweet corn in Sonepat district in Haryana	Dr. Parminder Singh
8	Sagar Rawal	2019A08M	A study on the effect of custom hiring centres on paddy and wheat cultivation in Haryana	Dr. Ashok Kumar
9	Sonia	2019A010M	Assessment of Kisan Credit Card Scheme in Haryana	Dr. D.P. Malik
10	Aarti	2020A01M	Economic analysis of production and processing of cluster bean (cymopsis tetragonoloba) in Southern Haryana	Dr. Gulab Singh
11	Indu	2020A03M	An economic analysis of sprinkler irrigation in Southern Haryana	Dr. Sanjay Kumar
12	Manasa M S	2020A04M	An economic analysis of carrot cultivation in Haryana	Dr. Janailin S Papang
13	Raveena Bishnoi	2020A05M	An economic analysis of super seeder technology of wheat cultivation in Haryana	Dr. Vijay Kumar
14	Sahil	2020A06M	Performance of Agriculture in different districts of Haryana	Dr. Vinay Mehla
Foreign M.Sc. students				
1	Jawid Rahman	2019A02M	An Economic Analysis of potato cultivation in India and Afghanistan	Dr. J.K. Bhatia
2	Nyein Aye Khine	2019A05M	An Economic analysis of production and trade performance of pulses in India vis-à-vis Myanmar	Dr. K.K. Kundu
3	Sediquallah Zahid	2019A09M	Export and import performance of major fruits and dry fruits in India vis-à-vis Afghanistan	Dr. D.K. Bishnoi
4	Syed Bahaudin	2019A011M	A study on economics of wheat cultivation in Afghanistan and India	Dr. Nirmal Kumar
5	Sayad Sanaullah Habibi	2020A134M	Synopsis yet not finalized	Dr. Kavita
6	Mohmmad Hussain	2020A135M	Synopsis yet not finalized	Dr. Sumit

D. List of Publications: 2020-21

Sr. No.	Details of Research paper	NAAS rating (2021)	Source
1	Pawar Neeraj, Bishnoi Nirmal and Malik D.P.(2021). Resource use and economic potential of pigeonpea cultivation in Haryana. *International Journal of Agricultural Sciences.* 17(2): 239-244.	4.73	T.P.
2	Pawar Neeraj, Sumit and Malik D.P.(2021).Resource use efficiency and constraints in cultivation of maize in Haryana. *Indian Journal of Agricultural Sciences* 91(2):292-295	6.21	T.P.
3	Pawar Neeraj, Sumit and Malik D.P.(2021). Growth performance and economic feasibility of kharif maize vis-à-vis paddy basmati cultivation in Haryana. *Research Journal of Agricultural Sciences* 12(2): 458–461.	4.54	T.P.
4	Malik, D.P., Bishnoi, D.K., Pawar, Neeraj, Kumar, N. and sumit (2021).Additional income generation from cultivation of summer mungbean in rice-wheat system of Haryana. *Legume Research* Online publication	6.53	T.P.
5	Kumar Joginder, Devi Monika, Verma Deepika, Malik D.P. and Sharma Ajay. (2021). Pre-harvest forecast of rice yield based on meteorological parameters using discriminant function analysis. *Journal of Agriculture and Food Research*	SCOPUS, Elsevier	T.P.
6	Devi, Monika, Kumar,Joginder, Malik D.P. and Mishra Pradeep (2021). Forecasting of wheat production in Haryana using hybrid time series model. *Journal of Agriculture and Food Research,* 5(12):100175.	SCOPUS, Elsevier	T.P.
7	Heena and Nisha (2020). An economic comparison of organic and conventional wheat crop in Haryana. *The Pharma Innovation Journal,.SP-9(7):257-266.*	5.23	Other
8	Heena, Malik D.P. and Pant Pooja (2021). An economic comparison of organic and conventional guava cultivation in Hisar district of Haryana. *The Pharma Innovation Journal. SP-10(4): 366-371.*	5.23	Other
9	Punia Meenu, Kundu K.K. and Mehla Vinay (2021). Crop Insurance in India: status of PHFBY against different crop insurance schemes. *The Pharma Innovation Journal, SP-10(4): 82-86.*	5.23	Other
10	Punia Meenu, Kundu K.K. and Nimbrayana Parveen Kumar(2021). Instability pattern of wheat and rapeseed mustard in India and Haryana. *The Pharma Innovation Journal*, SP-10(4):87-89	5.23	Other
11	Ritu, Mehta V.P., Malik D.P., Kumar Raj and Nisha (2020). Impact of agricultural price policy on major food crops in Haryana. *Economic Affairs* 65 (2): 267-274.	5.08	Other
12	Priyadarshini Mousami, Kundu K.K. and Kumar P. (2020). Impact of mission for integrated development of horticulture (MIDH) in Haryana. *Journal of Agriculture and Ecology* 9:83-91.	4.09	Other
13	Priyadarshini Mousami, Kundu K.K. and Bishnoi Dalip Kumar (2020).Growth trends in area production and productivity of total horticultural crops in India (Haryana and Odisha states). *International Journal of Current Microbiology and Applied Sciences*, (7): 3658-3661.	5.38	Other
14	Priyadarshini Mousami, Kundu K.K., Bishnoi Dalip Kumar and Kumar Nirmal (2020). An Economic Analysis of kinnow cultivation in Sirsa district of Haryana. *International Journal of Current Microbiology and Applied Sciences*, 9(7): 2341-2351.	5.38	Other
15	Singh,Ajay Bishnoi Dalip Kumar, Kumar Nirmal and Kumar Raj (2020). Constraints Faced in adoption of establishment techniques of wheat in Karnal and Kaithal districts of Haryana. *Economic Affairs*, 65(2): 179-181.	4.82	Other
16	Sehal Mohit, Pawar Neeraj and Malik D.P. (2021). Economic impact of	5.08	Other

	practicing IPM and INM technology in paddy (basmati) crop in Haryana. *Economic Affairs*.66 (1): 85-92.		
17	Singh, Ajay Bishnoi Dalip Kumar, Kumar Raj and Sumit (2021).Comparative economics of wheat cultivation establishment techniques in Haryana. *Economic Affairs*, 66 (1):93-99.	5.08	Other
18	Nisha, Malik D.P., Kundu K.K. and Neeraj (2020). Economic returns and elements influencing sugarcane cultivation in Haryana. *International Journal of Chemical Studies*. 8(3): 2776-2780.	5.31	Other
19	Sanjay, Swamy HM, Seidu Moro, Sangram B Singh (2020). Issues of paddy stubble burning in Haryana: current perspective. *Paddy and water environment*	7.26	Other
20	Malik D.P. and Devi Monika (2020).Global prominence of pigeonpea production with special reference to India. *African-Asian Journal of Rural Development.* 53(2): 64-98.	-	Other
21	Singh, J., Pawar, Neeraj, Hans Raj, Panghal, V. Pand Duhan, D.S. (2020). Productivity and profitability of relay cropping of muskmelon (Cucumis meloL.) in wheat (Triticum aestivum). *Green Farming*, 11 (6): 555-557.	4.38	Other
22	Nimbrayan, P.K. , Sumit, Bhatia, J.K., Bishnoi, D.K. and Pawar, Neeraj(2020).Profitability of rabi crops in Haryana. .*International Journal of Education and Management Studies*, 10(4):406-410.	4.79	Other
23	Sangwan, M., Singh, J., Pawar, Neeraj, Siwach, M., Solanki, Y.P. and Ram Karan (2021). Evaluation of front line demonstration on mustard crop in Rohtak district of Haryana. *Indian Journal of Extension Education*, 57(2):6-10.	5.95	Other
24	Singh, J., Singh, K. and Pawar, Neeraj(2021). Training needs of vegetable growers in Sonipat District (Haryana). *Journal of community mobilization and sustainableDevelopment*16 (1) :185-191.	5.67	Other
25	Kabir, A., Kundu K. K, and Malik D.P. (2020).Contribution of lending institutions in the growth of Indian agriculture. Journal of Economics, Business and Market Research. 2(1): 225-233.	-	Other
26	Malik D.P. and Monika Devi (2020). Diffusion and Economics of Bt-Cotton Cultivation in Haryana. *Agricultural Situation in India* 77 (6):24-33.	3.15	Other
27	Mahajan Sumit, Papang Janailin S., Panchal Indu and Sharanagouda B. (2021).Impact of rising food prices on food security in Rajasthan and Gujarat. *Indian Journal of Agricultural Sciences,* 91(4): 559-562.	6.21	Other
Book Chapter			
1	Malik, D.P. (2020). Organic cultivation: its significance to Indian perspective. Advance Research in Agricultural and Veterinary Sciences-Vol-1. (Eds. by Deepti Singh,Pramod Prabhakar).VidyaKutir Publications, New Delhi: 01-22.	-	-
2	Kaur Manpreet, Malhi Gurdeep Singh, Malik D.P. (2021).Role of public polices in agricultural development in India and their consequences. Sustainable Soil Fertility Management (Eds. H.S. Jatav, S.K. Singh, V.D. Rajput, T. Minkina). Nova Science Publishers Inc. New York, USA. 303-325.	-	
3	Pawar Neeraj, Rathi Anil, Malik D.P., Ghanghas B.S., Bishnoi D.K., Bishnoi Nirmal, Dillion Ashok and Bhatia J.K.(2020). Krishi Me Farm Parbhandan Ka Mahatav. Adunik Krishi Vigyan (Eds. Neeraj Pawar, Ashok Kumar Deshwal, Kulbir Singh Bangarwa). Agri-Biovet Press, New Delhi, India:425-441.	-	
4	Ghanghas, B.S., Pawar, N. and yadav, V.P. (2020). Kisano Hetu Parikshan Aavm Ran Snvidhay, " Aadhunik Krishi Vigyan. Adunik Krishi Vigyan (Eds. Neeraj Pawar, Ashok Kumar Deshwal, Kulbir Singh Bangarwa). Agri-Biovet Press, New Delhi, India:412-25.	-	

Annexure **-1**

Table: Energy coefficient of input and output used in agriculture

S. No.	Particulars	Units	Equivalent Energy, MJ
1.	Human		
	a. Adult men	Man-hour	1.96
	b. Women	Woman-hour	1.57
	c. Children	Child-hour	0.98
2.	Animal		
	a. Bullocks:		
	i. Large	Pair-hour	14.05
	ii. Medium	Pair-hour	10.1
	iii. Small	Pair-hour	8.07
	b. He-Buffaloes	Pair-hour	15.15
	c. Camel or Horse	Animal-hour	10.1
	d. Mule and other small animals	Animal-hour	4.04
3.	Diesel	Litre	56.31
4.	Petrol	Litre	48.23
5.	Electricity	kW-h	11.93
6	Machinery		
	a. Electric motor	Kg	64.8
	b. Prime mover other than Electric motors including self-propelled machines	Kg	68.4
	c. Farm machinery excluding self-propelled machines	Kg	62.7
7.	Chemical Fertilizer		
	a. N	Kg	60.6
	b. P_2O_5	Kg	11.1
	c. K_2O	Kg	6.7
8.	Farm Yard Manure	Kg	0.3
9.	Chemicals		
	a. Superior chemicals	Kg	120
	b. Zinc sulphate	Kg	20.9
	c. Inferior Chemical	Kg	10
Main Product			
1.	Cereal crops, such as: Wheat, Maize, Sorghum, Bajra, Barley, Oats, Paddy (Not shelled rice), etc.	kg (dry mass)	14.7
2.	Pulses, such as: Mash, Moong, Lentil, Arhar, Soybean, Peas, Beans, etc.	kg (dry mass)	14.7
3.	Oilseed, such as: Cotton seed, Groundnut pods (not shelled, Seasamum, rapeseed, mustard, Linseed, sunflower Seed etc.)	kg (dry mass)	25
4.	Sugarcane	kg (dry mass)	5.3
By Product			
1.	Straw, Vines, etc.	kg (dry mass)	12.5
2.	Stalks, Cobs, Fuelwood, Fruits, Vines, Plantwood	kg	18

		(dry mass)	
3.	Leaves, Vines and straw from vegetables	kg (dry mass)	10
4.	Cotton seed	kg (dry mass)	25
5.	Fibre crop seed other than cotton and fuel crop seed	kg (dry mass)	10
6.	Sugarcane leaves & tops	kg (dry mass)	16.1

Formula to work out Energy

1. Energy efficiency = energy output ($MJha^{-1}$) /energy input ($MJha^{-1}$)
2. Specific energy = energy input ($MJha^{-1}$)/grain output($kgha^{-1}$)
3. Energy productivity = grain output($kgha^{-1}$)/ energy input ($MJha^{-1}$)
4. Net energy = = energy output ($MJha^{-1}$) - energy input ($MJha^{-1}$)
5. Water productivity = grain yield ($kgha^{-1}$) /water applied (M^3ha^{-1})

REVIEW OF RESEARCH SCHEMES (2021-22) AND FINALIZATION OF TECHNICAL PROGRAMME (2022-23)

A. Report by the Head of the Department

1. **Name of the Department:** Agricultural Economics
2. **Staff position** (Scheme wise and post wise details)

Title and Number of scheme	Sanctioned post with number	In position	Name of faculty/staff with designation			Vacant
Research Schemes						
(a)1202-Dte-R-1-Agri (A)-Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming						
1.	Senior Scientist (FM) -01	Nil	Vacant			01
2.	Assistant Scientist-06 (Ag. Economics)	02	Dr. D. P. Malik, Principal Scientist Dr. D. K. Bishnoi, Asstt .Scientist			04
3.	Assistant Scientist- 01 (Sociology)	Nil	Vacant			01
4.	Assistant Scientist -01 (Statistics)	01	Dr. Monika Devi			Nil
5.	Research Associate -01 (Rural Sociology)	Nil	Vacant			01
6.	Assistant -02	01	Sh. Jitender			01
7.	Messenger -01	01	Sh. Krishan Kumar			Nil
(b) 3066-C(c) Econ-1 CS-Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana						
1.	Field Officer (Ag. Economics)-01	01	Vacant			01
2.	Assistant Scientist-03 (Ag. Economics)	03	Dr. Neeraj Pawar, Asstt .Scientist, RRS, Rohtak Dr. Sumit, Asstt .Scientist ,RRS Kaul Dr. Vinay Mehla, Asstt .Scientist Deptt. of Agril. Economics, Hisar			Nil
3.	Assistant Scientist-01 (Statistics)	01	Dr. Joginder, Asstt .Scientist (Statistics)			Nil
4.	Computer/clerk-05	03	Sh. Rahul Sh. Paswan Sh. Sushil (up to 02.06.2021) Smt. Alka Arora Sh. Bhanu Partap (up to 08.09.2021)			02
5.	Field men/ Agri. Inspectors -30	14	Agril.Inspector	cluster	Tehsil	16***
			Sh. Ved Pal Singh	Alawalpur	Palwaal	
			Sh. Mahabir Prasad	NayaGoan	Rewari	
			Sh. Rajender Kumar	Silani	Jhajjar	
			Sh. Mahender Singh	Mandola	M/garh	
			Sh. Bhim Singh	Sohasra	Loharu	
			Sh. Suresh Kumar	Dhamana	Hansi	
			Sh. Shyam Sunder	Dhakal	Narwana	
			Sh. Kuldeep Singh	Kinana	Jind	
			Sh. Sanjeet Kumar	KheriDamkan	Gohana	
			Sh. Mohinder Kumar**	Gogripur	Karnal	
			Sh. Raj Kumar	Gadauli	Naraingarh	
			Sh. Nafe Singh	Bhagal	Guhla	
			Sh. Ram Phal	Mundhri	Kaithal	
			Sh. Pawan Kumar	Harnaul	Jagadhri	
6.	Messenger -01	01	Vacant			01***

Teaching Scheme				
(a) 541/T-1 (B) state – Teaching scheme				
1.	Assistant Professor -06 (Agril. Economics)	03	Dr.K.K.Kundu, Assoc. Professor Mr. Sanjay, Asstt. Professor Dr.J.S.Papang, Asstt. Professor	03
2.	Steno-Typist-01	01	Sh. Ashok Kumar (up to 30.12.2021)	Nil
3.	Sweeper-01	01	Vacant	Nil

, ** working at RRS, Karnal, *** 18 persons (16 A.Is+ 01clerk+01 Messenger) engaged through outsourcing

3. Research Achievements (2021-22):

- Normal sown cauliflower (Net returns Rs. 70162 ha^{-1}) cultivation was found to be profitable over mid sown cauliflower (Net returns Rs.18728 ha^{-1}) cultivation based on 20 sampled farms of Hisar district. In disposal of cauliflower, marketing channel –III (producer to consumer) was perceived most efficient with higher marketing efficiency index (61.86 & 33.29) and lower price spread (Rs 35 $quintal^{-1}$).

- The constraints faced by growers like labour scarcity during plucking and planting time (85-100%), inadequate availability and high prices of seed (65-100%), difficulty in raising of nursery for normal cauliflower (100%), wide fluctuation in market prices (90-100%), lack of grading and packing facilities at village level (85%), limited numbers of buyers (90%) were identified in production and marketing of cauliflower.

- Based on data collected from 03 sugar mills,10 each for jaggery and cane juice processing units of Karnal, Kurukshetra, Yamunanagar districts of Haryana, channel-I (producer-cane collection centre-sugar mill) in disposal of cane was found most efficient with marketing index of 21.66. Similarly, channel-III (producer - kohlu owner– consumer) was found most efficient (marketing index 5.09) among all the marketing channels of jaggery product. The extraction of juice from cane was found economically beneficial with higher B-C ratio (2.28) over jaggery (B:C ratio 1.06) and sugar (B:C ratio 1.02).

- Labour scarcity and higher wages of labour during peak season (85-100%), intensive manual operations specially in case of harvesting (95%), short crushing season (90%) in sugarcane cultivation, while in case of juice and jaggery, small and uneconomic size of unit, increasing cost of production/processing (90%) were identified major constraints.

- For forecasting prices of vegetables (onion & potato) and fruits (kinnow & guava), monthly wholesale price data collected from markets of Kurukshetra & Yamunanagar districts for vegetables, Haryana & Punjab as whole for fruits for the period 2010-20. It was observed that the average prices of onion and potato for Kurukshetra and Yamunanagar were Rs.1569.58 q-1 & Rs. 1633.14 q-1 and Rs.826.15 q-1 & Rs.867.16 q-1, respectively. In the case of fruits, the average value of kinnow and guava prices for Haryana and Punjab were Rs.1607.25 q-1 & Rs.1271.42 q-1 and Rs.1811.02 q-1 & Rs. 1618.31 q-1, respectively. The statistical model (ARCH-1) model used for forecasting prices of selected vegetables & fruits and it was observed that 95 per cent of the forecasted values were within the limits of 2 standard errors with mean absolute percentage error (MAPE) between 15-20 per cent.

- FCI owned storage capacity increased from 7.34 to 10.46 lakh tonnes in Haryana during last thirty years (1990-2020). In Haryana, the total number of cold storage was 198 and the capacity was 22.67 lakh tonnes during 2019-20. The highest number of cold storage (51) and their capacity (0.80 lakh tonne) was recorded in Kurukshetra.

- The monthly data of onion price collected from APMC markets of Kurukshetra, Yamunanagar, Panipat and Gurugram of Haryana as well as national markets i.e. Nasik and Delhi for the period 2010-2020 were collected. Further, based on seasonal indices, prices in onion markets was higher during July to January than the average annual price recorded in APMC markets of Haryana (Rs. 15.40 kg-1) and Nasik market (Rs. 13.95 kg-1) whereas in February to June, the prices remained below the average prices. Pairwise Granger Causality Test indicated that onion prices of Nasik and Delhi markets effected prices of onion in all four selected markets of Haryana.

- Based on time series data of 40 years (1980-2020), area under gram in Haryana declined at a rate of 7.90 per cent per annum and yield revealed positive sign (1.59%). At national level, variation was noted lowest in case of arhar area (13.33%), production (23.03%) and yield (11.67 %) as compared to other pulse crops like lentil, moong, urad, Gram. Holts ETS method performed better for prediction of pulses production at national level as root mean square error (RMSE) was lesser.
- The gross returns and return over variable cost of sesame cultivation worked out Rs. 47048 ha-1 and Rs. 26697 ha-1, respectively based on 60 sampled farms of Mahendergarh and Rewari districts. The constraints faced by farmers were low yielding varieties (87%) followed by low input used (78%) and problem of seed shattering (71%).
- Net returns for groundnut (₹ 33,472ha-1, ₹ 38,975ha-1, ₹ 40,318 ha-1 and ₹ 57,397 ha-1) for Hisar, Fatehabad, Sirsa, and Rewari districts worked out based on 40 sampled farms. The constraints faced by farmers were unavailability of quality seeds (86%) and less price realisation (81%) in the study area.
- Based on NSSO data (55th and 68th round) in terms of per capita per day (PCPD) consumption of orange/mosami in Haryana is among the top in India.The PCPD consumption of watermelon and guava (2nd) was highest in Haryana an average of 3.68 g/capita/day in rural and 3.58 g/capita/day in urban areas for watermelon, and it was around 4.82 g/capita/day in rural and 0.043 g/capita/day in urban areas. The nutrient intake from all fruits was found highest in Goa with calorie intake of 200.8 and 191.5 cal/capita/ day in rural and urban areas, respectively. The states with lowest PCPD nutrient intake noticed were Jharkhand (7.68 cal/capita/day in rural) and Bihar, (18.78 cal/capita/day in urban).
- Haryana ranked 9th among all states in micro-irrigation coverage with 10.4 per cent of gross irrigated area under micro-irrigation and ranked 4th as considering area under micro-irrigation (9.1 %) as a proportion of gross cultivated area under micro-irrigation. In total, Haryana had 5.46 lakh acres of area under micro-irrigation i.e. 6.1 per cent of cultivated area. Currently, the share of drip and sprinkler irrigation in the state is 21.58 and 78.42 per cent, respectively.
- High dependence on erratic electricity as one of the major constraints confronted by farmers in adopting sprinkler irrigation in Bhiwani and Mahendergarh districts was ranked first followed by lack of operational and maintenance training (2), poor quality of product (3), suppliers not honoring product warranty(4) and lack of technical and maintenance support from the installing company (5). The key constraints encountered by farmers in adopting drip irrigation was ranked as lack of operational and maintenance training (1), erratic electricity(2), heavy initial investment (3), poor quality of product (4)and lack of technical support from supplier (5).
- Gross return from garlic worked out Rs. 426341 ha-1 based 30 sampled farms of Karnal district whereas; in turmeric, it was found Rs. 536995 ha-1 based on 30 sampled farms of Yamunanagar district. The B: C ratio of garlic and turmeric computed was 1.35 and 1.33, respectively. The producer's share in channel-I (producer-consumer) was more than 90 per cent of consumer's rupee in both the crops. The major production and marketing constraints faced by the garlic growers were high cost of seed (73%), high cost of post-harvest technology (86%), high fluctuation in market price (77%) and lack of grading (60%) for garlic as well as turmeric in the respective study area.
- Based on 40 sampled farms of Yamunanagar district, net return from poplar plantation worked out was Rs. 11.70 lakh ha-1 in 7th year however additional income also generated from cultivation of wheat (5 years) and sugarcane (2years) as intercrops. The producer share was found to be 73.63 per cent by direct sale and 62.77 per cent by contract sale in retailer's price. Income after long gestation period (95%), shed effect on crops in nearby field (85%), low yield level of other crops grown as intercrop (80%), high price fluctuation (83%), lack of support price to growers(78%) and high marketing cost (65%) were identified production and marketing constraints in poplar plantation .

- Based on 60 sampled farms of Sonipat district, net return from paddy cultivated under mechanical and conventional methods worked out Rs. 34962.50 ha-1 and Rs.20180 ha-1, respectively. Inadequate local manufacturer (93%), higher total cost of cultivation (90.00%) and more initial investment and maintenance cost (87%) were some of the major constraints in adoption of mechanical transplanting of paddy.
- Mustard arrivals were recorded highest in Rewari market. The compound annual growth rate (CAGR) of arrivals of mustard exhibited positive sign in Bhiwani (4.4%), Rewari (1.8%), Narnaul (12.9%) markets except Hisar (-0.6%) during the period 2001-20. The CAGRs for mustard market price over period reflected positive sign in Bhiwani (7.9 %), Rewari (8.0%), Narnaul (6.5%) and Hisar (7.30%) markets. The positive seasonal trend in arrivals of mustard during the month of March to June indicated the maximum arrival in this period. The increasing trend in arrivals of mustard in all four markets indicated that area shifted from less remunerating crops like barley, gram. While prices of mustard exhibited an increasing trend from 2001 to 2020 for all four selected markets.

4. Emerging/Thrust Areas

- Socio-economic analysis of emerging agricultural problems.
- Demand, supply and price analysis of agricultural inputs and output.
- Resource use efficiency in farm enterprises in different agro-climatic zones.
- Diversification in agriculture, sustainable agriculture , utilization of natural resources
- Marketing of agricultural produce and value addition in agriculture.

5. Action taken report of proceedings of meeting of Review Research Schemes (2020-21) and Finalization of Technical Programme (2021-22) held on 28.07.2021

S.N.	Observations	Action taken
1.	Young scientists should submit projects for outside funding agencies at least one each. (Action: HOD, Agril. Economics; Concerned Scientists)	Matter was discussed in the meeting to review proceeding of TP held on 30.08.2022 and letter circulated dated 17.09.2022.
2.	Sample size should be increased to minimize the error in new experiments and quality of the experiments needs to be improved. The new experiments should be formulated only in the thrust areas of the scheme. New experiments formulated after the meeting should be got approved from the Directorate. (Action: HOD, Agril. Economics; Concerned Scientists)	Sample size for new proposed experiments increased. New experiments were formulated in thrust areas and approved from Directorate.
3.	New experiment should be formulated on impact assessment of e-mausam in collaboration with Department of Agril. Meteorology. (Action: HOD, Agril. Economics, Agri. Met.; Concerned Scientists)	Ph.D. student was doing research on same theme
4.	New experiment should be formulated on assessment of DSR and transplanted rice. (Action: HOD, Agril. Economics; Concerned Scientists)	New experiment included
5.	New experiment should be formulated on assessment of hybrid vegetable seeds and improved/high yielding varieties. (Action: HOD, Agril. Economics; Concerned Scientists)	New experiment included
6.	Standard units and standard universal symbols of units (‘g’ for grams, ‘q’ for quintals, ‘kg’ for kilograms, ‘ha’ for hectares) should be used throughout the document. (Action: HOD, Agril. Economics; Concerned Scientists)	Corrected as suggested in document
7.	Dr. Joginder should formulate experiments to contribute in RRS, Rohtak also to justify his stay for 3 days at Rohtak and get approved from the directorate. (Action: RD, RRS, Rohtak; HOD, Agril. Economics; Concerned Scientists)	He was involved in experiments as proposed from RRS, Rohtak
8.	Page 2: The research achievements may be revised as suggested. (Action: HOD, Agril. Economics)	Revised as discussed in TP meeting
9.	Page 4: ATR Point No.1, 3 and 6 should be followed and corrections should be made as suggested. (Action: HOD, Agril. Economics)	Needful done

10.	Page 6: Only scientific equipments should be given in the list of equipments. (Action: HOD, Agril. Economics)	Needful done
11.	Page 10-15, Expt. 1: Units of the particulars should be specified in Table 1. Hoeing /weeding and Plant protection should be separated. The conclusion should be concise highlighting the important findings. (Action: Concerned Scientist)	Corrected
12.	Page 15-21, Exp.1: The conclusion should be concise highlighting the important findings Specify channel-I and Channel-III in the conclusion. (Action: Concerned Scientist)	Corrected
13.	Page 22, Expt.3: The X-axis and Y-axis should be specified in all the figures. Give full form of ARCH. Price forecasting model should be developed for major crops by Dr. Joginder. (Action: Concerned Scientist)	Corrected
14.	Page 34-37, Expt.5: The conclusion may be deleted and continue for primary data. (Action: Concerned Scientist)	Corrected
15.	Page 48, Expt.8: R2 may be replaced with R2 in the table 2. (Action: Concerned Scientists)	Corrected
16.	Page 54, Expt. 10: Status of Haryana State should be included/ highlighted in the results. (Action: Concerned Scientist)	Included
17.	Page 59-63, Expt.11: Check the interpretation of results. (Action: Concerned Scientist)	Checked and corrected
18.	Page 66, Expt. 12: 'Variety' in tables 1-3 should be replaced by 'Sources'. (Action: Concerned Scientist)	Corrected
19.	Page 71-78, Expt.13: The data may be rechecked and revised in consultation with HOD, Vegetable Science. Continue the experiment including collaborator from Vegetable Science. (Action: HOD, Veg. Science; Concerned Scientist)	Discussed with concerned scientist and HoD, vegetable Science. The necessary corrections were done
20.	Page 79-86, Expt. 14: The titles of the tables may be revised and column headings may be specified. Table 4 and 5 should be rechecked and revised. Continue the experiment including collaborator from Forestry. (Action: HOD, Forestry; Concerned Scientist)	Discussed with concerned scientist and HoD, Forestry. The necessary corrections were done
21.	Page 87, Expt.15: Unit of the particulars should be specified in table 1. Keep Conventional' or 'Traditional' throughout the experiment. The data should be thoroughly checked. (Action: Concerned Scientist)	Conventional word was used
22	Page 97, Expt. 1: Collaborator may be included from Horticulture. (Action: HOD, Horticulture; Concerned Scientist)	Dr. R. P. Dalal included as Collaborator
23.	Page 98, Expt. 2: The title may be revised. (Action: Concerned Scientist)	Revised as per suggestion
24.	Page 99, Expt. 3: Finalize experiment in discussion with HOD, Agril. Meteorology. (Action: HOD, Agril. Met.; Concerned Scientist)	Discussed with HoD Agril. Meteorology and included Dr. M.L.Kicher as Collaborator
25.	Page 100, Expt. 4: The experiment may be dropped. (Action: Concerned Scientist)	Dropped
26.	Page 103-4, Expt. 7-8: The experiments may be dropped. (Action: Concerned Scientist)	Dropped
27.	Page 107, Expt.11: The title may be revised as suggested. (Action: Concerned Scientist)	Revised
28.	Page 108, Expt.12: The crop may be changed based on importance and the district selected should be based on area under crop. (Action: Concerned Scientist)	Districts included based on area coverage
29.	Page 109-110, Expt. 13-14: The experiments may be dropped. New experiments should be formulated by the Scientists on alternative cropping systems. (Action: Concerned Scientist)	New experiments on alternative cropping systems in eastern and western zones were included
30.	Page 122: 'Others' may be specified. The authorship in Sr.No.23 may be checked. (Action: Concerned Scientist)	Specified
31.	The revised Technical Programme should be compiled and submitted two copies to this office and also upload through ERP module within 15 days. (Action: HOD, Agril. Economics.)	Two copies submitted

6. **List of research projects (from state as well as outside agencies) in operation along with sanctioned budget (2022-23)**

S.N.	Number and name of the scheme	Sanctioned Budget (in Rs.)	Funding Agency
Research Schemes			
a.	**State Funded Scheme**		
1.	**1202-Dte-R-1- Agri (A)-state scheme** Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	20520.00	State
b.	**Other Agencies**		
2.	**3066-C(c) Econ-1 CS** Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops in India- Haryana.	3,20,00,000.00	DES, Ministry of Agriculture and Farmers Welfare, Govt. of India.
Teaching scheme			
1.	541/T-1 (B) state – Teaching scheme	00.00	State
2.	1051/T-1(A) state-Teaching scheme	28000.00	State

7. **Research projects completed during 2021-22: Nil**

8. **Research projects sanctioned/submitted during 2022-23: Nil**

9. **Scheme-wise summary of experiments**

Scheme/project	No. of Experiments				
	Planned (2020-21)	Conducted (2020-21)	Concluded (2020-21)	Continued (2021-22)	New Expt. (2021-2022)
1202-Dte-R-1- Agri (A)-state scheme Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming	**16**	**16**	**15**	**01**	**15**
3066- C(c) Econ.1 (CS) Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in India- Haryana	**02**	**02**	**02**	**-**	**02**

10. **List of equipment's (last three years)**

Year	Name of equipment	Quantity	Cost (in Rs.)	Status
2019 - 20	Multimedia	01	Transferred from IDP Project	Functional
2020-21	Computer (3) and printer (3)	06	199981.00	Functional
2021-22	Nil	----	------	------

11. **Recommendations generated for field application : Nil**

12. **Protection of IPR instruments, if any (patents, registration of variety/germplasm, copyright etc.)**

:Nil

B. Details of Each Research Scheme(s) for Review:

1. Scheme No. : 1202-Dte-R-1-Agri (A)

Title: Economic Studies into Emerging Marketing and Production Problems Related to Haryana Farming

2. Year of Start : 2002-2003

3. Location : Haryana

4. Objectives of the scheme:

- To analyse the resource use efficiency in Haryana farming.
- To carry out studies into different marketing aspects of major farm inputs and products.
- To study the possible agricultural diversification in different zones of Haryana.

5. Any need to modify the objectives as per the need of the state

- No-

6. Budget for the year 2021-22 (head-wise sanction and expenditure details) (inRs.)

Sr. No.	Particulars	Allotment	Expenditure	Balance
1	TA	5000	3558	1442
2	Other expenses (O)	7000	6787	213
	Total	**12000**	**10345**	**1655**

7. Salient Research Findings of the Scheme during 2021-22

- Net returns, were estimated to be Rs. 28065 and Rs. 12485 in normal and mid sown cauliflower cultivation, respectively. Similarly, benefit cost ratio was found to be higher in normal sown cauliflower (1.24) over mid sown cauliflower cultivation (1.14) indicated that cultivation of normal sown cauliflower was found to be profitable over mid sown cauliflower.
- Marketing channel –III (Producer to consumer) were found to efficient marketing channel based on higher marketing efficiency index (61.86 & 33.29) and lower price spread (Rs 35) in normal and mid sown cauliflower respectively.
- Labour scarcity during plucking and planting time (85-100%), inadequate availability and high prices of seed (65-100%), difficulty in raising of nursery for normal sown cauliflower (100%), wide fluctuation in market prices (90-100%), lack of grading and packing facilities at village level (85%), limited numbers of buyers (90%) were identified production and marketing constraints in study area.
- In disposal pattern of cane, channel-I (Producer –cane collection centre – sugar-mill) was found most efficient with marketing index of 21.66. Similarly, in case of cane products, channel-III (Producer - Kohlu owners– Consumer) was found most efficient (Higher marketing index 5.09) among all the marketing channels of jaggery product. Whereas, cane juice was found economically beneficial with higher B-C ratio (2.28) over jaggery (B:C ratio 1.06) and sugar (B:C ratio 1.02).
- Labour scarcity and higher wages of labour during peak season(85-100%), intensive manual operations specially in case of harvesting (95%),short crushing season (90%), small and uneconomic size of unit, increasing cost of production/processing (90%) were identified major constraints for all the cane stakeholders in the study area.
- The average value of onion prices for Kurukshetra and Yamunanagar were Rs.1569.58 & Rs. 1633.14 with S.D. Rs.881.48 & Rs.993.63, respectively.

- The minimum and maximum values of the prices of onion for Kurukshetra and Yamunanagar during this period for both the markets were Rs. 442.16 & Rs.4624.98 and Rs.488.99 & Rs.5849.83, respectively.
- The average value of potato prices for Kurukshetra and Yamunanagar were found Rs.826.15 & Rs.867.16 with S.D. Rs.436.10 & Rs.469.91 respectively based on monthly price data of selected markets from Jan., 2010 to Dec., 2020.
- The minimum and maximum prices of potato for Kurukshetra and Yamunanagar were estimated to be Rs.259.93 & Rs. 2661.96 and Rs.255.59 & Rs.2584.04, respectively.
- The minimum and maximum values of the prices for Haryana and Punjab for guava for the period 2010-20were Rs.616.60 & Rs. Rs.4500.00 and Rs.598.01 & Rs.3847.06 respectively.
- For forecasting prices of onion and potato based on data collected from for Kurukshetra and Yamunanagar markets as well as kinnow for the period 2010-20,ARCH (1) model was found good fit for forecasting of price. Whereas, in case of Guava prices of Haryana and Punjab, it was observed that there is no ARCH effect.
- FCI owned storage capacity increased from 7.34 to 10.46 lakh tonnes in Haryana. In Haryana, the total number of cold storage was 198 and the capacity was 22.67 lakh tonnes during 2019-20. The highest number of cold storage (51) and their capacity (0.80 lakh tonne) were registered i n Kurukshetra 51 and 80 thousand tonnes, respectively.
- In case of Nashik market, the mean price was observed Rs. 13.95 per kg. Whereas, it was ranged between Rs. 14 -17 per kg in other markets during the study period. High instability/volatility of prices has been remained in case of Nashik market (C V 78%).Prices of onion markets differ significantly from the average price during July to January whereas in February to June the prices remained below the average price. The overall highest prices were observed in the month of September and October. While, it was remained lowest during month of April to May for all the markets.
- Trace test and Max-eigen value test indicate that there are co-integration equations at the 0.05 level respectively. Therefore, series are co-integrated. Pair-wise Granger Causality Tests shows that Nasik and Delhi markets, effected prices of onion in other selected markets.
- Area under gram declined at a rate of 7.90 per cent per annum at state level whereas maximum rate was found in Sirsa district (10.32 per cent per annum) followed by Hisar, Mahendergarh and Bhiwani. Similar trend were observed in case of production and production which was declining at a rate of 6.43 per cent per annum in Haryana.
- It was also observed that despite declining pattern of area in gram, yield was growing at a rate of 1.59 per cent per annum at state level and was positive for all the selected districts. Variation was lowest in case of arhar area (13.33 percent), production (23.03 percent) and yield (11.67 per cent).Two univariate time series models were applied and it was observed that Holts ETS method performed better for prediction as RMSE was lesser.
- The gross returns and return over variable cost of sesame cultivation worked out Rs. 47048, and Rs. 26697, respectively in Mahendergarh and Rewari districts. The constraints faced by farmers were low yielding varieties (86.66%) followed by low input used (78.33%) and problem of seed shattering (70.55%).
- Net returns per hectare of groundnut(₹ 33,472, ₹ 38,975, ₹ 40,318 and ₹ 57,397) for Hisar, Fatehabad, Sirsa and Rewari districts, respectively. The constraints faced by farmers were unavailability of quality seeds (85.83%) and less price realisation (80.83%) in the study area.
- Per capita per day nutrient intake from all fruits it was found that per capita per day (PCPD) nutrient intake is highest in Goa with calorie intake of 200.8 and 191.5 cal/capita/day in rural and urban areas respectively.

- Goa protein intake is highest with 2.07 g/capita/day in rural and Goa as well as Kerala in urban area (2 g/capita/day). Again, in fat intake, the highest PCPD value is seen in Goa (15.56g in rural, 14.75g in urban).
- The states with lowest PCPD nutrient intake are Jharkhand and Bihar, with lowest intake of calorie from fruits is in Jharkhand (7.68 cal/capita/day in rural) and Bihar (18.78 cal/capita/day in urban).
- Lowest protein intake in Jharkhand (0.08g in rural, 0.21g in urban) and Bihar (0.17g in rural and 0.19g in urban), and lowest fat intake from fruits was seen in Bihar (0.09g in rural and 0.11g in urban) as well as Uttar Pradesh and Jharkhand.
- Per hectare gross returns of garlic and turmeric were Rs. 426341 and Rs. 596605, respectively. While B: C of garlic and turmeric was found to be 1.35 and 1.40, in the study area. The producer's share in channel-I *i.e.* producer to consumer, accounted 94.77 and 90.84 per cent of in the consumer's rupee in garlic and turmeric, respectively.
- The major production and marketing constraints faced by the garlic growers were high cost of seed (73.33%), high cost of post-harvest technology (86.67%), less information about seed treatment(60.00%) , high fluctuation in market price(76.67%) and lack of grading(60.00%) for garlic as well as turmeric in the respective study area .
- Net return of Rs. 1224297 from poplar plantation was received by sampled farmers in Yamunanagar district. The producer share was found to be 73.63 per cent by direct sale and 62.77 per cent by contract sale.
- Income after long gestation period (95.00%), shed effect on crops in nearby field (85.00%), low yield level of other crops grown as intercrop (80.00%), high price fluctuation (82.50%), lack of support price to growers(77.50%) and high marketing cost (65.00%) were identified production and marketing constraints in poplar plantation .
- Bhiwani (229397 acres), Mahendergarh (193259 acre) and Rewari (66495 Lakh acres) districts has highest area under micro-irrigation in Haryana. The gap between budgets allocated and utilized needs to be narrowed as only two thirds of allocated budget utilized during the study period.
- In Karnal district, the highest carbon footprint among basmati paddy varieties per hectare was observed in 1509 variety which was 20584.9 Kg followed by PB 1121(5548.8 Kg) and least was seen in CSR 30 i.e. (5240.7 Kg), respectively. In non-basmati paddy in Karnal district, the carbon emissions were 23176.9 Kg Co2/ha. In Sirsa district, the carbon emissions per hectare was highest in case of 1692/1509 (11484.3 Kg) followed by 1718 (11028.5 Kg), 10609.9 Kg Co2/ha in case of PB 6/1401 and least in case of PB 1121 i.e. 10387 Kg Co2/ha.
- Net returns from paddy cultivated under mechanical and conventional methods worked out Rs. 34962.50 and Rs.20180, respectively. Inadequate local manufacturer (93%), higher total cost of cultivation (90.00%) and more initial investment and maintenance cost (87%) were some of the major constraints in adoption of mechanical transplanting of paddy.
- Mustard arrivals was almost stagnant during 2001 to 2017 and 2017 onwards, it showed increasing trend as area shifted from less remunerating crops like barley, gram. While, prices of mustard showed an increasing trend from 2001 to 2020 for all four selected markets *i.e.* Rewari, Bhiwani, Hisar and Narnaul as well as in Haryana.

8. Justification for continuation of the scheme

Objectives of the schemes are of continuous nature. Hence, its continuation is required to study the emerging socio-economic problems of farmers, sustainable utilization of natural resources, diversification in agriculture; resource use is farm enterprise, marketing of agricultural produce and its value addition in Haryana.

9. Constraints, if any: Shortage of scientists in the scheme.

10. TECHNICAL PROGRRAME OF WORK DURING 2021-22

i	**Experiment No. 1: Economic evaluation of production and marketing of normal and mid sown cauliflower in Hisar district of Haryana.**	
ii	**Objectives of the Experiment**	• To work out cost and returns of cauliflower cultivation • To study the marketing pattern of cauliflower • To identify the production and marketing constraints in cauliflower cultivation
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Data collection and report writing • Dr. DP Malik Planning, finalization of interview schedule
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• **2021-22**
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of the experiment**: Hisar • **Blocks and villages covered:** Village Dhani Piran and Dhani Pirawali from Hansi block of Hisar district were selected • **Number and types of respondents:** Ten cauliflower growers (10) from each selected village and five (5) market intermediaries from Hansi market were surveyed. • **Statistical design/methods:** The statistical tools like mean, percentage, price spread, Acharya's approach for marketing efficiency were used.
viii	**Observations recorded**	• Primary data related seed, agro-chemicals, human labour, inputs and output prices and marketing constraints of cauliflower cultivation were collected from twenty cauliflower growers from selected villages. • Information related to price received by producer, price spread and marketing constraints of cauliflower were recorded.

ix. Results achieved during 2021-22

Cost and returns of cauliflower in Hisar district of Haryana

Costs of cauliflower cultivation in Hisar district of Haryana are presented in table 1. Per acre total and variable cost of cultivation in normal sown cauliflower was found to be Rs118169 and Rs. 81507, respectively. Whereas, in case of mid sown cauliflower, per acre total and variable cost of production were found to be Rs. 91015and Rs58346respectively, in the study area.

Returns from cauliflower cultivation are presented in table 2. In case of normal sown cauliflower cultivation, gross returns were estimated to be Rs. 146234 per acre. Whereas, returns over variable cost and net returns, were estimated to be Rs. 64726 and Rs. 28065, respectively.

Table 1: Cost of cauliflower cultivation in Hisar district of Haryana (Rs. /Acre)

Sr. No.	Particulars	Normal		Mid	
		(Qty/No.)	(Rs./Acre)	(Qty/No.)	(Rs./Acre)
1	Preparatory tillage	6.2	5625 (4.76)	6	5167 (5.68)
2	Seed (g/acre)	335	15150 (12.82)	200	8333 (9.16)
3	Nursery Raising		3898 (3.30)		2500 (2.75)
4	Ridging and Transplanting	11.9	4650 (3.94)	12	4000 (4.39)
5	Total manure & fertilizer expenses	320.75	10575 (8.95)	291.66	4967 (5.46)
6	Irrigation	16	8980 (7.60)	9	4667 (5.13)
7	Hoeing/weeding		9330 (7.90)		7500 (8.24)
8	Plant protection		1485 (1.26)		1200 (1.32)
9	Harvesting/plucking (man-days)	55	17000 (14.39)	64	16000 (17.58)
10	Interest on working capital and miscellaneous		4815 (4.07)		4013 (4.41)
11	**Variable cost**		**81507 (68.98)**		**58346 (64.11)**
12	Packing & Transportation		5273 (4.46)		6000 (6.59)
13	Risk factor & Management		16301 (13.80)		11669 (12.82)
14	**Rental Value of land**		15088 (12.77)		15000 (16.48)
15	**Total cost**		**118169** (100.00)		**91015** (100.00)

***** Figure in parenthesis represents percent to the total cost

* Fertilizer and manure expenses includes FYM, Urea, DAP, Potash, Zinc and micro nutrients

Similarly, in case mid sown cauliflower cultivation, gross returns, were estimated to be Rs. 103500 per acre. While, returns over variable cost and net returns were obtained to be Rs. 45154 and Rs. 12485, respectively. Benefit cost ratio found to be higher in early cauliflower over mid cauliflower cultivation indicated that cultivation of early cauliflower is more beneficial in the study area.

Table 2: Returns from cauliflower cultivation in Haryana

Sr. No.	Particulars	Normal	Mid
1	Production (q/acre)	92	135
2	Average price (Rs./q.)	1588	767
3	Gross returns	146234	103500
4	Returns over variable cost	64726	45154
5	Net returns	28065	12485
6	**Benefit-cost ratio**	**1.24**	**1.14**

Disposal pattern and price spread of cauliflower in Hisar district of Haryana

Disposal patterns of cauliflower in Hisar district of Haryana are presented in Table 2. The following marketing channel has found to be in operation in the study area

Table 3: Disposal pattern of cauliflower in Hisar district of Haryana

Channel – I	Producer – Commission agent cum wholesaler – Retailer – Consumer
Channel – II	Producer – Retailer – Consumer
Channel – III	Producer – Consumer

Price spread in various marketing channels of cauliflower in Hisar district of Haryana

Price spread in various marketing channels of cauliflower in Hisar district of Haryana are presented in table 04. The result of the table revealed that in marketing channel –I, net price received by producer's in normal and mid sown cauliflower was Rs1466 and 642which were 47.04 and 39.84 per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 783 and 537 in normal and mid sown cauliflower, respectively. Whereas, total net marketing margin in normal and mid sown cauliflower were obtained Rs. 867 and 432, respectively. Price spread was found to be Rs. 1651 and Rs. 969 in normal and mid sown cauliflower which was 52.96 and 60.16 per cent of consumers purchase price.

Similarly, in case of Channel-II, net price received by producer's in normal and mid sown cauliflower was Rs1875 and 875 which were 68.93 and 62.50 per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 525 and 375 in normal and mid cauliflower, respectively. Whereas, total net marketing margin in normal and mid cauliflower were obtained Rs. 300 and 150, respectively. Price spread was found to be Rs. 845 and Rs. 525 in normal and mid sown cauliflower which was 31.07 and 37.50 per cent of consumers purchase price.

Likewise, in Channel –III, net price received by producer's in normal and mid sown cauliflower was Rs. 2165 and 1165which were 98.41and 97.08per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 35 in normal as well as mid sown cauliflower, respectively. Price spread was found to be only Rs. 35 in normal and mid sown cauliflower which was 1.59and 2.92per cent of consumers purchase price in the study area.

Table 4: Price spread in disposal patterns of cauliflower in various marketing channels in Hisar district of Haryana **(Rs./qtl)**

Sr. No.	Particulars	Normal		Mid	
		Cost (Rs/Qtl.)	Share in consumer's rupee (%)	Cost (Rs/Qtl.)	Share in consumer's rupee (%)
Channel - I (Producer- CA/WS-Retailer-Consumer)					
1	**Net price received by the producer**	**1466**	**47.04**	**642**	**39.84**
2	**Expenses incurred by**				
	i) Producer	125	4.01	125	7.76
	ii) CA-cum-Wholesaler	265	8.50	174	10.82
	iii) Retailer's	393	12.62	238	14.77
	Total marketing cost	**783**	**25.12**	**537**	**33.35**
3	**Market margin of**				
	i) Wholesaler's margin	239	7.66	115	7.14
	ii) Retailer's margin	628	20.16	317	19.67
	Total marketing margin	**867**	**27.82**	**432**	**26.81**
4	**Consumer's purchase price**	**3117**	**100.00**	**1611**	**100.00**
5	**Price spread**	**1651**	**52.96**	**969**	**60.16**
Channel - II (Producer-Retailer-Consumer)					
1	**Net price received by the producer**	**1875**	**68.93**	**875**	**62.50**
2	**Expenses incurred by**				

	i) Producer	125	4.60	125	8.93
	ii) Retailer's	420	15.44	250	17.86
	Total marketing cost	**525**	**20.04**	**375**	**26.79**
3	**Marketing margin**				
	i) Retailer's margin	300	11.03	150	10.71
	Total market margin	**300**	**11.03**	**150**	**10.71**
4	**Consumer's purchase price**	**2720**	**100.00**	**1400**	**100.00**
5	**Price spread**	**845**	**31.07**	**525**	**37.50**
Channel - III (Producer-Consumer)					
1	**Net price received by the producer**	2165	98.41	1165	97.08
2	**Total cost incurred by producer**	35	1.59	35	2.92
3	**Consumer's purchase price**	2200	100.00	1200	100.00
4	**Price spread**	**35**	**1.59**	**35**	**2.92**

*Producers marketing cost includes transportation, loading, unloading and packaging/ cost of gunny bag.
*CA-cum-commission agent marketing cost includes Market fee and HRDF@2 %, transportation, loading, and unloading.
*Retailers' marketing cost includes transportation, loading, unloading, commission and spoilage/losses.

Marketing efficiency among marketing channels of cauliflower in Hisar district of Haryana

Marketing efficiency of various marketing channel of cauliflower is presented in table 5. Based on marketing efficiency index ratio, channel – III (Direct marketing) was found to be efficient among other marketing channels of early as well as mid cauliflowers in the study area.

Table 5 : Marketing efficiency among marketing channels of cauliflower in Hisar district of Haryana

Sr. No.	Particulars	Channel – I		Channel-II		Channel - III	
		Normal	Mid	Normal	Mid	Normal	Mid
1	**Retailers sale price /consumer purchase price**	3117	1611	2720	1400	2200	1200
2	**Total marketing cost**	783	537	545	375	35	35
3	**Total net margins of intermediaries**	867	432	300	150	0	0
4	**Net price received by producers**	1466	642	1875	875	2165	1165
5	**Marketing efficiency (4/(2+3)**	**0.89**	**0.66**	**2.22**	**1.67**	**61.86**	**33.29**

Constraints in production and marketing of cauliflower cultivation in Hisar district of Haryana

Constraints in production and marketing of cauliflower cultivation in Hisar district of Haryana are presented in table 6. Labour scarcity during plucking and planting time (85-100%), erratic supply of electricity (100%), inadequate availability and high prices of seed (65-100%), high incidence of insects/pest/diseases (75 -90%)and difficulty in raising of nursery for normal cauliflower(100%) were recognized major production constraints.

Similarly, wide fluctuation in market prices (90-100%), lack of grading and packing facilities at village level (85%), limited numbers of buyers (90%), non-remunerative sale prices and lack of availability of market information & distant market (80%) were identified some of the marketing related constraints in study area.

Table 6 : Constraints/problems in production and marketing faced by cauliflower growers in Hisar district of Haryana

Sr. No.	Constraints /Problems	Normal	Mid
		Per cent response	
Production			
1	Labour scarcity during plucking and planting time	100	85
2	Poor quality of irrigation water	80	80
3	Low production of early cauliflower	70	0
4	Inadequate availability of quality seed	85	85
5	High prices of seed	100	65
6	Erratic supply of electricity	100	100
7	High incidence of insects/pest/diseases	90	75
8	Higher numbers of irrigation	100	40
9	Difficulty in raising of nursery for early cauliflower	100	0
Marketing			
1	Wide fluctuation in market prices	90	100
2	Lack of availability of market information& distant market	45	42
3	Lack of grading and packing facilities at village level	85	85
4	Limited numbers of buyers	90	90
5	Non-remunerative sale prices	80	80

x. Programme of work for 2022-23: Experiment concluded

Salient findings of the study:

- Per acre, total and variable cost of cultivation in normal sown cauliflower was found to be Rs 118169 and Rs. 81507, respectively. Whereas, in case of mid sown cauliflower, per acre total and variable cost of production were found to be Rs. 91015 and Rs 58346 respectively, in the study area.
- Per acre net returns, were estimated to be Rs. 28065 and Rs. 12485 in normal and mid sown cauliflower cultivation, respectively. Similarly, benefit cost ratio was found to be higher in normal sown cauliflower (1.24) over mid sown cauliflower cultivation (1.14) indicated that cultivation of normal sown cauliflower is more beneficial in the study area.
- Marketing channel –III (Producer to consumer) were found to efficient marketing channel based on higher marketing efficiency index (61.86 & 33.29) and lower price spread (Rs 35) in normal and mid sown cauliflower respectively, in the study area.
- Labour scarcity during plucking and planting time (85-100%), erratic supply of electricity (100%), inadequate availability and high prices of seed (65-100%), high incidence of insects/pest/diseases (75 -90%)and difficulty in raising of nursery for normal sown cauliflower (100%) were recognized major production constraints.
- Wide fluctuation in market prices (90-100%), lack of grading and packing facilities at village level (85%), limited numbers of buyers (90%), non-remunerative sale prices and lack of availability of market information & distant market (80%) were identified some of the marketing related constraints in study area.

Conclusion

It was concluded from the study that normal sown cauliflower (Rs. 28065) cultivation were found to be profitable over mid sown cauliflower (Rs.12485) cultivation. In disposal pattern of cauliflower, marketing channel –III (producer to consumer) were observed most efficient based on higher marketing efficiency index in normal (61.86) and mid cauliflower (33.29) and lower price spread *i.e.* Rs 35 among other marketing channels both in normal as well as mid sown cauliflower in the study area. Labour scarcity during plucking and planting time (85-100%), erratic supply of electricity (100%), inadequate availability and high prices of seed (65-100%) and difficulty in raising of nursery for normal cauliflower (100%) were recognized major production constraints. Likewise, wide fluctuation in market prices (90-100%), lack of grading and packing facilities at village level (85%), limited numbers of buyers (90 were identified some of the marketing related constraints in study area. Therefore, it was concluded that there is need to ensure availability of quality seeds at affordable prices and encourage to formation of FPO for better realisation of prices.

i	**Experiment No. 2 : Economic analysis of value addition of cane in Haryana**	
ii	**Objectives of the Experiment**	• To study the marketing pattern of cane • To work out the processing cost for value addition of cane • To identify constraints of various stakeholders in the identified value chains
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Planning, Finalization of interview schedule and report writing • Dr. Sumit Data collection
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One Year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Number and type of respondents:** Data related were recorded from three sugar mills namely The Asandh Sugarmill Ltd. Asandh, The Shahabad Cooperative Sugarmill Pvt. Ltd, Shahabad and The Sarswati Sugarmill Pvt. Ltd, Yamunanagar and from other stakeholder viz: Cane producers, Kohlu owners and Cane juice makers. • **Statistical design/methods:** The statistical tools like mean, percentage, price spread, Archarya's method for marketing efficiency were used.
viii	**Observations recorded**	• Information related to raw materials (cane), cane price, sugar processing expenses, cane quantity, margins, prices of finished products etc. were collected from the identified stakeholders • Information related to marketing channel, price spread and constraints regarding disposal pattern of cane were recorded.

ix. Results achieved during 2021-22

Marketing pattern for disposal of cane and cane products in Haryana

Disposal patterns of cane and cane products in Haryana are presented in Table 1. The following marketing channel has found to be in operation in the study area.

Table 1: Marketing pattern for disposal of cane and cane products in Haryana

Marketing channels for disposal of cane in Haryana	
Sugar mill	
Channel - I	Producer –Cane collection centre – Sugar-mil
Channel - II	Producer – Sugar-mil
Jaggery (Kohlu)	
Channel - I	Producer – Kohlu owners
Cane Juice	
Channel - I	Producer - Contractor /Wholesaler - Cane juicer
Marketing channels of can products (sugar, jaggery and cane juice) in Haryana	
Sugar	
Channel - I	Producer - Sugarmil - CA cum- Wholesaler - Retailer – Consumer
Jaggery	
Channel - I	Producer - Kohlu owners - Wholesaler - Retailer – Consumer
Channel - II	Producer - Kohlu owners - Retailer – Consumer
Channel - III	Producer - Kohlu owners– Consumer
Cane juice	
Channel - I	Producer - Contractor /Wholesaler - Cane juicer– Consumer

Price spread in various marketing channels of cane and cane products in Haryana

Price spread in various marketing channels of cane in Haryana are presented in table 02. In case of sugar mill, net price received by producers 'were Rs.325which was95.59 per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 15 which was 4.41 per cent of the consumers' purchase price in marketing channel – I. Whereas, in case of marketing channel – II, net price received by producer's was Rs319which were 93.82per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 21 which was 6.18 per cent of the consumers' purchase price.

Similarly, in case of Jaggery (Kohlu), there was only one channel –I in which net price received by producers' were obtained Rs330which were 94.29 per cent of the consumer's purchase price. The total marketing costs were estimated to be Rs. 20 which was 5.71 per cent of the consumers' purchase price.

Likewise, in case of cane juicer's, net price received by producers' were Rs. 350which was 82.35 per cent of the consumer's purchase price. Whereas, expenses incurred by CA- cum- wholesaler was estimated to be Rs. 25 which was 5.88 per cent of the consumers' rupee. Net margin received by CA/Wholesaler was Rs. 50 which was 11.77 per cent of the consumers' rupee in study area.

Price spread in various marketing channels of cane products in Haryana are presented in table 03. In case of sugar, net price received by producers' were Rs2766which were 68.13 per cent of the consumer's purchase price. The total marketing costs and net margin were estimated to be Rs. 857 and Rs. 437 which was 21.10 and 10.76 per cent of the consumers' purchase price, respectively. Price spared in disposal of sugar was found to be Rs. 1294 which was 31.87 per cent of the consumer's rupee.

Similarly, in disposal pattern of jaggery, there is marketing channel I, II & III in which net price received by producer'swasRs2925which were 69.86, 72.31 and 79.05 per cent of the consumer's purchase price, respectively. The total marketing costs were estimated to be Rs. 697, 580 and 360 in channel I, II & III respectively

Likewise, in case of cane juices, there was only one channel of disposal in which net price received by producers' Rs. 459 i.e. only 9.18per cent of the consumer's purchase price. The total marketing costs and net margins were estimated to be Rs. 1635 and Rs. 2906 respectively. Price spread in disposal of jaggery was found to be Rs. 4541which was 90.82per cent of consumers purchase price in the study area.

Table 2: Marketing patterns of cane in Haryana

Sr. No.	Particulars	Sugar mil				Jaggery (Kohlu)		Cane juicers'	
		Channel – I		Channel – II		Channel - I		Channel - I	
		Cost	Share in consumer's rupee	Cost	Share in consumer's rupee	Cost	Share in consumer's rupee	Cost	Share in consumer's rupee
1	**Net price received by the producer**	**325**	**95.59**	**319**	**93.82**	**330**	**94.29**	**350**	**82.35**
2	**Expenses incurred by producer**								
	i) Weighing, loading & unloading	8	2.35	8	2.35	8	2.29	0	---
	ii) Transportation	5	1.47	10	2.94	10	2.86	0	---
	iii) Miscellaneous charges	2	0.59	3	0.89	2	0.56	0	---
	Total marketing cost incurred by producer	**15**	**4.41**	**21**	**6.18**	**20**	**5.71**	**0**	---
3	**Producers' sale price / Wholesaler purchase price**	---	---	---	---	---	---	**350**	**82.35**
	Expenses incurred by Wholesaler								
	i)Weighing, packing & loading & Unloading	---	---	---	---	---	---	8	1.88
	ii)Transportation	---	---	---	---	---	---	10	2.35
	iii) Spoilage/losses @5 %	---	---	---	---	---	---	5	**1.18**
	iv) Miscellaneous	---	---	---	---	---	---	2	**0.47**
4	**v) Total cost incurred by Wholesaler**	---	---	---	---	---	---	**25**	**5.88**
5	**Wholesaler's margin**	---	---	---	---	---	---	**50**	**11.77**
6	**Wholesalers' sale price /Consumer purchase price**	**340**	**100.00**	**340**	**100.00**	**350**	**100.00**	**425**	**100.00**

Table 3: Marketing pattern of cane product in Haryana

Sr. No.	Particulars	Sugar		Jaggery						Cane juice	
		Channel - I		Channel – I		Channel - II		Channel - III		Channel - I	
		Cost	Share in consumer's rupee	Cost	Share in consumer's rupee	Cost	Share in consumer's rupee	Cost	Share in consumer's rupee	Cost	Share in consumer's rupee
1	**Net price received by the producer**	2766	68.13	2925	69.86	2925	72.31	2925	79.05	459	9.18
2	**Expenses incurred by**										
	i) Producer	165	4.06	165	3.94	165	4.08	165	4.46	32	0.64
	ii)Sugar mills/Kohlu owners/Cane juice maker	432	10.64	195	4.66	195	4.82	195	5.27	1453	29.06
	iii) CA/Wholesaler	190	4.68	130	3.1	0	0	0	0	150	3
	iv) Retailers	70	1.72	207	4.94	220	5.44	0	0	0	0
	Total marketing cost	**857**	**21.10**	**697**	**16.64**	**580**	**14.34**	**360**	**9.73**	**1635**	**32.70**
3	**Marketing margins of**										
	i) Sugar mills/Kohlu owners/Cane juice maker	87	2.14	215	5.13	215	5.32	215	5.81	2806	56.12
	ii) CA/Wholesaler	200	4.93	150	3.58	0	0	0	0	100	2
	iii)Retailer's	150	3.69	200	4.78	250	6.18	0	0	0	0
	Total marketing margin	**437**	**10.76**	**565**	**13.49**	**465**	**11.5**	**215**	**5.81**	**2906**	**58.12**
4	**Consumer purchase price**	**4060**	**100**	**4187**	**100**	**4045**	**100**	3700	100	**5000**	**100**
5	**Price Spread**	**1294**	**31.87**	**1262**	**30.14**	**1120**	**27.69**	**775**	**20.95**	**4541**	**90.82**

Marketing efficiency of cane and cane product disposal pattern in Haryana

Marketing efficiency of various marketing channel of cane and cane products are presented in table 4. It was observed that in case of cane disposal pattern, channel – I was found most efficient (Marketing index 21.66) within the sugar mill marketing channels and among all the marketing channels of cane.

Similarly, in marketing of cane products, channel-III was found most efficient (Marketing index 5.09) within the jaggery marketing channels and among all the marketing channels of cane products in the study area.

Table 4 : Marketing efficiency of cane and cane product disposal pattern in Haryana

Sr. No.	Particulars	Sugar mill		Jaggery (Kohlu)	Cane juicer
		Channel -I	Channel – II	Channel -I	Channel -I
Cane					
1	Retailers sale price /consumer purchase price	340	340	350	425
2	Total marketing cost	15	21	20	25
3	Total net margins of intermediaries	-	-	-	50
4	Net price received by producers	325	319	330	350
5	**Marketing efficiency (4/(2+3)**	**21.66**	**15.19**	**16.50**	**4.66**

Cane products						
Sr. No.	**Particulars**	**Sugar**	**Jiggery**			**Cane juice**
		Channel I	**Channel I**	**Channel II**	**Channel III**	**Channel I**
1	Retailers sale price /consumer purchase price	4060	4187	4045	3700	5000
2	Total marketing cost	857	697	580	360	1635
3	Total net margins of intermediaries	437	565	465	215	2906
4	Net price received by producers	2766	2925	2925	2925	459
5	**Marketing efficiency (4/(2+3)**	**2.14**	**2.32**	**2.80**	**5.09**	**0.10**

Processing cost for value addition of cane in Haryana

Cost of sugar processing in Haryana is presented in table 5. Total cost for sugar processing worked out to be Rs. 3916 per quintal. Whereas, gross returns and net returns from sugar processing were found to be Rs. 4003 and Rs. 87 per quintal, respectively. Benefit cost ratio worked out to be 1.02 indicated that sugar processing is economically viable in the study area.

Table 5 : Cost of sugar processing in Haryana **(Rs./qtl)**

Sr. No.	Particulars	Sugar	Per cent
A	**Expenses incurred by processor**		
1	i) Cane/raw material	2931	74.85
	ii) Cane development &other expenses	70	1.78
	Sub total	**3001**	**76.63**
2	**Expenses incurred at processing plant**		
	i)Electricity& Fuel expenses	23	0.59

	ii) Salary wages, bonus &gratuity	306	7.81
	iii) Repair &maintenance	122	3.12
	iv) Factory overheads	117	2.99
	v)Packing & loading	49	1.25
	vi)Other expenses (Interest, depreciation, selling commission)	298	7.61
	Sub total	**915**	**23.37**
3	**Total cost of sugar processing (1+2)**	**3916**	**100.00**
B	**Returns**		
4	**Income from sale of sugar**	**3450**	
5	**Income from sale of By-products**		
	i) Molasses sale	280	
	ii) Bagasse sale	55	
	iii) Sale of electric power	120	
	iv) Other income (Brown sugar, press mud and sugar export subsidy etc.)	98	
	Sub total	**553**	
6	**Gross returns sugar from sugar processing(4+5)**	**4003**	
7	**Net returns from sugar processing (6-3)**	**87**	
8	**B:C Ratio**	**1.02**	

Cost of jaggery processing in Haryana is presented in table 6. Per quintal jaggery processing cost worked out to be Rs. 3215. Whereas, gross returns and net returns from jaggery processing were found to be Rs. 3500 and Rs. 215 per quintal, respectively. Benefit cost ratio worked out to be 1.06 indicated that jaggery processing is economically viable in the study area.

Table 6: Cost of jaggery processing in Haryana **(Rs./qtls)**

Sr. No.	Particulars	Jaggery	Per cent
A	**Expenses incurred by processor**		
1	i) Cane/raw material	3090	94.07
	ii) Transportation	25	0.76
	Sub total	**3115**	**94.82**
2	**Expenses incurred at processing plant (Kohlu)**		
	i) Fuel (diesel) and electricity charges	100	3.04
	ii) Labour charges	48	1.46
	iii) Other expenses (Repair &maintenance, interest, depreciation etc.)	22	0.67
	Sub total	**170**	**5.17**
3	**Total cost of jaggery processing (1+2)**	**3285**	**100.00**
B	**Returns**		
4	**Income from sale of jaggery**	**3500**	
5	**Income from sale of By-products**	**0.00**	
6	**Gross returns (4+5)**	**3500**	
7	**Net returns from jaggery processing (6-3)**	**215**	
8	**B:C Ratio**	**1.06**	

Costs of cane juice preparation in Haryana are presented in table 7. Cost of cane juice preparation was worked out to be Rs. 2194 per hundred litre. Whereas, gross returns and net returns from cane juice was found to be Rs. 5000 and Rs. 2806 hundred litre, respectively. Benefit cost ratio worked out to be 2.28 indicated that cane juice preparation is economically viable in the study area.

Table 7 : Cost of cane juice in Haryana **(Rs./100 litre)**

Sr. No.	Particulars	Cane juice	Per cent
A	**Expenses incurred by processor**		
1	i) Cane/raw material	741	33.77
	ii) Transportation	30	1.37
	Sub total	**771**	**35.14**
2	**Expenses incurred at processing plant (cane juicer)**		
	i) Fuel charges	725	33.04
	ii) Labour charges	537	24.48
	iii) Other expenses (Repair &maintenance, interest, value addition, depreciation etc.)	161	7.34
	Sub total	**1423**	**64.86**
3	**Total cost of cane juice processing (1+2)**	**2194**	**100.00**
B	**Returns**		
4	**Income from sale of cane juice**	**5000**	
5	**Income from sale of By-products**	**0.00**	
6	**Gross returns (4+5)**	**5000**	
7	**Net returns from cane juice processing (6-3)**	**2806**	
8	**B:C Ratio**	**2.28**	

Constraints faced in production and processing of cane and cane products in Haryana

As far as sugarcane producers is concern, labour scarcity and higher wages of labour during peak season (85-100%), intensive manual operations specially in case of harvesting(95%),long waiting list for cane procurement by the sugar mills (70%) and increasing cost of cultivation (90%)were found major production constraints (Table 8).

Similarly, in case of suagr-mils, low rate of sugar recovery (100%), shortage of labour (90%), fluctuation in area and availability of raw cane due other competing crops. existence of large numbers of Kohlu and mining problems (85%) were identified major constraints. Whereas, in jaggery processing, lower rate of recovery(85%), short crushing season (80%) and high cost of production (90%) were recognized major constraints.

Likewise, in preparation of cane juice, high prices of cane especially during the summer season (85%), high prices of fuel (diesel)(95%) and small and uneconomical size of unit (75%)were identified major constraints in the study area.

Table 8 : Constraints faced in production and processing of cane in Haryana

Sr. No.	Constraints /Problems	Per cent response
Sugarcane growers		
1	Labour scarcity during peak season	100
2	Higher wage rate of labour	85
3	Intensive manual operations specially in case of harvesting	95
4	Long waiting list for cane procurement by the sugar mills	70
5	Increasing cost of cultivation	95
Sugar-mills		
1	Low rate of sugar recovery	100
2	Shortage of labour	90
3	Fluctuation in area and availability of raw cane due other competing crops, existence of large numbers of Kohlu and mining problems	85

Jaggery makers (Kohlu)		
1	Lower rate of recovery	85
2	Short crushing season	80
3	High cost of production	90
4	Small and uneconomic size of unit	75
5	Old and obsolete machinery	85
Cane juice maker		
1	High prices of cane specially during summer season	85
2	High prices of fuel (diesel)	95
3	Small and uneconomical size of unit	75

x. Programme of work for 2020-21: Experiment concluded

Salient findings of the study:

- In disposal pattern of cane, channel – I (Producer – Cane collection centre – Sugar-mill) was found most efficient (Marketing index 21.66) within the sugar mill marketing channels and among all the marketing channels of cane.
- Similarly, in marketing patterns of cane products, channel-III (Producer - Kohlu owners– Consumer) was found most efficient (Higher marketing index 5.09)within the jaggery marketing channels and among all the marketing channels of cane products in the study area
- Cane juice found to be economically beneficial with higher benefit cost ratio 2.28 over jaggery (B:C ratio 1.06) and sugar (B:C ratio 1.02).
- Labour scarcity and higher wages of labour during peak season(85-100%), intensive manual operations specially in case of harvesting(95%), long waiting list for cane procurement by the sugar mills (70%) lower rate of recovery (100%), short crushing season (90%), small and uneconomic size of unit, old and obsolete machinery (75%), increasing cost of production/processing (90%)were identified major constraints for all the cane stakeholders in the study area.

Conclusion

It was concluded from the study that channel – I (Producer – Cane collection centre – Sugar-mill) was found most efficient (Marketing index 21.66) within the sugar mill marketing channels and among all the marketing channels of cane. Similarly, in marketing patterns of cane products, channel-III (Producer - Kohlu owners– Consumer) was found most efficient (Marketing index 5.09) within the jaggery marketing channels and among all the marketing channels of cane products. Preparation of cane juice found to be economically beneficial with higher B-C ratio (2.28) over jaggery (B:C ratio 1.06) and sugar (B:C ratio 1.02). Labour scarcity and higher wages of labour during peak season(85-100%), intensive manual operations specially in case of harvesting(95%),long waiting list for cane procurement by the sugar mills (70%) lower rate of recovery (100%), short crushing season (90%), small and uneconomic size of unit, old and obsolete machinery (75%), increasing cost of production/processing (90%)were identified major constraints for all the cane stakeholders in the study area. Therefore, it is need to promote mechanization of operations like harvesting in sugarcane cultivation and explore for juice processing .

i	**Experiment No. 3: Study on Price and arrivals of vegetable crops in APMC markets of Haryana**	
ii	**Objectives of the experiment**	• To study volatility in price and arrivals of major vegetable crops • To develop forecast model for prices and arrivals of various vegetable crops
iii	**Name(s) of the investigators**	• Dr. Joginder Planning, compilation and analysis of data • Dr. Monika Devi Data analysis and technical writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Data compilation and report writing
V	**Year of start**	• 2021-22
Vi	**Duration**	• One year
Vii	**Treatment details**	• **Locale of experiment**: APMC Markets: Kurukshetra and Yamunanagar • **Crop:** Onion and Potato • **Period:** 2010-2020 • **Statistical design/methods:** Time series model: Autoregressive Conditional Heteroscedasticity (ARCH) model have been used.
viii	**Observations recorded**	• Monthly average wholesale price and arrival data of vegetable & fruit crops were collected from identified APMC markets of Haryana.

ix. Results achieved during the year 2021-22:

The following results have been obtained based on monthly average wholesale prices and arrivals of Onion and Potato crops for the selected markets of Haryana:

(a) Onion Crop Results

Table 1: Descriptive Statistics (Onion)

	P_KURUKSHETRA	P_YAMUNANAGAR	A_YAMUNANAGAR	A_KURUKSHETRA
Mean	1569.59	1633.14	1647.41	1160.54
Median	1284.69	1249.43	838.42	544.33
Maximum	4624.98	5849.83	7710.68	7580.15
Minimum	442.16	488.99	104.01	55.53
Std. Dev.	881.48	993.63	1765.64	1543.10
Skewness	1.43	1.56	1.63	2.40
Kurtosis	4.61	5.14	4.66	8.31
Jarque-Bera	59.39611	78.67	73.78	281.37
Probability	0.000000	0.000000	0.000000	0.000000
Observations	132	132	132	132

Table 1 shows the prices and arrivals pattern/trend of onion crop for Kurukshetra and Yamunanagar. From Table 1, it is also observed that the average value of onion prices for Kurukshetra and Yamunanagar are 1569.58 & 1633.14 with std. Dev. 881.48 & 993.63 respectively based on data collected from APMC markets from 2010-2020. The minimum and maximum values of the prices of onion during this period for both the markets are 442.16 & 4624.98 and 488.99 & 5849.83 respectively.

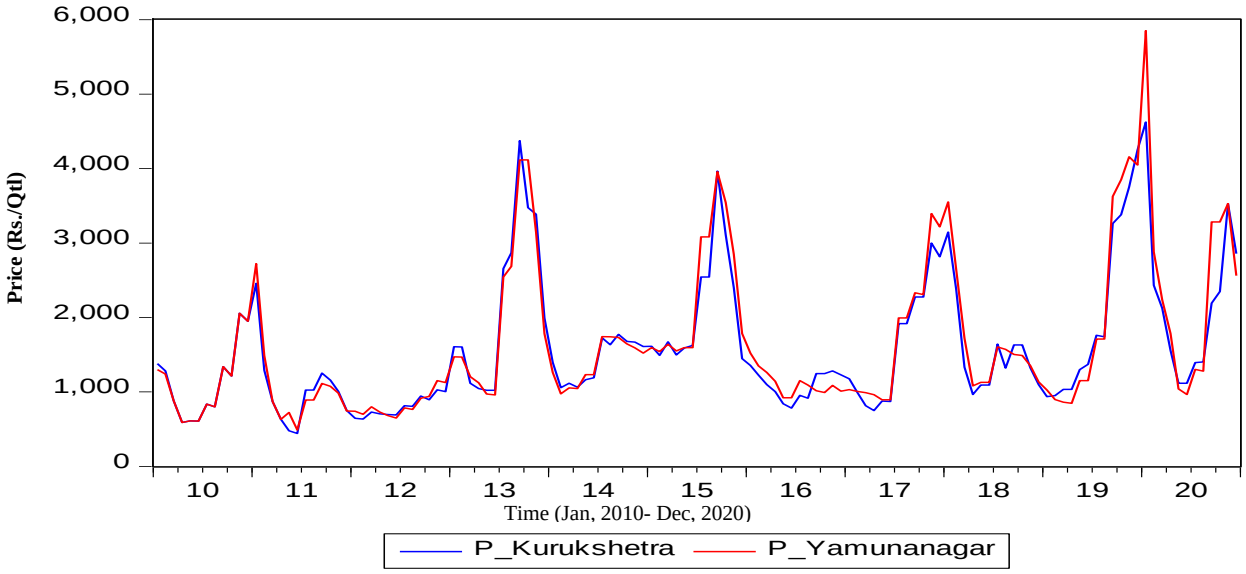


Fig.1: Time Series Plot of Onion Price Data (Rs./Qtl)

Fig. 1 shows the trend of onion prices in Kurukshetra and Yamunanagar markets during Jan, 2010 to Dec., 2020. From this graph, it can be observed that the prices of onion in both the markets are high from August to February in every year.

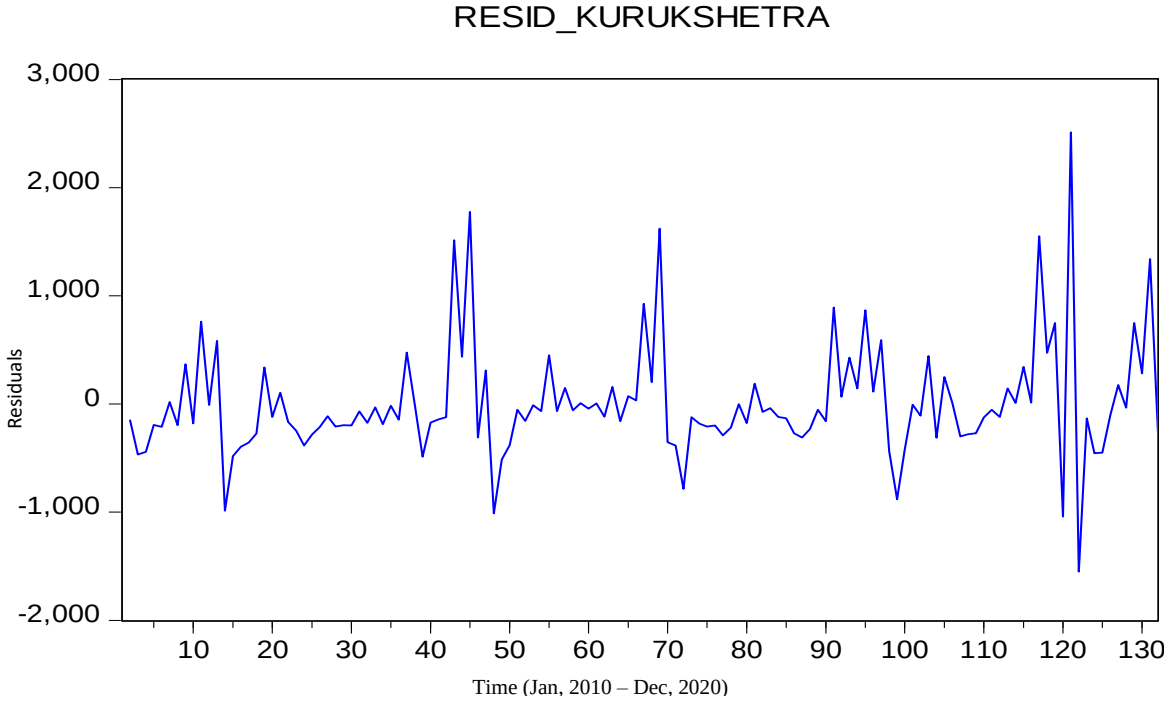


Fig. 2: Volatility Plot of Onion Price – Kurukshetra

Fig. 2 shows the behaviour of volatility/variance of residuals for onion price in Kurukshetra market. This graph indicates the presence of conditional heteroscedasticity. Therefore, we have to check the presence of Autoregressive Conditional Heteroscedasticity (ARCH) effect using LM statistic and the results of ARCH test is given below in table 2. As p-value is found significant, therefore we reject the null hypothesis at 5% level of significance and conclude that the series has ARCH effect.

Table 2: ARCH Test (Heteroscedasticity)

Null hypothesis: no ARCH effect

Test Equation				Heteroscedasticity Test: ARCH	
Variable	Coefficient (b_1)	t- statistic	p- value	LM-statistic	p- value
Kurukshetra	0.23	2.61	0.01	6.57	0.01
Yamunanagar	0.20	2.34	0.02	5.35	0.02

Table 3 gives the estimation of ARCH (1) model for both mean and variance. This table also gives the estimate of parameters for forecasting the mean and variance of the series using its lag values.

Table 3: Estimation of ARCH (1) Model: Kurukshetra

Mean Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	248.66	119.89	2.07	0.04
P_KURUKSHETRA(-1)	0.85	0.05	17.18	<0.01

Variance Equation

C	207429.30	23171.89	8.95	<0.01
RESID(-1)^2	0.27	0.09	2.89	<0.01

Note: AIC=15.35 &Adj. R^2=60.10

Forecasting ARCH Volatility – Kurukshetra

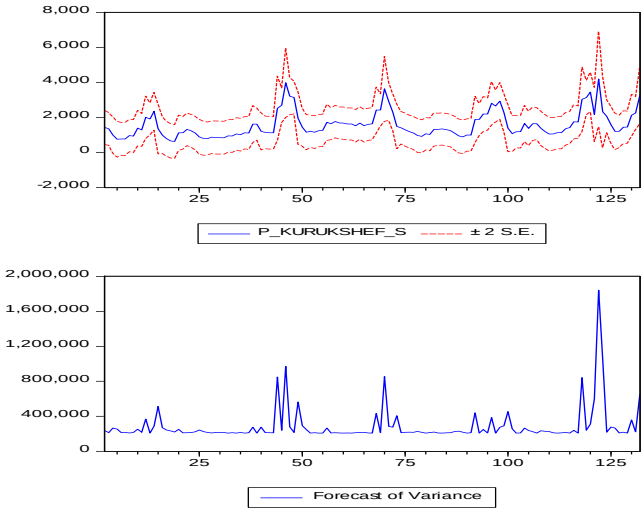
Forecast uses the estimated ARCH model to compute forecasts of the mean and its conditional variance

Forecast Mean: $\widehat{b_0}$= 248.66 + 0.85 * P_Kurukshetra (-1)

Forecast Variance:

$$\widehat{h_{t+1}} = \widehat{b_0} + \widehat{b_1} * \widehat{u_t^2}$$

$$= 207429.30 + 0.27 * \widehat{u_t^2}$$



Forecast: P_KURUKSHEF_S	
Actual: P_KURUKSHETRA	
Forecast sample: 1 132	
Adjusted sample: 2 132	
Included observations: 131	
Root Mean Squared Error	535.2392
Mean Absolute Error	341.7026
Mean Abs. Percent Error	21.54855
Theil Inequality Coefficient	0.152956
Bias Proportion	0.000516
Variance Proportion	0.059554
Covariance Proportion	0.939929
Theil U2 Coefficient	0.966202
Symmetric MAPE	20.49424

Fig. 3: Volatility Forecast Plots – Kurukshetra

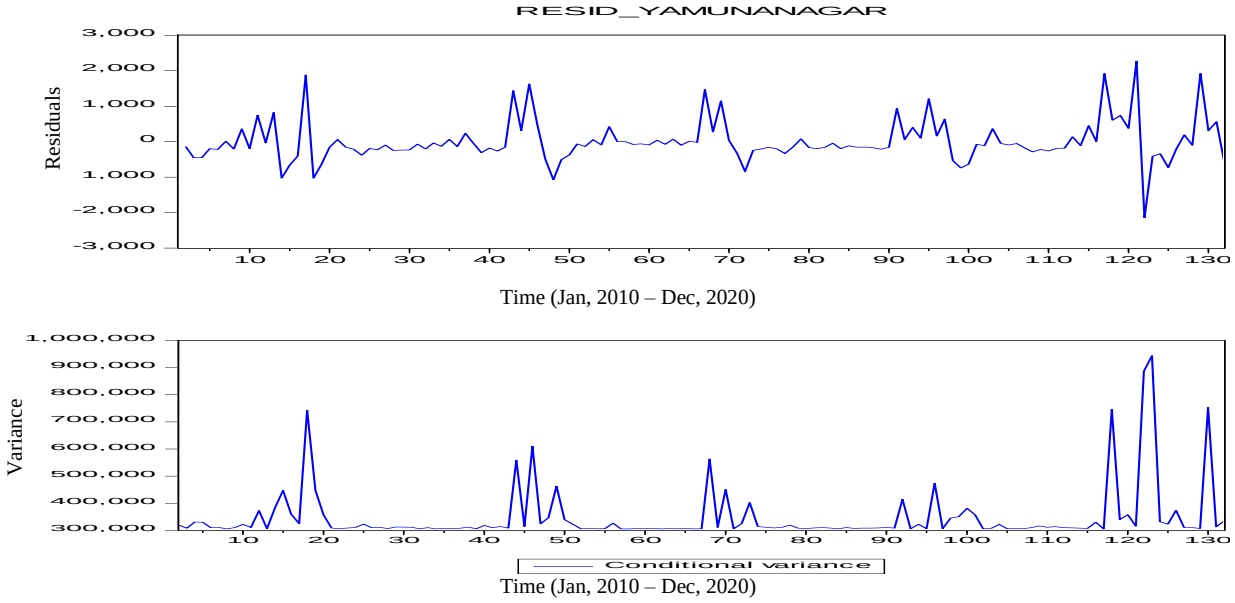


Fig. 4: Volatility and Conditional Variance Plot – Yamunanagar

From Fig. 4, it can be observed that the behaviour of residuals and conditional variance of onion price for Yamunanagar market is same. It is also observed that the series has ARCH effect. The results of estimation of mean and variance equations using ARCH model are given below in table 4.

Table 4: Estimation of ARCH (1) Model: Yamunanagar

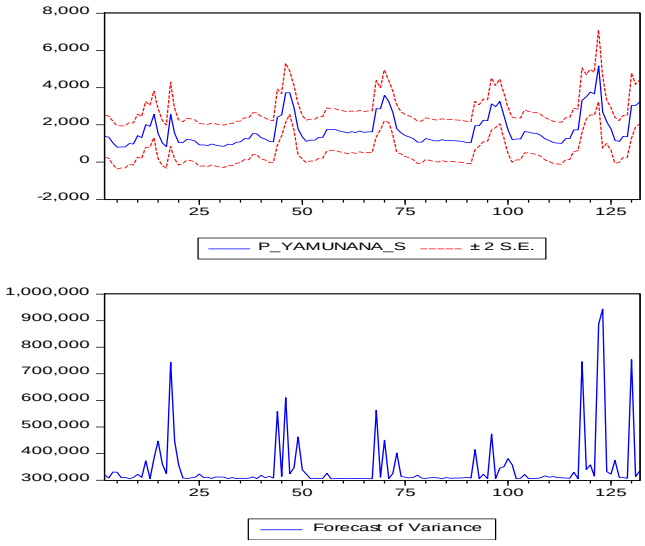
Mean Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	304.06	118.95	2.56	0.01
P_YAMUNANAGAR(-1)	0.83	0.05	17.14	<0.01

Variance Equation

C	305398.10	39164.92	8.00	<0.01
RESID(-1)^2	0.12	0.09	2.34	0.03

Note:AIC=15.63 & Adj. R^2=63.79



Forecast: P_YAMUNANA_S
Actual: P_YAMUNANAGAR
Forecast sample: 1 132
Adjusted sample: 2 132
Included observations: 131

Root Mean Squared Error	595.2478
Mean Absolute Error	380.8628
Mean Abs. Percent Error	22.87366
Theil Inequality Coefficient	0.156801
Bias Proportion	0.000754
Variance Proportion	0.080661
Covariance Proportion	0.918584
Theil U2 Coefficient	0.953934
Symmetric MAPE	21.73331

Fig. 5: Forecasting ARCH Volatility – Yamunanagar

Fig. 3 and 5, reveal that the forecast of price of onion for Kurukshetra and Yamunanagar markets based on its lag values always lie between 2 standard errors and the behaviour of forecasted and

conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for both the series.

(b)Potato Crop Results

Table 5: Descriptive Statistics (Potato)

	P_KURUKSHETRA	P_YAMUNANAGAR	A_YAMUNANAGAR	A_KURUKSHETRA
Mean	826.15	867.16	3703.66	6997.53
Median	678.11	742.89	1814.60	996.47
Maximum	2661.96	2584.04	26482.53	64016.20
Minimum	259.93	255.59	126.84	54.13
Std. Dev.	436.10	469.90	4659.76	11178.21
Skewness	1.3517	1.31	2.46	2.76
Kurtosis	5.16	4.80	9.86	12.22
Jarque-Bera	65.92	56.07	392.02	635.53
Probability	0.000000	0.000000	0.000000	0.000000
Observations	132	132	132	132

Table 5 gives the descriptive statistics of prices of potato in Kurukshetra and Yamunanagar markets of Haryana and also show the prices and arrivals pattern/trend of Potato crop for both markets. From Table 5, it is also observed that the average value of Potato prices for Kurukshetra and Yamunanagar are 826.15 & 867.16 with std. Dev. 436.10 & 469.91 respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020. The minimum and maximum values of the prices of Potato during this period for both the markets are 259.93 & 2661.96 and 255.59 & 2584.04 respectively

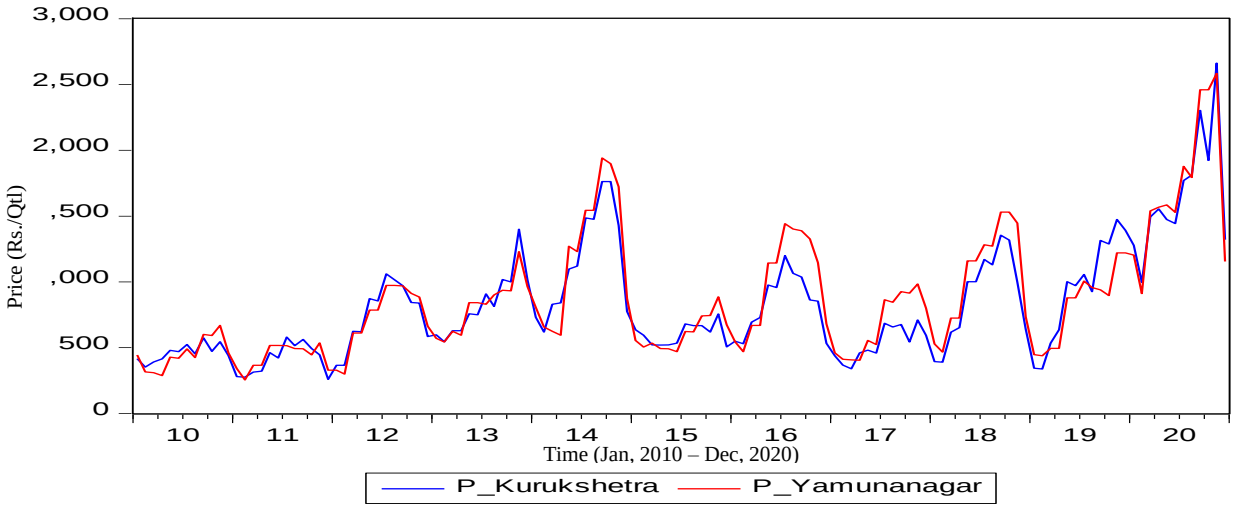


Fig. 6: Time Series Plot of Potato Price (Rs. /Qtl)

Fig. 6 shows the trend of tomato prices in Kurukshetra and Yamunanagar markets during Jan, 2010 to Dec., 2020. From this graph, it can be observed that the prices of Potato in both the markets are not stable and hence there may be exist effect of conditional variance. Therefore, ARCH test has been applied to check the heteroscedasticity in both series. The results of ARCH test are given in the below table 6. As p-value is found significant for both the series, thus we can apply ARCH model to estimate the mean and variance equations for forecasting the Potato prices for both the markets. The estimated equations of mean and variance are given in table 7 and 8.

Table 6: ARCH Test (Heteroscedasticity)

Null hypothesis: no ARCH effect

Test Equation				Heteroscedasticity Test: ARCH	
Variable	Coefficient (b_1)	t- statistic	p- value	LM-statistic	p- value
Kurukshetra	0.87	7.70	<0.01	41.19	<0.01
Yamunanagar	0.41	2.43	0.03	4.51	0.04

Table 7: Estimation of ARCH (1) Model: Kurukshetra

Mean Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	35.73	35.53	2.05	0.03
P_KURUKSHETRA(-1)	1.06	0.03	33.68	<0.01

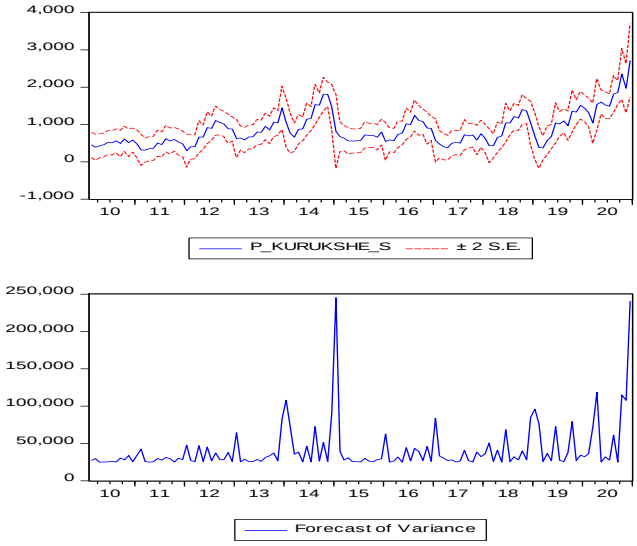
Variance Equation

C	24932.63	3958.74	6.29	<0.01
RESID(-1)^2	0.45	0.12	3.85	<0.01

Note:AIC=13.39 &Adj. R^2=72.59

Forecasting ARCH Volatility – Kurukshetra

Forecast uses the estimated ARCH model to compute forecasts of the mean and its conditional variance



Forecast: P_KURUKSHE_S
Actual: P_KURUKSHETRA
Forecast sample: 2010M01 2020M12
Adjusted sample: 2010M02 2020M12
Included observations: 131

Root Mean Squared Error	227.5226
Mean Absolute Error	151.2989
Mean Abs. Percent Error	19.57152
Theil Inequality Coefficient	0.119551
Bias Proportion	0.021673
Variance Proportion	0.000062
Covariance Proportion	0.978265
Theil U2 Coefficient	0.969521
Symmetric MAPE	17.90997

Fig. 7: Forecasting ARCH Volatility – Kurukshetra

Table 8: Estimation of ARCH (1) Model: Yamunanagar

Mean Equation

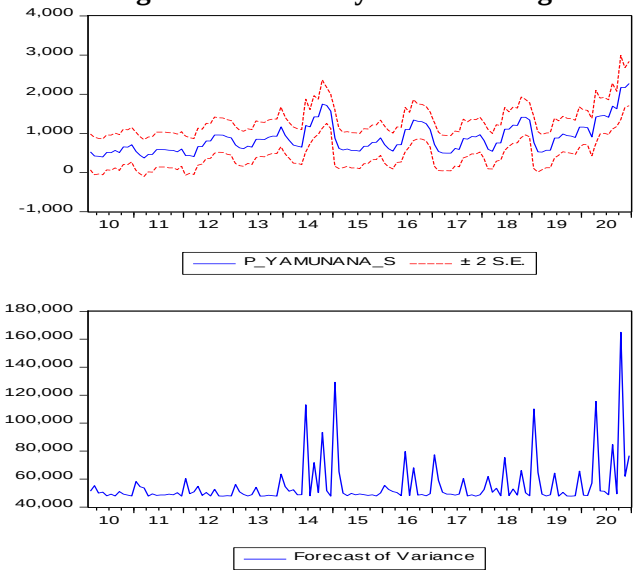
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	163.34	51.07	3.19	<0.01
P_YAMUNANAGAR(-1)	0.82	0.04	20.77	<0.01

Variance Equation

C	47844.22	4842.82	9.88	<0.01
RESID(-1)^2	0.17	0.11	2.56	0.02

Note: AIC=13.80 & Adj. R^2=74.84

Forecasting ARCH Volatility – Yamunanagar



Forecast: P_YAMUNANA_S	
Actual: P_YAMUNANAGAR	
Forecast sample: 2010M01 2020M12	
Adjusted sample: 2010M02 2020M12	
Included observations: 131	
Root Mean Squared Error	234.9702
Mean Absolute Error	156.9796
Mean Abs. Percent Error	20.52867
Theil Inequality Coefficient	0.121237
Bias Proportion	0.000031
Variance Proportion	0.132687
Covariance Proportion	0.867282
Theil U2 Coefficient	0.964046
Symmetric MAPE	18.86705

Fig. 8: Forecasting ARCH Volatility – Yamunanagar

Fig. 7 and 8, give the forecast of price of Potato for Kurukshetra and Yamunanagar markets based on its lag values and it can also be seen that the forecasted values always lie between 2 standard errors. Also, the behaviour of forecasted and conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for both the series.

ix) Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

- The average value of onion prices for Kurukshetra and Yamunanagar wereRs.1569.58 & Rs. 1633.14 with S.D. Rs.881.48 &Rs.993.63, respectively.
- The minimum and maximum values of the prices of onion for Kurukshetra and Yamunanagar during this period for both the markets were Rs. 442.16 &Rs.4624.98 and Rs.488.99 &Rs.5849.83, respectively.
- The behaviour of residuals and conditional variance of onion price for Yamunanagar market was same (*AIC=15.63 & Adj. R^2=63.79).*
- The average value of potato prices for Kurukshetra and Yamunanagar are Rs.826.15 &Rs.867.16 with S.D. Rs.436.10 &Rs.469.91 respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020.
- The minimum and maximum values of the prices for Kurukshetra and Yamunanagar of potato during this period for both the markets wereRs.259.93 & Rs. 2661.96 and Rs.255.59 &Rs.2584.04, respectively.
- The forecasted value of prices of onion and potato for Kurukshetra and Yamunanagar markets based on its lag values always lie between 2 standard errors.
- The prices of onion and potato based on ten years monthly wholesale price data using ARCH (1) model resulted into best estimation.

Conclusion:

The study revealed that the forecasted value of prices of onion and potato for Kurukshetra and Yamunanagar using ARCH (1) model lies between 2 standard errors. Also, the behaviour of forecasted and conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for prices of Onion and Potato for Kurukshetra and Yamunanagar markets.

i	**Experiment No. 4: Time series models for forecasting the prices of fruit crops in India**	
ii	**Objectives of the experiment**	• To study the status of arrival of major fruit crops in markets of India • To develop price and arrivals forecast models of selected fruit crops
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, execution and analysis of data • Dr. Monika Devi Data analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Data compilation and technical writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Fruit markets: Haryana and Punjab • **Crop:** Major fruit crops: Guava and Kinnow • **Period:** 2010-2020 • **Statistical design/methods:** Explorative data analysis, time series models: Autoregressive Conditional Heteroscedasticity (ARCH) model have been used.
viii	**Observations recorded**	• Monthly time series data of prices of Guava and Kinnow have been collected

ix. Results achieved during the year 2021-22:

The following results have been obtained based on monthly average wholesale prices of Guava and Kinnow fruits collected from selected markets of Haryana and Punjab. The arrival data of kinnow and guava was not found, therefore the present study has been done only for price data for both fruit crops.

(a) Kinnow Fruit Results

Table 1: Descriptive Statistics (Kinnow)

	P_HARYANA	P_PUNJAB
Mean	1607.250	1271.421
Median	1533.060	1116.660
Maximum	3200.000	3500.000
Minimum	397.6200	527.1400
Std. Dev.	554.5909	470.8363
Skewness	0.702835	1.843997
Kurtosis	3.445741	7.839654
Jarque-Bera	8.970198	152.7222
Probability	0.011276	0.000000
Observations	99	99

Table 1gives the descriptive statistics of prices of Kinnow in Haryana and Punjab markets and also show the prices pattern/trend of Kinnow for both the markets. From Table 1, it is also observed that the average value of Kinnow prices for Haryana and Punjab are 1607.25&1271.42 with std. Dev. 554.59&470.84 respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020. The minimum and maximum values of the prices of Kinnow during this period for both the markets are 397.62&3200.00 and 527.14&3500.00 respectively.

Note:*The price data of Kinnow was not available for June, July and August months of every year*

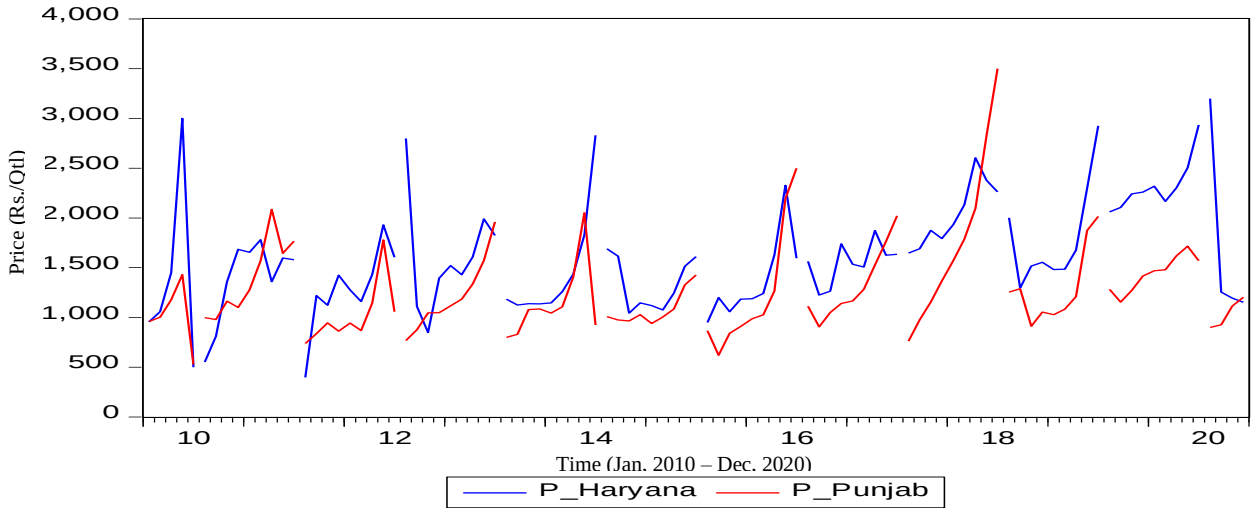


Fig. 1: Time Series Plot for Price of Kinnow (Rs./Qtl)

Fig. 1 shows the trend of Kinnow prices in Haryana and Punjab markets. From this graph, it can be observed that the prices of Kinnow are not stable in both the markets.

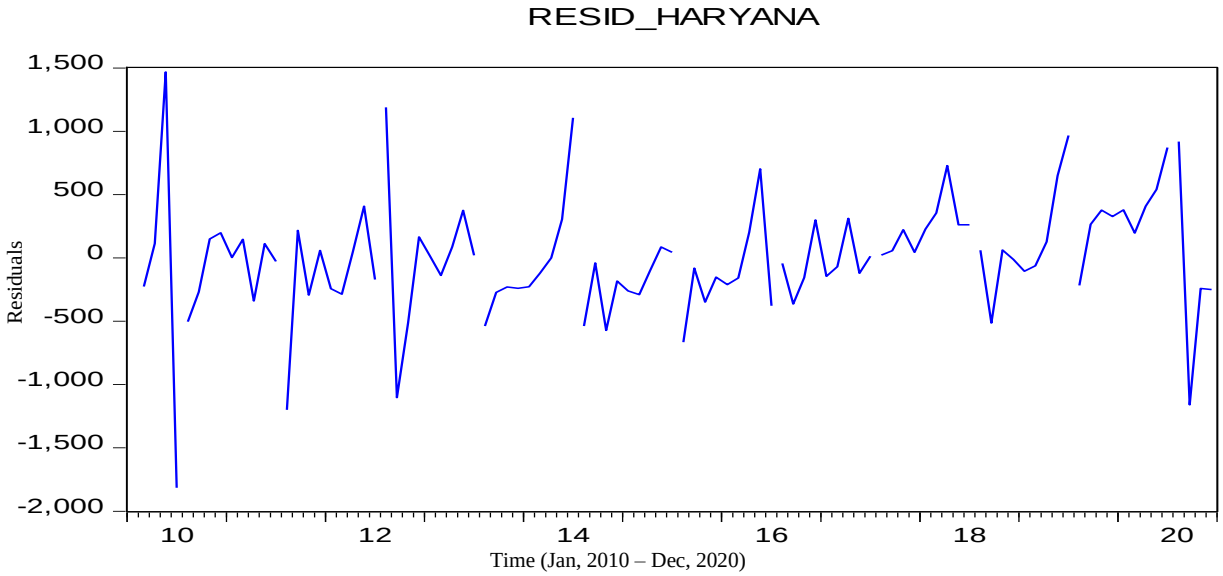


Fig. 2: Volatility Plot of Price of Kinnow in Haryana

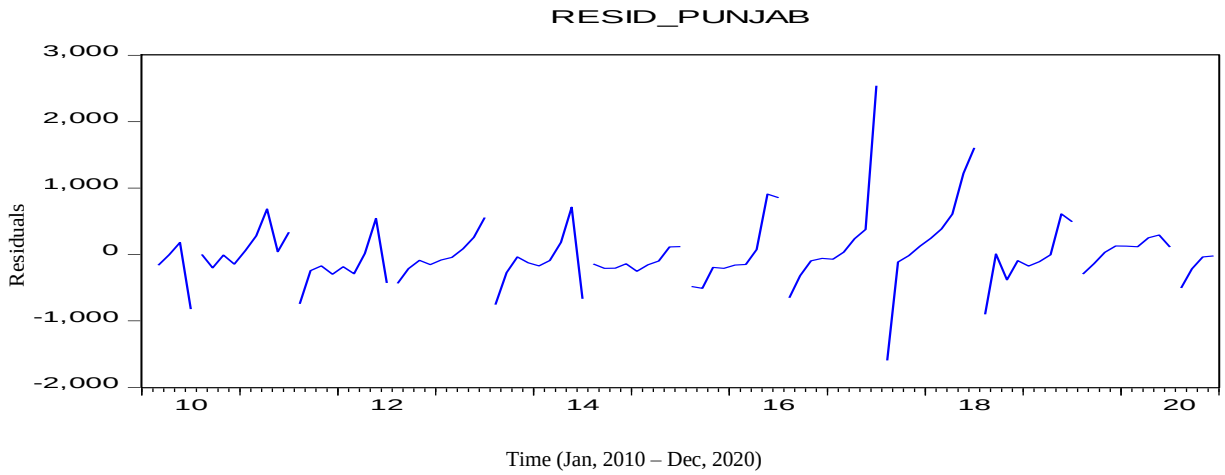


Fig. 3: Volatility Plot of Price of Kinnow in Punjab

Fig. 2 and 3 show the behaviour of volatility/variance of residuals for Kinnow price in Haryana and Punjab markets respectively. These graphs indicate the presence of heteroscedasticity as residuals are fluctuated over the time. Therefore, we have to check the presence of Autoregressive Conditional Heteroscedasticity (ARCH) effect using LM statistic for both series.

Table 2: ARCH Test (Heteroscedasticity)

Null hypothesis: no ARCH effect

Test Equation				**Heteroscedasticity Test: ARCH**	
Variable	Coefficient (b_1)	t- statistic	p- value	LM-statistic	p- value
Haryana	0.37	3.84	<0.01	13.01	<0.01
Punjab	0.36	3.71	<0.01	12.29	<0.01

Table 3: Estimation of ARCH (1) Model: Haryana

Mean Equation

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	589.71	175.84	3.35	<0.01
P_HARYANA(-1)	0.63	0.09	6.91	<0.01

Variance Equation

C	141889.50	17066.60	8.31	<0.01
RESID(-1)^2	0.36	0.18	2.00	0.04

Note:AIC=15.09 &Adj. R^2=63.93

Table 4: Estimation of ARCH (1) Model: Punjab

Mean Equation

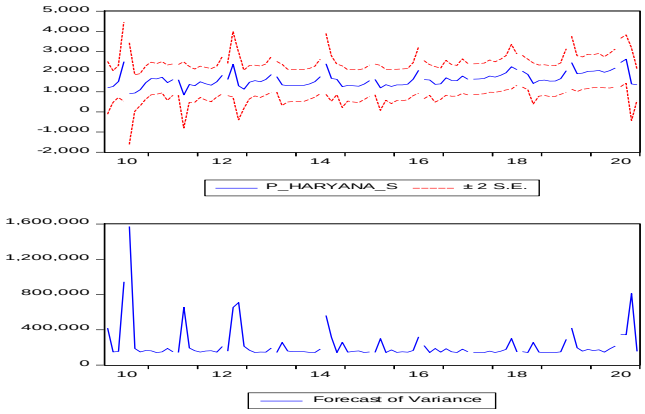
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	623.97	78.17	7.98	<0.01
P_PUNJAB(-1)	0.40	0.07	5.38	<0.01

Variance Equation

C	14525.43	5512.40	2.64	<0.01
RESID(-1)^2	0.25	0.39	5.71	<0.01

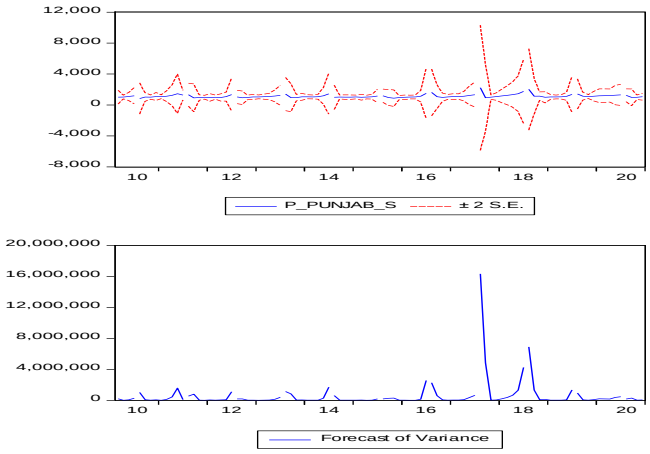
Note:AIC=15.09 &Adj. R^2=54.62

The results of ARCH test are given table 2 (p-value is found significant) therefore we reject the null hypothesis at 5% level of significance and conclude that the series has ARCH effect. Therefore, the parameters have been estimated using ARCH model and estimated equations for mean and variance are given in table 3 and 4 for Haryana and Punjab markets respectively.



Forecast: P_HARYANA_S	
Actual: P_HARYANA	
Forecast sample: 2010M01 2020M12	
Adjusted sample: 2010M02 2020M12	
Included observations: 98	
Root Mean Squared Error	480.2232
Mean Absolute Error	321.2052
Mean Abs. Percent Error	25.33708
Theil Inequality Coefficient	0.143152
Bias Proportion	0.000021
Variance Proportion	0.173817
Covariance Proportion	0.826162
Theil U2 Coefficient	0.794974
Symmetric MAPE	19.78180

Fig. 4: Forecasting ARCH Volatility – Haryana



Forecast: P_PUNJAB_S	
Actual: P_PUNJAB	
Forecast sample: 2010M01 2020M12	
Adjusted sample: 2010M02 2020M12	
Included observations: 98	
Root Mean Squared Error	521.0586
Mean Absolute Error	323.0911
Mean Abs. Percent Error	22.94816
Theil Inequality Coefficient	0.203350
Bias Proportion	0.089548
Variance Proportion	0.387477
Covariance Proportion	0.522975
Theil U2 Coefficient	0.992603
Symmetric MAPE	22.63762

Fig. 5: Forecasting ARCH Volatility – Punjab

Fig. 4 and 5, give the forecast of price of Kinnow for Haryana and Punjab markets based on its lag values and it can also be seen that the forecasted values always lie between 2 standard errors. Also, the behaviour of forecasted and conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for both the series.

(b) Guava Fruit Results

Table 5: Descriptive Statistics (Guava)

	P_HARYANA	P_PUNJAB
Mean	1811.017	1618.313
Median	1621.855	1524.790
Maximum	4500.000	3847.060
Minimum	616.6000	598.0100
Std. Dev.	778.4805	643.5612
Skewness	0.689786	0.821222
Kurtosis	3.114260	3.418095
Jarque-Bera	10.53951	15.79835
Probability	0.005145	0.000371
Observations	132	132

Table 5gives the descriptive statistics of prices of Guava in Haryana and Punjab markets and also show the prices pattern/trend of Guava for both the markets. It was observed that the average value of Guava prices for Haryana and Punjab are 1811.02&1618.31 with S.D. 778.48&643.56, respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020. The minimum and maximum values of the prices of Guava during this period for both the markets are 616.60&4500.00 and598.01 & 3847.06 respectively.

Table 6: ARCH Test (Heteroscedasticity)

Null hypothesis: no ARCH effect

Test Equation				Heteroscedasticity Test: ARCH	
Variable	Coefficient (b_1)	t- statistic	p- value	LM-statistic	p- value
Haryana	-0.03	-0.33	0.74	0.11	0.73
Punjab	0.12	1.39	0.16	1.96	0.16

From table 6, it is observed that the p-value was found not significant; therefore, we do not reject the null hypothesis. Thus we conclude that the prices of Guava for Haryana and Punjab are not having ARCH effect. So, we cannot use ARCH model for forecasting the prices of Guava in Haryana and Punjab markets.

ix) Programme of work for 2021-22: Experiment concluded

Salient findings of the study:

- The average value of kinnow prices for Haryana and Punjab are Rs.1607.25 &Rs.1271.42 with S.D.Rs.554.59 &Rs.470.84 respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020.
- The minimum and maximum values of the prices for Haryana and Punjab of Kinnow during this period are Rs.397.62 &Rs.3200.00 and Rs.527.14 &Rs.3500.00 respectively.
- The average value of guava prices for Haryana and Punjab are 1811.02 & 1618.31 with S.D.Rs.778.48 &Rs.643.56 respectively based on monthly price data collected from selected markets from Jan., 2010 to Dec., 2020.
- The minimum and maximum values of the prices for Haryana and Punjab of guava during this period for both the markets are Rs.616.60 &Rs. Rs.4500.00 and Rs.598.01 &Rs.3847.06 respectively.
- The forecasted value of prices of kinnow for Haryana and Punjab markets based on its lag values always lie between 2 standard errors.
- Also, the behaviour of forecasted and conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for both the series.
- Based on ten year monthly whole sale prices of kinnow and guava, the prices can be estimated using ARCH (1) model.

Conclusion

The study revealed that the forecasted value of prices of Kinnow Haryana and Punjab using ARCH (1) model lies between 2 standard errors. Also, the behaviour of forecasted and conditional variance is also having the same pattern. Thus, ARCH (1) model gives the good fit for prices of Kinnow for Haryana and Punjab markets. For prices of Guava of Haryana and Punjab, it is observed that there is no ARCH effect. Thus, ARCH model is not good fit for Prices of Guava in both the markets.

i	Experiment No. 5: Assessment of storage infrastructure for agri - horti products in Haryana	
ii	**Objectives of the Experiment**	• To study the growth and capacity utilization of storage and warehouses in Haryana • To analyze the commodity profile stored in warehouses • To explore the storage of agricultural products in public-private partnership (PPP) mode
iii	**Name (s) of the investigators**	• Dr. KK Kundu Planning, finalization of interview schedule and report writing • Dr. Sumit Data collection
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• Two Years (2021-23)
vii	**Treatment details**	• **Locale of the experiment**: Haryana • **Number and types of respondents:** Appropriate number of storages were selected for primary data • **Statistical design/methods:** The statistical tools like mean, percentage etc. were used.
viii	**Observations recorded**	• In the first year (2021-22) study was done based on secondary data • Number and storage capacity of all warehouses for the period 1990-2020 • Primary data will be collected in the second year (2022-23) to elicit the functioning of at least five private- godowns and five state owned warehouses

ix. Results achieved during 2021-22

Table 1: Storage Capacity of Food Corporation of India ***(in Lakh Tonnes)***

Sr. No.	Year	Owned	Hired	Total
1	1991	130.40	90.70	221.20
2	2002	209.50	141.10	350.60
3	2010	154.80	133.60	288.40
4	2012	187.52	148.52	336.04
5	2013	212.03	165.32	377.35
6	2014	156.40	212.50	368.90
7	2015	189.36	167.27	356.63
8	2016	185.12	172.77	357.89
9	2017	134.15	218.56	352.71
10	2018	148.96	213.54	362.50
11	2019	154.89	233.76	388.65
12	2020	155.22	256.81	412.03
13	2021	152.25	262.45	414.70
14	2022	156.27	270.42	426.69

Source: FCI, New Delhi and Ministry of food, Government of India, New Delhi

It was observed that there was an increase in owned and hired storage capacity of FCI (Table 1). The total storage capacity of FCI increased from 221.20 to 426.69 lakh tonnes.The FCI owned storage capacity increased from 130.40 to 156.27 lakh tonnes while that of hired storage capacity increased from 90.70 to 270.42 lakh tonnes.

Agency wise storage capacity of State owned storages in Haryana

The agency wise compound annual growth rates of storage capacity for state owned storages over the period of 1990-2020 are presented in table 2. In the decadal period from 1990-91 to 1999-00, the highest growth rate under storage was registered for Hafed (3.88%) followed by central warehousing corporation (1.48%), state warehousing corporation (1.44%) and other marketing board (0.47%). The negative growth rate of storage was registered for Food Corporation of India (FCI) which is two part i.e. owned and agriculture refinance development corporation, A.R.D.C. (with HWC) i.e. -0.04, -1.79, -1.34 and -5.33 per cent, respectively. In the 2nd decadal period from 2000-01 to 2009-10, highest growth rate under storage was again registered for Hafed (16.75%) followed by food and supply department (8.24%), central warehousing corporation (6.25%), FCI (Owned 5.98%) and state warehousing corporation (5.10%). The negative growth rate of storage was registered for other marketing board (-1.23%) and in the decadal period from 2010-11 to 2019-20, highest growth rate under storage was registered for state warehousing corporation (6.09%) followed by food and supply department (5.85%), Haryana Agro Industries corporation (4.86%), and central warehousing corporation (2.64%). The negative growth rate of storage was registered for FCI (Owned), Hafed and other marketing board i.e. -0.20, -1.37 and -0.15 per cent. Similarly, the compound annual growth rate of storage capacity from period 1990-2020 was recorded as the highest storage under Hafed (9.19%) followed by central warehousing corporation (5.52%), food and supply department (4.56%), state warehousing corporation (4.34%) and FCI (Owned 1.98%). There was no negative growth rate was registered under any of the storage agencies and there was no growth rate under A.R.D.C. (With HWC), Food and Supply (Bins), Haryana Agro Industries Corporation and Private entrepreneur guarantee (PEG) FCI. The compound annual growth rate of total storage of wheat and paddy agencies wise was highest from the period 2010-11 to 2019-20 i.e. 7.91 per cent followed by 2000-01 to 2009-10 (6.52%) and 1990-91 to 1999-00 (0.69%).

Table 2: Agency wise storage capacity of State owned storages in Haryana (000 tonnes)

	Years	Food Corporation of India		F&S	Hafed	SWC	CWC	A.R.D.C. (with HWC)	F&S (Bins)	HAIC	Other	PEG	Total
S. No.	Name of Agency/ year	(a) Owned	(b) ARDC										
1	1990-91	734	333	166	290	556	134	70	0	0	378	0	2661
2	1994-95	730	355	151	436	586	141	66	0	0	387	0	2852
3	1995-96	730	355	151	436	586	141	66	0	0	387	0	2852
4	1999-00	731	242	151	441	677	166	45	20	0	412	0	2885
5	2000-01	743	267	151	425	706	171	49	20	0	399	0	2931
6	2004-05	743	243	168	998	888	348	233	20	0	511	0	4152
7	2005-06	1085	0	256	1517	1124	366	0	0	145	417	0	4910
8	2009-10	1100	0	298	2521	1189	475	0	0	174	426	0	6183
9	2010-11	1086	0	250	2486	985	364	0	0	142	424	0	5737
10	2014-15	1091	0	388	2461	1528	496	0	0	117	403	0	6484
11	2015- 16	1090	0	407	2157	1517	472	0	0	194	419	3402	9658
12	2019-20	1046	0	490	2376	1616	455	0	0	194	419	3402	9998
CAGR (%)	1990-2000	**-0.04**	**-1.79**	**-1.34**	**3.88**	**1.44**	**1.48**	**-5.33**	**-**	**-**	**0.47**	**-**	**0.69**
	2001 to 2010	**5.98**	**-**	**8.24**	**16.75**	**5.10**	**6.25**	**-**	**-**	**-**	**-1.23**	**-**	**6.52**
	2011 to 2020	**-0.20**	**-**	**5.85**	**-1.37**	**6.09**	**2.64**	**-**	**-**	**4.86**	**-0.15**	**-**	**7.91**
	1990-2020	**1.98**	**-**	**4.56**	**9.18**	**4.34**	**5.52**	**-**	**-**	**-**	**0.31**	**-**	**5.29**

Note: ARDC: Agriculture Refinance Development Corporation, F &S: Food and Supplies Department.
HAIC: Haryana Agro Industries Corporation , Other : Marketing Board, PEG: Private Entrepreneur Guarantee (PEG) FCI,

Table 3: Number of cold storage and their capacity in Haryana

S. No.	Years	No. of Cold Storages	Capacity (000 tonnes)
	1992-93	160	203
1	1996-97	176	233
2	1997-98	195	262
3	2007-08	198	267
4	2008-09	198	267
5	2012-13	198	267
6	2013-14	198	267
7	2019-20	198	267
CAGR (%)	**1992-93 to 2007-08**	**2.77**	**3.61**
	2008-09 to 2019-20	**0.00**	**0.00**
	1992-93 to 2019-20	**0.91**	**1.17**

Note: Information for the year 1999-2000 onward is not available due to repeal of cold storage Order 1979 w.e.f. 18-5-1999.

Number of cold storage and their capacity in Haryana

The CAGRs of number and capacity of cold storage in Haryana over the period of 1992-93 to 2019-20 are presented in table 3.The CAGRs of number of cold storage and capacity during the period 1992-93 to 2007-08 was registered 2.77 and 3.61 per cent, respectively, but there was no growth rate was registered during the period 2008-09 to 2019-20 because of repeal of cold storage Order 1979 w.e.f. 18-5-1999. The growth rate of number of cold storage and storage capacity during the period of 1992-93 to 2019-20 registered at rate of 0.91 and 1.17 per cent, respectively.

Districts wise status of number and capacity of cold storage in Haryana during 2019-20

The districts wise number and capacity of cold storage in Haryana during 2019-20 are presented in Table 10. In Haryana, the total number of cold storage was 198 and the capacity was 267 thousand tonne during 2019-20 (Table 4). The highest number of cold storage were registered in Kurukshetra followed by Sonipat, Karnal, Yamunanagar and Ambala i.e. 51, 29,, 27, 23 and 22, respectively. Similarly, in case of capacity of cold storage was highest in Kurukshetra, Sonipat, Ambala, Karnal &Yamunanagar and Fatehabad districts i.e. 80, 48, 30,29& 29 and 10 thousand tonnes, respectively. The highest percentage of number of cold storage and capacity was recorded in Kurukshetra districts i.e. 25.76 and 29.96 per cent, respectively while; the lowest number of cold storage and capacity was recorded in Bhiwani and Mahendergarh district. .

Table 4: District wise status of number and capacity of cold storage in Haryana during 2019-20

S. No.	Districts	No. of Cold Storage	Percentage	Capacity (000 tonne)	Percentage
1	Ambala	22	11.11	30	11.24
2	Bhiwani	0	0.00	0	0.00
3	Faridabad	3	1.52	3	1.12
4	Fatehabad	6	3.03	10	3.75
5	Gurugram	3	1.52	1	0.37
6	Hisar	6	3.03	9	3.37
7	Jhajjar	0	0.00	0	0.00
8	Jind	7	3.54	8	3.00
9	Kaithal	6	3.03	7	2.62
10	Karnal	27	13.64	29	10.86
11	Kurukshetra	51	25.76	80	29.96
12	Mahendragarh	0	0.00	0	0.00
13	Panchkula	3	1.52	2	0.75
14	Panipat	5	2.53	6	2.25
15	Rewari	0	0.00	0	0.00
16	Rohtak	3	1.52	3	1.12
17	Sirsa	4	2.02	2	0.75
18	Sonipat	29	14.65	48	17.98
19	Yamunanagar	23	11.62	29	10.86
Total		**198**	**100.00**	**267**	**100.00**

x. Programme of work for 2021-22: Experiment to continue for the year 2022-23. The primary data will be collected during the year 2022-23

Salient findings of the study

- FCI owned storage capacity increased from 130.40 to 156.27 lakh tonnes while that of hired storage capacity increased from 90.7 to 270.42 lakh tonnes in India.
- The CGARs of storage during period 1990-2020 the highest growth rate of storage was registered under Hafed (9.19%) followed by CWC (5.52%), food and supply department (4.56%), SWC (4.34%) and FCI (Owned) (1.98%).
- In Haryana, the total number of cold storage was 198 and the capacity was 267 thousand tonnes during 2019-20. The highest number of cold storage and capacity were registered in Kurukshetra 51 and 80 thousand tonnes, respectively.

i	**Experiment No. 6:Analysis of arrival and prices pattern of onion in Haryana**	
ii	**Objectives of the experiment**	• To study the arrival and price pattern of onion in major APMC markets of Haryana • To co-integrate prices of onion in selected markets of Haryana with prices of onion in major markets at national level
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Data collection and technical writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 year
vii	**Treatment details**	• **Locale of experiment:** Kurukshetra, Panipat, Yamunanagar, Gurugram from Haryana , Delhi and Nasik markets • **Crop:** Onion • **Period:** Monthly price data of onion for the period 2010-2020 from selected markets • **Statistical design/methods:** Johansen Co-integration analysis and Granger Causality test were used.
viii	**Observations recorded**	• Monthly time series data related to onion arrival and prices were collected.

Results achieved during 2021-22:

Price Pattern of onion ins elected markets (2010-2020):

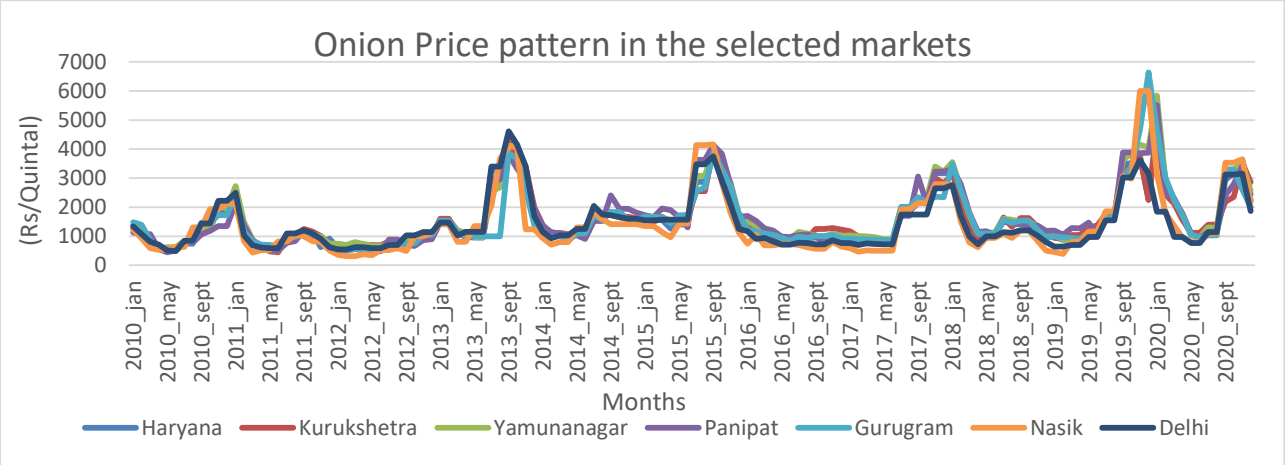


Table:1 Descriptive Statistics of selected onion markets (2010-2020)

Statistics	*Haryana*					*India*	
	Haryana	***Kurukshetra***	***Yamunanagar***	***Panipat***	***Gurugram***	***Nasik***	***Delhi***
Mean (Rs./q)	1540.524	1554.435	1631.414	1588.453	1526.504	1395.932	1431.295
Skewness	1.61	1.53	1.70	1.52	2.22	2.14	1.59
Kurtosis	2.11	2.25	2.83	1.99	6.61	5.21	1.98
Maximum(Rs./q)	4796.22	4624.98	5849.83	5510	6636.08	6004.31	4605.99
Minimum(Rs./q)	486.9	442.16	486.9	444.78	485.63	315.06	488.05
CV (%)	61.30	54.58	60.78	62.12	64.07	78.38	62.16
CMGR	0.513	0.545	0.604	0.708	0.633	0.506	0.301

Table 1 presents descriptive statistics of the selected markets prices. In case of Nashik market, the mean price was observed Rs.13.95 per kg, whereas 14 to 17 per kg in other markets during the study period. High instability/volatility of prices has been observed in case of Nashik market (CV 78%). The skewness value for Nasik and Gurugram markets show presence of asymmetric behaviour in them and also the coefficient of kurtosis was high in these two markets which reflect the leptokurtic distribution and high degree of extreme values.

Table 2: Correlation matrix of onion prices series in selected markets:

	Haryana	***Kurukshetra***	***Yamunanagar***	***Panipat***	***Gurugram***	***Nasik***	***Delhi***
Haryana	1.00						
Kurukshetra	0.98	1.00					
Yamunanagar	0.97	0.97	1.00				
Panipat	0.95	0.95	0.97	1.00			
Gurugram	0.85	0.85	0.93	0.89	1.00		
Nasik	0.85	0.84	0.88	0.86	0.88	1.00	
Delhi	0.92	0.90	0.89	0.86	0.81	0.91	1.00

**** all correlations are found highly significant**

It has seen that the price markets are significantly highly correlated with each other implying higher co-movement and greater integration between them (Table 2).

Arrival Pattern of onion in selected markets of Haryana (2011-2020)

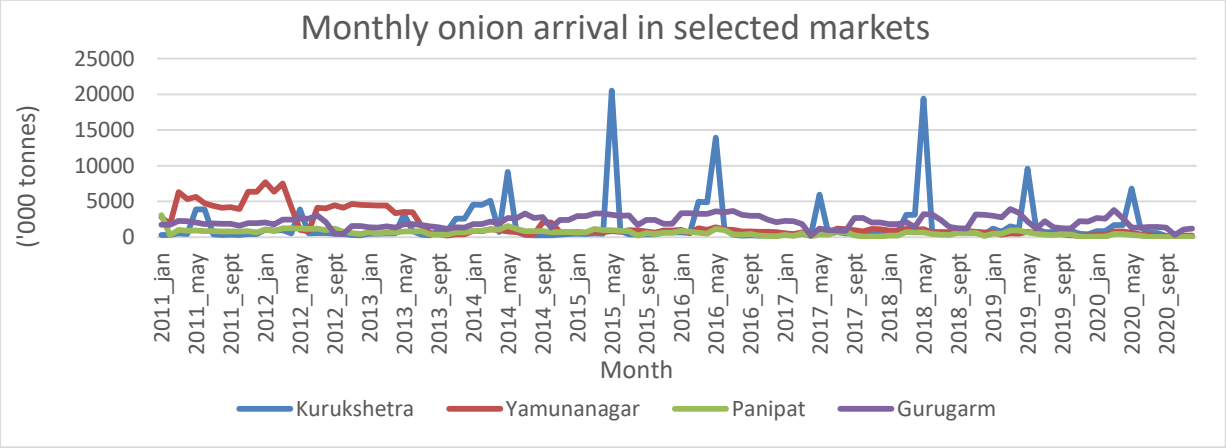


Table 3: Seasonal factors of selected onion markets prices

Market	Delhi	Nasik	Gurugram	Kurukshetra	Panipat	Yamunanagar	Haryana
January	1.047	1.007	1.176	1.203	1.217	1.24	1.247
February	0.811	0.717	0.944	0.908	0.948	0.929	0.937
March	0.681	0.575	0.8	0.767	0.816	0.789	0.78
April	0.648	0.558	0.685	0.668	0.718	0.681	0.636
May	0.671	0.693	0.683	0.663	0.652	0.64	0.649
June	0.675	0.757	0.659	0.66	0.586	0.631	0.629
July	1.149	1.134	0.981	1.047	1.068	1.039	1.103
August	1.134	1.284	0.96	1.017	1.064	1.034	1.087
September	1.385	1.367	1.375	1.396	1.385	1.308	1.389
October	1.305	1.389	1.336	1.279	1.225	1.271	1.317
November	1.36	1.323	1.273	1.327	1.246	1.321	1.182
December	1.133	1.197	1.128	1.065	1.076	1.116	1.045

From this table we can say that the prices of onion markets differ significantly from the average price during July to January whereas in February to June the prices remained below the average price (Table 3). The overall highest and lowest price can be observed in the month of September, October and April, May for all the markets.

In order to check the stationarity, ADF test was employed and ADF test confirms the presence of unit root in every case but after first differencing of, they are found to be stationary and therefore, they are integrated of order one, i.e. I(1).

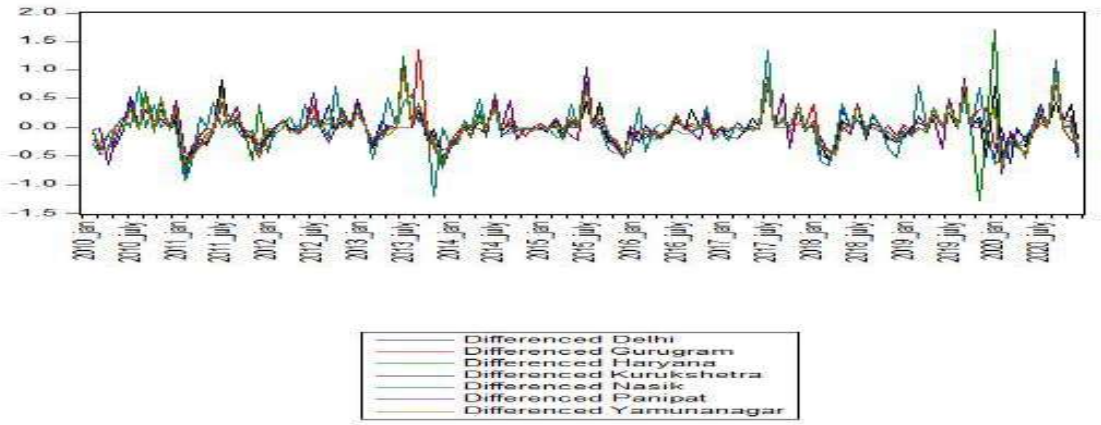


Fig 2: Time series plot of log variables after taking first difference

Johansen Co-integration test with the null hypothesis that no co-integration equation was applied. From the results of trace test and Max-eigenvalue test we found 6 and 5 co-integration equations at the 0.05 level respectively. Therefore, series are co-integrated and we can estimate relationship using VAR and model:

Vector Autoregression Estimates							
Standard errors in ( ) & t-statistics in [ ]							
	Delhi	Gurugram	Haryana	Kurukshetra	Nasik	Panipat	Yamunanagar
Delhi(-1)	0.580840	-0.127132	-0.040450	-0.006367	0.461621	0.033294	-0.038943
	(0.15092)	(0.14313)	(0.16889)	(0.13565)	(0.20476)	(0.15406)	(0.13375)
	[3.84861]	[-0.88824]	[-0.23951]	[-0.04694]	[2.25441]	[0.21612]	[-0.29118]
Gurugram(-1)	-0.306601	0.236700	-0.165484	-0.183964	-0.183316	-0.043505	-0.218824
	(0.14402)	(0.13658)	(0.16116)	(0.12945)	(0.19540)	(0.14701)	(0.12763)
	[-2.12887]	[1.73302]	[-1.02682]	[-1.42116]	[-0.93816]	[-0.29593]	[-1.71453]
Haryana(-1)	0.131277	-0.151701	0.452254	0.078650	-0.168603	-0.053590	-0.095940
	(0.13231)	(0.12548)	(0.14806)	(0.11892)	(0.17952)	(0.13506)	(0.11725)
	[0.99216]	[-1.20896]	[3.05449]	[0.66134]	[-0.93920]	[-0.39679]	[-0.81822]
Kurukshetra(-1)	0.117897	0.192528	-0.145376	0.354031	0.334571	0.049367	0.075023
	(0.22941)	(0.21756)	(0.25671)	(0.20619)	(0.31125)	(0.23417)	(0.20330)
	[0.51392]	[0.88495]	[-0.56630]	[1.71700]	[1.07494]	[0.21082]	[0.36903]
Nasik(-1)	0.579161	0.546070	0.618140	0.520097	0.866323	0.434873	0.541344
	(0.10253)	(0.09724)	(0.11474)	(0.09216)	(0.13911)	(0.10466)	(0.09086)
	[5.64858]	[5.61588]	[5.38752]	[5.64362]	[6.22759]	[4.15507]	[5.95783]
Panipat(-1)	-0.041094	0.024889	-0.065342	0.018061	0.049865	0.458757	-0.072624
	(0.14780)	(0.14016)	(0.16539)	(0.13284)	(0.20052)	(0.15087)	(0.13098)
	[-0.27805]	[0.17757]	[-0.39508]	[0.13596]	[0.24867]	[3.04082]	[-0.55448]
Yamunanagar(-1)	-0.332297	0.086085	0.081324	-0.028202	-0.536961	-0.023626	0.610788
	(0.25716)	(0.24388)	(0.28776)	(0.23113)	(0.34890)	(0.26250)	(0.22789)
	[-1.29220]	[0.35299]	[0.28261]	[-0.12202]	[-1.53902]	[-0.09000]	[2.68020]
C	2.036971	1.450900	2.004142	1.901309	1.297998	1.132488	1.548921
	(0.36452)	(0.34569)	(0.40790)	(0.32763)	(0.49456)	(0.37209)	(0.32303)
	[5.58812]	[4.19708]	[4.91327]	[5.80319]	[2.62455]	[3.04362]	[4.79495]
R-squared	0.797668	0.814329	0.742355	0.803636	0.750846	0.805590	0.832576
Adj. R-squared	0.786153	0.803762	0.727693	0.792461	0.736667	0.794527	0.823048
F-statistic	69.27307	77.06593	50.62879	71.91265	52.95306	72.81214	87.38027

Granger causality test was applied to find the direction of price flow between selected markets and results are presented here:

	Haryana	Kurukshetra	Yamunanagar	Panipat	Gurugram	Nasik
Kurukshetra			-			
Yamunanagar				→		
Panipat		-				
Gurugram		←	←	↔	-	↔
Nasik	→	↔	↔	→		
Delhi	→	→	↔	→	→	↔

Salient features of the study:

- In case of Nashik market, the mean price was observed rupees13.95 per kg, whereas 14 to 17 per kg in other markets during the study period. High instability/volatility of prices has been remained in case of Nashik market (C V 78%).
- It has seen that the price markets are significantly highly correlated with each other implying higher co-movement and greater integration between them.
- Prices of onion markets differ significantly from the average price during July to January whereas in February to June the prices remained below the average price.
- The overall highest prices were observed in the month of September, October while lowest prices were found in month of April, May for all the markets.
- Trace test and Max-eigenvalue test indicate that there are co-integration equations at the 0.05 level respectively. Therefore, series are co-integrated.
- Pairwise Granger Causality Tests shows that Nasik and Delhi markets onion prices effected prices of onion in every other selected markets.

Conclusions:

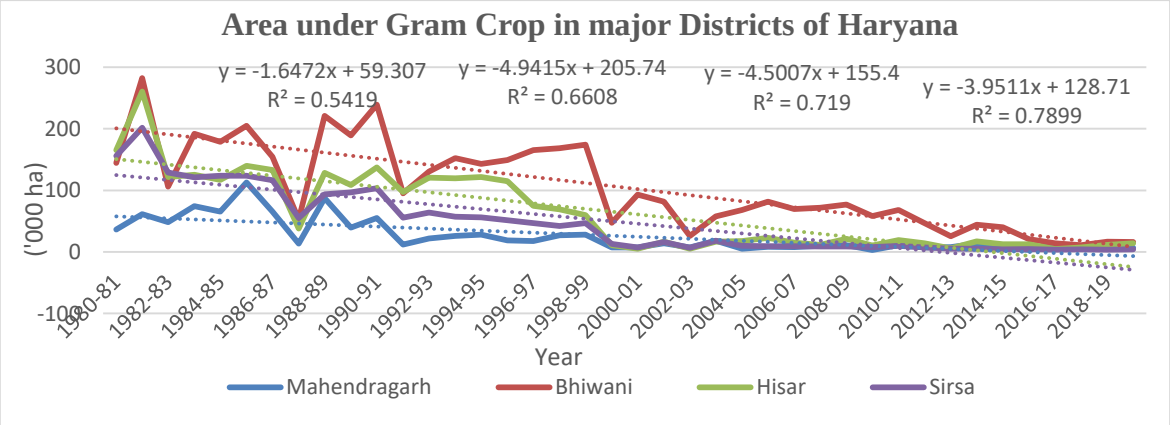
Four markets (Kurukshetra, Yamunanagar, Panipat, Gurugram) from Haryana and two national markets (Delhi, Nasik) were considered for onion price transmission mechanism. The mean prices were lowest in Nasik market (Rs.13.95 per kg). The price markets were significantly highly correlated with each other implying higher co-movement and greater integration between them. Seasonal factors were also calculated and prices of onion markets differed significantly from the average price and it was higher during July to January whereas in February to June, the prices remained below the average price. Onion price series of selected markets were found co-integrated and pairwise Granger Causality Tests showed that Nasik market onion prices affected every other selected market prices of onion

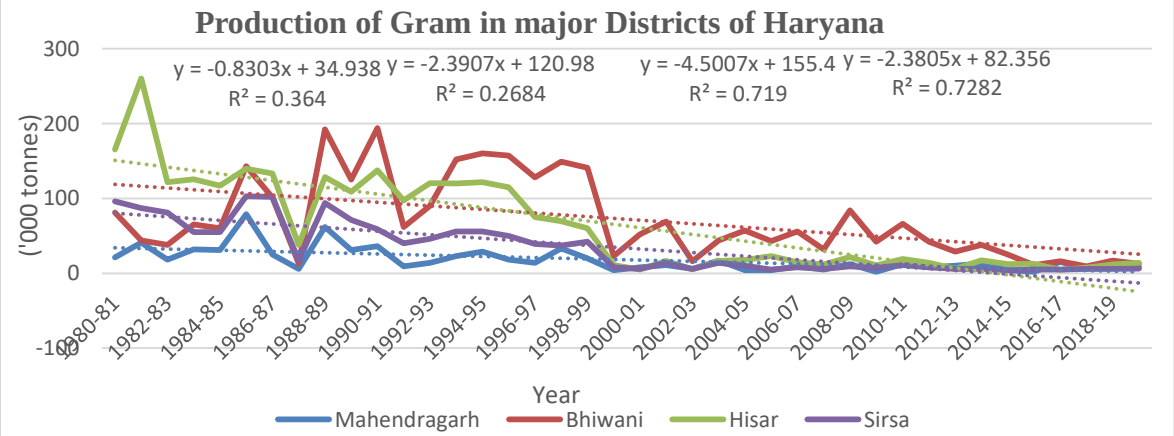
i	**Experiment No. 7:A study on status and forecasting of pulses production at state and national level**	
ii	**Objectives of the experiment**	• To examine the trends in area, production and productivity of pulses in various districts of Haryana • To identify major pulses producing states in India • To develop forecast models for pulses production at state and national level
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik

		Technical report writing
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 year
vii	**Treatment details**	• **Locale of experiment:** Major gram growing districts (Mahendragarh, Bhiwani, Hisar and Sirsa) of Haryana, top three pulses producing states of selected pulses and India • **Crop:** Three major pulses crops (Arhar, lentil, Moong, Urad, Gram) • **Period:**1980-2020 • **Statistical design/methods:** Descriptive and explorative data analysis, compound annual growth rate and uni-variate time series models (ARIMA, Holts-ETS) were used.
viii	**Observations recorded**	• Time series data on pulses area, production and yield were collected.

Results achieved during 2021-22:

Trends in Area, Production and Yield of Gram crop in major districts of Haryana





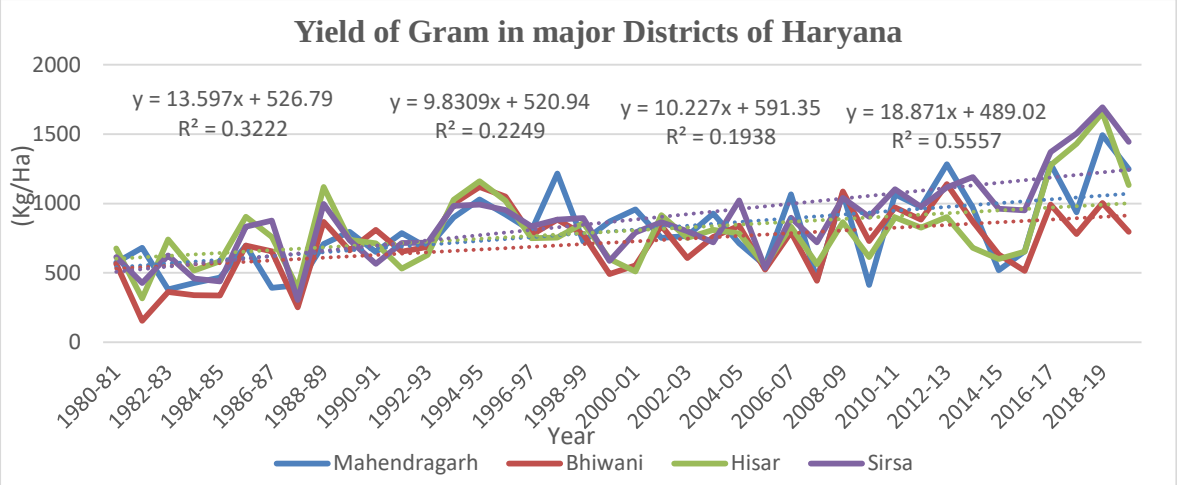


Table1: District-wise Gram crop summary statistics in Haryana (1980-2020)

Gram	Area			Production (In '000 tonne)			Yield (In)		
District	Mean (In '000 Ha)	CV (%)	CAR of change (%)	Mean (In '000 tonnes)	CV (%)	CAR of change (%)	Mean (In Kg/Ha)	CV (%)	CAGR (%)
Mgarh	25.54	101.13	-6.41	17.92	88.67	-4.61	805.53	34.32	1.69
Bhiwani	104.44	67.19	-5.99	71.97	74.02	-4.20	722.48	33.12	1.84
Hisar	63.14	97.05	-8.51	45.99	98.06	-7.35	801.00	33.48	1.25
Sirsa	47.71	107.55	-10.32	33.56	95.97	-8.32	875.88	33.36	2.23
Haryan	291.87	88.31	-7.90	206.68	82.24	-6.43	793.05	29.54	1.59

- During 2020-21, in Haryana area and production under gram were 35.69 thousand hectares and 47.12 thousand tonnes, respectively
- Table 1 shows that area under gram declined at rate of 7.90 per cent per annum at state level whereas maximum rate was found in Sirsa District (10.32 per cent per annum) followed by Hisar, Mahendergarh and Bhiwani. Same pattern was observed in case of production and production was declining at a rate of 6.43 per cent per annum in Haryana.
- It was also observed that despite declining pattern of area yield was growing at a rate of 1.59 per cent per annum at state level and was positive for all the selected districts. Also, variation was found very high in area and production of gram crop.

Table 2: State-wise major pulses summary statistics (1980-2021):

Crop	**State**	Area			Production			Yield		
		Mean (In '000 Ha)	CV (%)	CAGR (%)	Mean (In'000 tonne)	CV (%)	CAGR (%)	Mean (In Kg/Ha)	CV (%)	CAGR (%)
	Karnataka	598.40	45.88	2.77	319.41	74.85	4.25	495.88	28.92	1.46
Arhar	**Maharashtra**	1031.35	17.45	1.47	707.41	35.41	2.46	674.05	22.85	0.98
	UP	415.93	22.03	-1.87	464.15	36.14	-3.02	1087.38	19.51	-1.18
	India	3614.91	13.33	0.89	2621.85	23.03	1.12	724.33	11.67	0.2
Lentil	**Bihar**	170.29	10.01	-0.26	143.37	19.78	0.63	843.29	18.40	0.89
	MP	447.39	23.78	1.82	236.08	46.60	3.27	514.75	29.88	1.43
	UP	498.61	17.39	0.64	378.13	25.29	1.38	750.78	15.34	0.74
	India	1289.28	14.68	1.12	880.44	26.04	2.11	674.73	15.73	0.98
Moong	**Karnataka**	301.49	34.60	2.11	79.53	51.64	1.03	270.04	37.53	-1.05
	Maharashtra	584.63	23.13	-1.00	244.18	40.93	-0.39	409.39	29.03	0.63
	Rajasthan	729.77	74.57	5.93	272.63	116.19	9.36	295.39	56.86	3.24
	India	3254.20	14.94	0.74	1332.89	30.18	1.18	403.70	17.06	0.44
Urad	**MP**	734.14	55.74	0.97	277.72	94.61	3.02	348.35	34.15	1.98
	Maharashtra	460.94	20.10	-0.89	207.00	39.10	-0.20	446.42	29.49	0.76

	UP	397.74	37.55	3.39	178.95	56.33	5.31	418.06	26.48	1.83
	India	3291.01	18.87	0.78	1561.75	33.54	1.78	466.67	16.05	0.99
Gram	**Haryana**	291.87	88.31	-7.90	206.68	82.24	-6.43	793.05	29.54	1.59
	MP	2561.13	16.24	1.03	2340.18	35.30	2.74	892.25	22.33	1.69
	Maharashtra	957.38	48.35	3.86	668.41	77.34	6.36	616.38	31.03	2.41
	Rajasthan	1406.96	33.66	-0.15	1069.63	46.74	0.77	742.30	21.52	0.93
	UP	922.78	38.51	-3.25	818.64	34.86	-2.73	904.90	17.47	0.54
	India	7511.61	16.58	0.87	6204.78	31.63	2.08	810.33	15.80	1.20

- During 2020-21, Karnataka, Madhya Pradesh, Rajasthan, Madhya Pradesh and Maharashtra were the area-wise leading states of Arhar, Lentil, Moong, Urad and Gram, respectively.
- Table 2 shows that maximum mean (7511.61 thousand hectare) area and mean production (6204.78 thousand tonnes) was under gram crop at national level over the years.
- Yield growth was found positive for all the states except Uttar Pradesh and Karnataka for arhar and moong respectively.
- CV was lowest in case of Arhar area (13.33 %), production (23.03 %) and yield (11.67 %).
- Maximum annual growth was found in case lentil area, production and gram yield at national level.

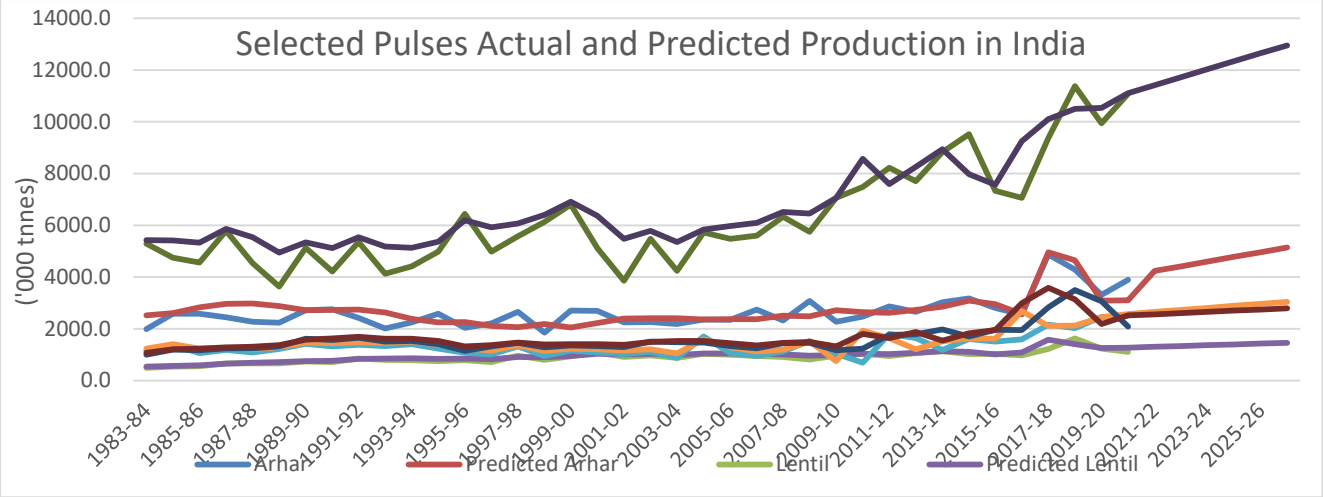
On the basis of accuracy measures it was observed that Holts ETS method performed better than ARIMA as RMSE was lesser in Holts ETS method.

Table 3: Smoothing constants of Holts ETS Model:

Arhar	**State**	**Karnataka**	**Maharashtra**	**Uttar Pradesh**	**India**
Method	α	0.922487	0.606718	0.824043	0.247771
	β	0.001091	0.001032	0.145817	0.416099
Lentil	**State**	**Bihar**	**Madhya Pradesh**	**Uttar Pradesh**	**India**
Method	α	0.817284	0.004584	0.812256	0.446954
	β	0.20337	0.448652	0.190791	0.001039
Moong	**State**	**Karnataka**	**Maharashtra**	**Rajasthan**	**India**
Method	α	0.294478	0.034501	0.754954	0.719945
	β	0.067743	0.001034	0.000000	0.001027
Urad	**State**	**MP**	**Maharashtra**	**UP**	**India**
Method	α	0.915639	0.084032	0.664952	0.647673
	β	0.001024	0.001035	0.372321	0.016628

Gram	**State**	**Haryana**	**MP**	**Maharashtra**	**Rajasthan**	**UP**	**India**
Method	α	0.68221	0.982712	0.345478	0.421359	0.875194	0.477565
	β	0.104218	0.001044	0.053772	0.00103	0.199324	0.001024

Above table shows the smoothing constants of Holts ETS Model denoted by α and β. India level forecast of selected pulses crops by the Holts ETS model:



Salient findings of the study:

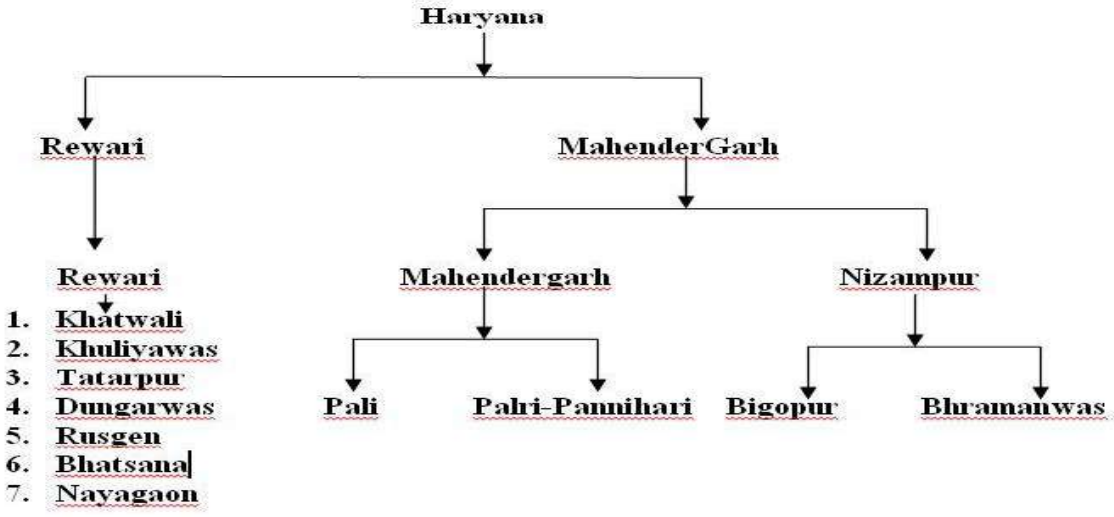
- Trend plots showed that there is a rapid decline in area and production of gram crop in all the selected districts of Haryana whereas some positive trend was found in case of yield.
- Area under gram declined at a rate of 7.90 per cent per annum at state level whereas maximum rate was found in Sirsa District (10.32 per cent per annum) followed by Hisar, Mahendergarh and Bhiwani. Same pattern was observed in case of production and production was declining at a rate of 6.43 per cent per annum in Haryana.
- It was also observed that despite declining pattern of area, yield was growing at a rate of 1.59 per cent per annum at state level and was positive for all the selected districts. Also, variation was found very high in area and production of gram crop.
- Maximum mean (7511.61 thousand ha) area and mean production (6204.78 thousand tonnes) was under gram crop at national level over the years.
- Variation was lowest in case of arhar area (13.33 %), production (23.03 %) and yield (11.67 %).
- Maximum annual growth was found in case lentil area, production and gram yield at national level.
- Two univariate time series models were applied and it was observed that Holts ETS method performed better for prediction as RMSE was lesser.

Conclusions: The area under gram declined at a rate of 7.90 per cent per annum at state level whereas maximum rate of decline was found in Sirsa District (10.32 %) followed by Hisar (8.51 %), Mahendergarh (6.41 %) and Bhiwani (5.99 %). Yield was growing at a rate of 1.59 per cent per annum at state level and was found highest in Sirsa (2.%) and positive for all the selected districts. Also, variation was found very high in area and production of gram crop. At national level, variation was lowest in case of Arhar area (13.33%), production (23.03%) and yield (11.67 %). On the basis of accuracy measures it was observed that Holts ETS method performed better for prediction.

i	**Experiment No. 8: Economic appraisal of sesame cultivation in Haryana**	
ii	**Objectives of the experiment**	• To work out the costs and returns of sesame cultivation • To compare the resource use efficiency in sesame cultivation with competing crops • To study the constraints in cultivation of sesame
iii	**Name (s) of the investigators**	• Dr Neeraj Pawar Finalization of schedule, compilation and analysis of data. • Dr.D.P.Malik Report writing
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2021-22
vi	**Duration of experiment**	• One Year
vii	**Treatment details**	• **Locate of the experiment:** Haryana • **Districts covered:** Rewari and Mahendergarh • **Block & Villages:** Rewari block from Rewari, two blocks Mahendergarh and Nizampur blocks from Mahendergarh. Further villages namely Khatwali, Khuliyawas, Tatarpur, Dungarwas, Rusgen, Bhatsana and Nayagaon from Rewari block. PaliandPalri-Pannihari from Mahendergarh block, Bigo-pur and Bharmanwas from Nizampur block were selected. • **Statistical design/methods:** Purposive Multistage sampling, Descriptive statistics, Cobb-Douglas production function technique were used. Constraints were identified on the basis of their rating (severe, moderate and least) in production of sesame.
viii	**Observations recorded**	• 60 farmers were interviewed to collect information regarding various input used, output prices • Information related to resources use i.e. seed, irrigation, fertilizer, agro-chemicals, machinery, input, output, prices and constraints

ix. Results achieved during 2021-22

Fig. 1: Sampling design of the study



Economics of sesame and its competing crops (Bajra & Clusterbean) cultivation in Haryana

The comparative Economics of sesame and its major competing crops *viz.*bajra and cluster bean has been displayed in Table 1. The total variable cost per hectare on sample farms was found to be Rs. 20351 in sesame, Rs. 28447 in Bajra and Rs. 22409 in cluster bean. The total cost per hectare was Rs. 40613 in sesame, Rs. 51362 in Bajra and Rs. 45380 in cluster bean crops. Gross income came out to be Rs.47048 in sesame, Rs. 56349 in bajra and Rs. 54984 in cluster bean crop, while return over variable cost were Rs. 26697, Rs 27902 and Rs. 32575, respectively. The benefit cost ratio was 1.16 in sesame, 1.09 in Bajra and 1.21 in cluster bean crop. Thus, returns over variable cost were higher in Bajra and Cluster bean than sesame due to higher gross returns.

Table 1: Comparative economics of sesame and competing crops (Bajra & Clusterbean) cultivation in Haryana (Rs. ha^{-1})

Sr. No.	Items	Sesamum	Bajra	Difference (Sesamum -Bajra	Cluster bean	Difference (Sesame-Clusterbean)
A. Variable Expenses						
1	Field Preparation and sowing	4818	5725	**-907**	5613	**-795**
2	Seed	728	1019	**-291**	1138	**-410**
3	Fertilizer Investment	1453	2943	**-1490**	1611	**-158**
4	Irrigation	1119	1405	**-286**	1788	**-669**
5	Plant protection	4414	3356	**1058**	3063	**1351**
6	Harvesting and Threshing	6888	12800	**-5912**	8225	**-1337**
7	Int. +miscellaneous	933	1199	**-266**	971	**-38**
8	Sub-Total	20351	28447	**-8096**	22409	**-2058**
B. Fixed cost						
9	Management and risk charges	4068	3684	**384**	4488	**-412**
10	Rental value of land	15413	18500	**-3087**	17816	**-2403**
11	Transportation	595	731	**-136**	675	**-80**
12	Sub Total	2263	22915	**-2652**	22971	**-2708**
13	Total cost (A+B)	40613	51362	**-10749**	45380	**-4767**
C. Gross Returns						
14	a)Main product	45135 (4.46)*	47736 (23.06)*	-	51309 (10.5)*	-
	b) By-product	1913	8613		3675	
15	Gross Return	47048	56349	**-9301**	54984	**-7936**
16	R.O.V.C	26697	27902	**-1205**	32575	**-5878**
17	Net Return	6435	4987	**-1448**	9604	**-3169**
18	**B:C(R.O.V.C)**	**2.31**	**1.98**	-	**2.45**	-
19	**B:C(T.C.)**	**1.16**	**1.09**	-	**1.21**	-

Note- Figure in parenthesis indicate the percentage to total cost
*Figures in brackets denote yield in terms of quintals

Marginal value productivity

The efficiency level of individual resource used in Mahendergarh, Rewari and overall were determined with the help of Cobb Douglas production function based on the collected data from sesame cultivation. The resources like human labour, fertilizer, seed and plant protection chemicals were the major contributing exogenous variables in cultivation of sesame crop. The production function analysis fitted for resource use in the selected districts reveals that the regression co-efficient of machine hrs., fertilizer cost, irrigation and plant protection cost were positive for both the districts. Human labour and seed costs were negative in both the districts but positive for human labour in Rewari district. In case of overall all these variables were positive (Table 2).

Table 2: Resource use efficiency in sesame in Haryana

Variables	Mahendergarh District					
	GM	**b**	**MVP**	**MFC**	**MVP/MFC**	**Utilization**
Human labour (Rs./ha)	9.49	-0.19	-0.22	1	-0.22	Over utilized
Machine (Rs./ha)	9.36	1.73	2.02	1	2.02	Under utilized
Seed cost	6.94	-1.65	-2.60	1	-2.60	Over utilized
Fertilizer cost	7.41	0.86	1.27	1	1.27	Under utilized
Irrigation Cost	7.73	1.04	1.47	1	1.47	Under utilized
Plant protection cost	8.03	0.93	1.27	1	1.27	Under utilized
R2	0.9883					
Variables	**Rewari District**					
	GM	**b**	**MVP**	**MFC**	**MVP/MFC**	**Utilization**
Human labour (Rs./ha)	9.39	0.47	0.55	1.00	0.55	Over utilized
Machine (Rs./ha)	9.33	1.14	1.33	1.00	1.33	Under utilized
Seed cost	6.97	-1.07	-1.68	1.00	-1.68	Over utilized
Fertilizer cost	7.24	0.85	1.28	1.00	1.28	Under utilized
Irrigation Cost	7.22	1.12	1.69	1.00	1.69	Under utilized
Plant protection cost	7.97	1.43	1.96	1.00	1.96	Under utilized
R2	0.9827					
Variables	**Overall**					
	GM	**b**	**MVP**	**MFC**	**MVP/MFC**	**Utilization**
Human labour (Rs./ha)	9.44	0.38	0.44	1.00	0.44	Over utilized
Machine (Rs./ha)	9.34	1.28	1.50	1.00	1.50	Under utilized
Seed cost	6.96	0.23	0.36	1.00	0.36	Over utilized
Fertilizer cost	7.32	1.23	1.83	1.00	1.83	Under utilized
Irrigation Cost	7.47	0.78	1.14	1.00	1.14	Under utilized
Plant protection cost	8.00	0.87	1.19	1.00	1.19	Under utilized
R2	0.8256					

The MVP value of machine hrs., fertilizer cost, irrigation and plant protection were greater than unity in both the districts and overall which indicates that all these inputs were underutilized. On the other side, the value MVP were less than unity for human labour and seed cost were over utilized in both the districts and overall indicates that all these inputs were over utilized and use of these inputs needs to be curtailed for higher returns. The reduction in the use of over utilized inputs will help in reduction of expenses incurred. There is ample scope for exploitation the use of these underutilized resources to maximize the production and to increase the gross returns. It is imperative from the study that use of underutilized resources in the cultivation of sesame crops resulted into higher yield.

Constraints faced by sesame growers

Major production and marketing constraints highlighted by the growers (Table. 3) were low yielding varieties (86.66%) which are followed by low input used (78.33%) and problem of seed shattering (70.55%). Lack of price information, then followed by shortage of ground water, high incidence of insect-pest and non-existence of processing unit.

Table 3: Constraints faced by sesame growers **(N = 60)**

S. No.	Constraints	Total	Percentage	Farmers Ranking
1.	Low yielding varieties	156	86.66	I
2.	Non-adoption of package of practice/low input used	141	78.33	II
3.	Problem of seed shattering	127	70.55	IV
4.	Price variability/lack of price information	139	77.22	III
5.	Problem of irrigation/shortage of groundwater	121	67.22	V
6.	High incidence of insect pest	119	66.11	VI
7.	Non-existence of processing unit	111	61.66	VII

x. Programme of Work for 2022-23: Experiment concluded

Salient finding of the study

- The gross returns and return over variable cost per hectare were Rs. 47048, Rs. 56349, Rs. 54948 and Rs. 26697 Rs. 27902, Rs. 32575 in sesamum, bajra and cluster bean crops, respectively.
- B: C ratio over total cost was accounted 1.16, 1.09 and 1.21 in sesamum, bajra, and cluster bean crops respectively.
- The machine hours, fertilizer cost, irrigation cost and plant protection cost for Mahendergarh and Rewari and overall were greater than unity. It indicates that these inputs were underutilized in respective districts and overall.
- The major constraints faced by sesame growers were low yielding varieties which is followed by low input used and problem of seed shattering, Lack of price information, then followed by shortage of ground water and non-existence of processing units.

Conclusion

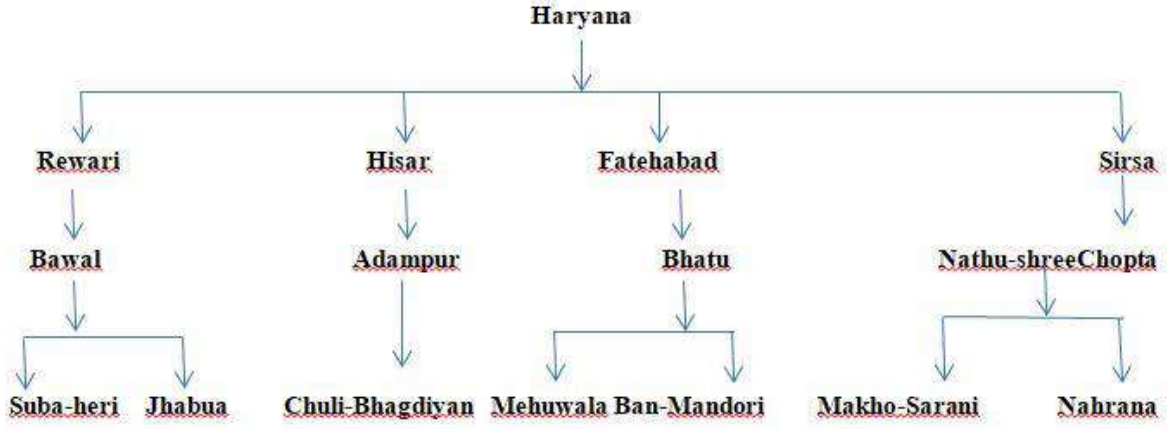
The gross returns and return over variable cost per hectare were Rs. 47048, Rs. 56349, Rs. 54948 and Rs. 26697 Rs. 27902, Rs. 32575 in sesame, bajra and cluster bean, respectively. B: C ratio over total cost was accounted 1.16, 1.09 and 1.21 in sesame, bajra, and cluster bean crops respectively. It has been found that sesame provides lower returns in term of gross returns as well as returns over variable cost as compared to its major competing crops bajra and cluster bean. The regression analysis has brought out that the ratio of MVP/MFC is (>1) there exists sufficient potential in spending on fertilizers, irrigation and plant protection measures. The constraints faced by farmers indicate that the technological up gradation, effective market support (for inputs & output) are required to make sesame production a remunerative enterprise.

I	**Experiment No. 9: Economic appraisal of groundnut cultivation in Haryana**	
Ii	**Objectives of the Experiment**	• To work out the cost and returns of groundnut cultivation. • To analyze the resource use efficiency in groundnut cultivation. • To identify the constraints in cultivation of groundnut.
iii	**Name (s) of the investigators**	• Dr. Neeraj Pawar • Finalization of interview schedule, collection of data, compilation and analysis of data. • Dr. J.S. Papang • Report writing
Iv	**Name (s) of the collaborators with activity profile**	• Nil
V	**Year of start**	• 2021-22

vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• **Locate of the experiment:** Haryana • **Districts covered:** Rewari, Hisar, Fatehabad and Sirsa • **Block & Villages:** Bawal block from Rewari, Adampur from Hisar, Bhatu from Fatehabad and Nathushree Chopta from Sirsa were selected. Further villages namely Subasheri, Jhabua from Bawal, Chuli Bagidyan (Adampur), Mehuwala and Banmandori (Bhatu), Makho Sarani and Nahrana (Nathushree Chopta) were selected. • **Statistical design/methods:** Purposive Multistage sampling,Descriptive statistics, Cobb-Douglas production function technique were used. Constraints were identified on the basis of their rating (Severe, moderate and least) in production of groundnut.
viii	**Observations recorded**	• Forty farmers were interviewed to collect information regarding various input used, output prices • Information related to resources use i.e. seed, irrigation, fertilizer, agro-chemicals, machinery, input, output, prices and constraints.

ix. Results achieved during 2021-22

Fig. 1: Sampling design of the study



Cost and returns of Groundnut cultivation in Haryana

Harvesting was the major components of total variable expenses shared around 14.12 per cent of the total cost in Hisar, 15 per cent in Fatehabad and Sirsa districts and around 16.95 per cent in Rewari district of Haryana (Table 1). The highest component of total expenses incurred in cultivation of groundnut in Haryana were rental value of land with 36.22 per cent of total cost in Hisar, 34.63 per cent in Fatehabad, 35.28 per cent in Sirsa and 29 per cent in Rewari district. The other components with higher percentage share in total cost seed with 10.42, 10.76, 10.67 and 16.84 per cent in Hisar, Fatehabad, Sirsa and Rewari, respectively. The management and risk charges accounted for 10.30, 10.61, 10.49 and 11.50 per cent of total cost Hisar, Fatehabad, Sirsa and Rewari, respectively. Plant protection cost ranges from 6.46 to 7.42 per cent across all the districts, which is then followed by miscellaneous cost and transportation charges. The large share of rental value of land to the total cost shows that the land rent is high in the study area.

The average yield of groundnut cultivation in Hisar district was 21.42 q/ha main product with gross returns of ₹ 1,14,915 and net returns of ₹ 33, 472 per hectare. In Fatehabad the yield is 22.25 q/ha with gross returns of ₹ 1,20,545 and net returns of ₹ 38,975 per hectare. The average yield in Sirsa

and Rewari district is around 23.40 q/ha and 28.25 q/ha with a gross return ₹ 1,26,058 and 1,49,573 and net returns of ₹ 40,318 and ₹ 57,397 per ha, respectively during 2021-22. The value of B: C ratio with ranges of 1.41to 1.62 across districts indicates profitability of groundnut cultivation in the study area. The total cost of groundnut cultivation was estimated to be ₹85232 per hectare overall Haryana with district wise value of ₹ 81443, ₹ 81570, ₹ 85740 and ₹ 92176 per ha in Hisar, Fatehabad, Sirsa and Rewari, respectively.

Marginal value productivity

The efficiency level of individual resource used in Hisar, Fatehabad, Sirsa and Rewari were

Table 1: Cost and returns of groundnut cultivation in Hisar, Fatehabad, Sirsa and Rewari districts of Haryana

Sr. No.	Item	Hisar	Fatehabad	Sirsa	Rewari	Overall
A. Variable cost						
1	Field Preparation and sowing	7578 (9.30)	7453 (9.14)	7660 (8.93)	6810 (7.39)	7375 (8.65)
2	Seed	8490 (10.42)	8775 (10.76)	9150 (10.67)	15518 (16.84)	10608 (12.45)
3	Fertilizer investment	4633 (5.69)	4835 (5.93)	5183 (6.05)	4160 (4.51)	4703 (5.52)
4	Irrigation	2050 (2.52)	2460 (3.02)	2448 (2.86)	3125 (3.39)	2521 (2.96)
5	Plant Protection	5763 (7.08)	6050 (7.42)	6130 (7.15)	5950 (6.46)	5973 (7.01)
6	Harvesting and threshing	11500 (14.12)	12250 (15.02)	12900 (15.05)	15625 (16.95)	13069 (15.33)
7	Int. & Miscellaneous	1418 (1.74)	1464 (1.79)	1521 (1.77)	1792 (1.94)	1549 (1.82)
8	Total Variable cost	41932 (51.49)	43287 (53.07)	44992 (52.47)	52980 (57.48)	45798 (53.73)
B. Fixed cost						
9	Management and risk charges	8386 (10.30)	8658 (10.61)	8998 (10.49)	10596 (11.50)	9160 (10.75)
10	Rental value of land	29500 (36.22)	28250 (34.63)	30250 (35.28)	26750 (29.02)	28688 (33.66)
11	Transportation charge	1625 (1.99)	1375 (1.69)	1500 (1.75)	1850 (2.01)	1588 (1.86)
12	Total fixed cost	39511 (48.51)	38283 (46.93)	40748 (47.53)	39196 (42.52)	39435 (46.27)
C. Total cost (A+B)		81443 (100.00)	81570 (100.00)	85740 (100.00)	92176 (100.00)	85232 (100.00)
D. Returns structure						
13	(a) Main product	109755 (21.42)*	115255 (22.25)*	119808 (23.40)*	144923 (28.25)*	122435 (23.83)*
	(b) By-product	5160	5290	6250	4650	5338
14	Gross return	114915	120545	126058	149573	127773
15	ROVC	72983	77258	81066	96593	81975
16	Net returns	33472	38975	40318	57397	42541
17	B:C (ROVC)	2.74	2.78	2.80	2.82	2.79
18	B:C (TC)	1.41	1.48	1.47	1.62	1.49

*Note: Values in parenthesis indicate percentage of total cost; ROVC = Return over Variable cost, * Values in parenthesis indicate yield in quintal*

determined with the help of Cobb Douglas production function based on the collected data from groundnut cultivation. The resources like fertilizer, human labour and plant protection chemicals were the major contributing exogenous variables in cultivation of groundnut crop. The production function analysis fitted for resource use in the selected districts reveals that the regression co-efficient of human labour, irrigation and plant protection chemicals were positive for all four districts as well as overall Haryana (Table 2). The regression co-efficient of machinery was positive for Hisar, Fatehabad and Rewari districts but it is negative for Sirsa district and overall Haryana. In case of seed cost the regression coefficient was found to be positive only in Hisar district and overall Haryana, whereas it is negative for Fatehabad, Sirsa and Rewari districts. For that of fertilizer the co-efficient was positive for all districts and overall Haryana except for Fatehabad district.

Table 2: Marginal value productivity of resource use in Haryana and selected districts

	Hisar District					
Variables	**GM**	**B**	**MVP**	**MFC**	**MVP/MFC**	**Utilization**
Human labour (Rs./ha)	10.02	1.35	1.57	1.00	1.57	Under utilized
Machine (Rs./ha)	9.50	0.80	0.10	1.00	0.10	Over utilized
Seed cost	9.01	0.65	-0.84	1.00	-0.84	Over utilized
Fertilizer cost	8.46	1.63	2.24	1.00	2.24	Under utilized
Irrigation Cost	7.63	0.62	0.95	1.00	0.95	Near optimum
Plant protection cost	8.66	1.20	1.61	1.00	1.61	Under utilized
R^2	0.9976					
	Fatehabad District					
Variables	**GM**	**B**	**MVP**	**MFC**	**MVP/MFC**	
Human labour (Rs./ha)	10.04	0.96	1.12	1.00	1.12	Under utilized
Machine (Rs./ha)	9.52	0.01	0.01	1.00	0.01	Under utilized
Seed cost	9.00	-0.15	-0.19	1.00	-0.19	Over utilized
Fertilizer cost	8.48	-0.78	-1.07	1.00	1.08	Near optimum
Irrigation Cost	7.78	0.68	1.02	1.00	1.02	Near optimum
Plant protection cost	8.72	0.83	1.11	1.00	1.11	Under utilized
R^2	0.8937					
	Sirsa District					
Variables	**GM**	**B**	**MVP**	**MFC**	**MVP/MFC**	
Human labour (Rs./ha)	10.07	1.06	1.23	1.00	1.23	Under utilized
Machine (Rs./ha)	9.52	-0.48	-0.59	1.00	-0.59	Over utilized
Seed cost	9.01	-0.68	-0.89	1.00	-0.89	Over utilized
Fertilizer cost	8.52	1.71	2.36	1.00	2.36	Under utilized
Irrigation Cost	7.92	0.66	0.98	1.00	0.98	Over utilized
Plant protection cost	8.69	0.86	1.16	1.00	1.16	Under utilized
R^2	0.9923					
	Rewari District					
Variables	**GM**	**B**	**MVP**	**MFC**	**MVP/MFC**	
Human labour (Rs./ha)	10.15	0.53	0.62	1.00	0.62	Over utilized
Machine (Rs./ha)	9.56	1.33	1.65	1.00	1.65	Under utilized
Seed cost	9.47	-0.53	-0.66	1.00	-0.66	Over utilized
Fertilizer cost	8.40	1.06	1.50	1.00	1.50	Under utilized
Irrigation Cost	8.02	0.69	1.02	1.00	1.02	Near optimum
Plant protection cost	8.69	1.21	1.65	1.00	1.65	Under utilized
R^2	0.9907					
	Overall					
Variables	**GM**	**B**	**MVP**	**MFC**	**MVP/MFC**	
Human labour (Rs./ha)	10.08	0.95	1.11	1.00	1.11	Under utilized
Machine (Rs./ha)	9.53	-0.68	-0.84	1.00	-0.84	Over utilized
Seed cost	9.16	0.20	0.25	1.00	0.25	Over utilized
Fertilizer cost	8.45	1.09	1.51	1.00	1.51	Under utilized
Irrigation Cost	7.86	0.69	1.03	1.00	1.03	Near optimum
Plant protection cost	8.69	0.96	1.30	1.00	1.30	Under utilized
R^2	0.9848					

The MVP value of human labour for groundnut crop is greater than unity for Hisar, Fatehabad, Sirsa district and overall Haryana which indicates that all these inputs were underutilized in the respective districts and overall. On the other side, the value MVP were less than unity for human labour in Rewari district which shows that the resource was over utilized and use of human labour needs to be curtailed for higher returns. The MVP value for seed is less than unity in all districts. In case of machinery, the MVP is greater than unity for all districts and overall Haryana except for Rewari district indicating that this particular input has been over utilized in all districts as well as overall Haryana, thus reduction in the use of over utilized inputs (seed, machinery) will help in reduction of expenses incurred. The results also showed that for fertilizer and irrigation cost the input is either underutilized or near optimum use in all selected districts as well as overall Haryana. There is ample scope for exploitation the use of these underutilized resources to maximize the production and to increase the gross returns. It is imperative from the study that use of underutilized resources in the cultivation of groundnut crops resulted into higher yield.

Constraints faced by groundnut growers

The various constraints faced by the growers in production of groundnut in the selected districts of Haryana is shown in Table 3. The results revealed that unavailability of improved seed in local market is the major constraint faced by the farmers which is followed by under-pricing od produce, lack of buyer for sale of produce, then followed by low input use and high incidence of insect pest.

Table 3: Constraints Faced by Farmers in the Production of groundnut in Haryana

(N=40)

Sr. No	Constraints	Total	Percentage	Farmer's Ranking
1	Less availability of improved varieties of seeds in local markets	103	85.83	I
2	Price realization less than M.S.P/ Under-pricing their produce	97	80.83	II
3	Lack of buyer for the sale of produce	95	79.16	III
4	Non-adoption of package of practice/low input used	91	75.83	IV
5	High incidence of insect pest	77	64.17	V

ix. Programme of work for 2022-23: Experiment concluded

Salient findings of the study:

- The gross returns of groundnut cultivation in Hisar, Fatehabad, Sirsa, and Rewari districts as well as overall Haryana is ₹ 1,14,915, ₹ 1,20,545, ₹ 1,26,058, ₹1,49,573, ₹127773 per ha, respectively during 2021-22.
- The net returns of groundnut cultivation in Hisar, Fatehabad, Sirsa, and Rewari districts is of ₹ 33,472, ₹ 38,975, ₹ 40,318 and ₹ 57,397 per ha, respectively. Whereas the overall net return in Haryana was ₹42,541 per ha.
- The value of B: C ratio ranges from 1.41 to 1.62 across districts indicates profitability of groundnut cultivation in the study area.
- The major constraints faced by groundnut growers were unavailability of improved seed in local market (85.83%) is the major constraint faced by the farmers which is followed by under-pricing of produce.

Conclusions

The net returns (₹ 33,472, ₹ 38,975, ₹ 40,318 and ₹ 57,397per ha for groundnut in Hisar, Fatehabad, Sirsa, and Rewari districts and benefit cost ratio (>1) in all districts revealed that groundnut cultivation is a profitable and promising enterprise in selected districts. The regression analysis has brought out that ratio of MVP/MFC is (>1) indicates that there exist sufficient potential in spending on fertilizer and plant protection measures. The constraints faced by farmers were unavailability of quality seeds (85.83%) and less price realisation (80.83%).

I	Experiment No. 10: Assessing the quantity and dynamics intake of fruits in India	
Ii	**Objectives of the Experiment**	• To quantity the monthly consumption of fruits across different income groups in different regions of India including Haryana • To assess the dynamics of nutrient intake from fruits
iii	**Name (s) of the investigators**	• Dr.Janailin S. Papang: Collection, extraction, compilation, processing, analysis of data, report writing • Dr D P Malik: Report writing.
Iv	**Name (s) of the collaborators with activity profile**	• Nil
V	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• Locale of experiment: All India • Data : NSSO data (55th round and 68th round) • Statistical design/methods: Descriptive statistics and OLS regressions was applied.
viii	**Observations recorded**	• From the data, the observations for different states will be extracted separately and the food consumption (quantity) will be converted into nutrient equivalents using the conversion tables. • Then unit value of different food products will be calculated using the consumption data.

ix. Results achieved during 2020-21:

Results achieved during 2020-21:

The consumption pattern of major fruits (banana, apple watermelon, orange/mosami and guava) across different income groups in India for the 68th round (2011-12) is presented in Table 1. In banana, the highest consumption per capita per day (PCPD) is in the southern states with Kerala and Goa in the lead across all income groups in both rural and urban areas. The average consumption PCPD across all income groups in Kerala was 0.23 and 0.30 g/capita/day in rural and urban areas, respectively. The eastern states have the lowest consumption in banana with Jharkhand having the lowest PCPD in rural area (0.02 g/capita/day) and Jharkhand along with Bihar in urban area (0.06 g/capita/day). In Haryana the consumption per capita per day of banana with 0.11 g/capita/day in rural areas is on the average level (all India average = 0.10 g/capita/day), Whereas, in urban Haryana, per capita per day of banana is on the higher side which is around 0.17 g/capita/day as compared to all India average of 0.14 g/capita/day at the overall income group level.

Table 1: Quantity consumed PCPD of fruits across the income groups in different states (2011-12) (in g/capita/day**)**

	States	Rural					Urban				
		LIG	LMIG	UMIG	HIG	Overall	LIG	LMIG	UMIG	HIG	Overall
Banana	KL	0.13	0.21	0.28	0.45	0.23	0.16	0.24	0.34	0.59	0.30
	Goa	0.17	0.18	0.21	0.41	0.22	0.13	0.21	0.26	0.32	0.22
	HR	0.06	0.09	0.15	0.18	0.11	0.09	0.15	0.18	0.31	0.17

	Bihar	0.04	0.07	0.08	0.18	0.07	0.03	0.05	0.08	0.08	0.06
	JH	0.01	0.02	0.03	0.07	0.02	0.02	0.04	0.09	0.10	0.06
Apple	JK	3.70	5.24	6.62	11.174	6.278	3.67	6.67	7.58	15.8	8.43
	HP	1.79	3.96	6.54	6.602	4.199	2.79	6.75	11.51	17.34	8.95
	Goa	1.299	5.906	5.733	13.143	5.663	2.40	4.38	5.82	9.93	5.32
	HR	0.964	2.35	4.571	6.993	3.473	2.20	8.55	12.49	26.51	11.54
	MN	0.079	0.118	0.346	2.12	0.484	0.07	0.45	1.21	2.99	1.07
	MZ	0.001	0.002	0.106	0.002	0.016	0.001	0.09	0.78	1.86	0.64
Watermelon	HR	0.94	3.468	4.261	7.136	3.683	1.98	2.61	5.14	5.07	3.58
	RJ	2.34	3.893	3.449	5.56	3.648	1.91	2.4	3.71	4.42	2.91
	KL	1.629	1.376	3.184	5.836	2.527	0.77	3.32	3.82	7.61	3.46
	GJ	1.11	2.384	4.052	2.818	2.333	1.36	2.97	3.51	6.88	3.44
	AS	0.007	0.018	0.061	0.099	0.034	0.0	0.28	0.47	0.47	0.31
	SK	0.028	0.098	0.231	0.3	0.113	0.0	0.0	0.14	0.0	0.03
Guava	HR	2.062	4.955	6.18	7.147	4.872	0.02	0.034	0.044	0.084	0.043
	Delhi	8.909	12.77	2.381	0.755	5.357	0.023	0.022	0.054	0.075	0.037
	Goa	0	0.233	0.029	0.01	0.069	0.002	0.027	0.04	0.039	0.026
	MN	0.338	0.866	1.434	1.083	0.848	0.002	0.006	0.006	0.013	0.007
Orange*	AR	0.052	0.074	0.068	0.063	0.062	0.01	0.044	0.08	0.154	0.059
	HR	0.009	0.02	0.026	0.039	0.022	0.02	0.034	0.044	0.084	0.043
	JH	0.0	0.001	0.004	0.012	0.003	0.002	0.008	0.019	0.034	0.015
	Orissa	0.0	0.001	0.002	0.005	0.002	0.001	0.011	0.009	0.019	0.01

*Note: LIG = low income group, LMIG = lower middle income group, UMIG = upper middle income group, HIG = high income group, HR = Haryana, JH = Jharkhand, JK = Jammu and Kashmir, MN = Manipur, MZ = Mizoram, RJ = Rajasthan, KL = Kerala, GJ = Gujarat, AS = Asssam, SK = Sikkim, AR= Arunachal Pradesh, * Indicates orange and mosami*

In apples, it is seen that PCPD consumption is highest in Haryana with overall average of 11.54 g/capita/day in urban areas whereas in rural areas the quantity consumed PCPD is highest in Jammu and Kashmir (6.28 g/capita/day). It is also noted that in rural areas of Haryana the consumption of apples PCPD is on the higher side which is 3.47 g/capita/day as compared to all India average of 1.96 g/capita/day. The other states with high consumption of apples PCPD are Himachal Pradesh and Goa (Table 1). The per capita per day consumption of apples is found to be least in the North eastern states like Manipur and Mizoram which is approximately around 1g/capita/day.

Haryana stands at first rank in per capita per day consumption of watermelon with an overall average of 3.68 g/capita/day in rural and 3.58 g/capita/day in urban areas for overall income group level. The all India average PCPD consumption of watermelon is around 1.33 g/capita/day in rural areas and 1.65 g/capita/day in urban areas overall income group. In watermelon, Haryana is then followed by Rajasthan, Kerala and Gujarat in rural areas, whereas it is followed by Kerala and Gujarat in urban areas.

In guava, Haryana have the 2nd highest PCPD consumption which is around 4.87 g/capita/day in rural areas and 0.043 g/capita/day in urban areas at the overall income group level. The other states with highest PCPD consumption is Delhi with 5.36 g/capita/day in rural areas, however Delhi is behind Haryana in case of urban area PCPD consumption of guava. It is observed that PCPD consumption of watermelon and guava is least in the north eastern parts of India with negligible amount. It is also noted that, Goa being one of the leaders in PCPD consumption in most fruits, however in case of guava, the PCPD consumption is among the least in India, especially in rural areas. The all India average PCPD consumption of guava in overall income group is 1.81 and 0.026 g/capita/day in rural and urban areas, respectively.

In case of orange/mosami, the PCPD consumption is highest in Arunachal Pradesh (0.06g) in both rural and urban areas. The PCPD consumption of orange/mosami in Haryana is among the top in India with PCPD consumption of 0.022 g/capita/day in rural areas and 0.043 g/capita/day urban areas as compared to all India level of 0.017 and 0.026 g/capita/day, respectively. In the other hand, the states with almost negligible amount PCPD consumption of orange/mosami was observed in Orisa and Jharkhand.

Table 2: Nutrient intake[1] from fruits PCPD (g/person/day) across income groups in different states (At 2011-12 Prices)

	States	Rural					Urban				
		LIG	**LMIG**	**UMIG**	**HIG**	Overall	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**
Calorie	Goa	187.37	200.66	209.08	215.66	200.81	134.58	188.67	221.52	231.90	191.52
	KL	128.34	171.49	217.81	274.09	181.87	134.90	174.38	206.82	283.87	190.42
	HR	12.35	24.59	37.53	44.41	28.39	19.17	34.99	47.59	83.79	44.01
	JH	3.33	5.03	9.44	21.26	7.68	5.64	17.18	26.04	38.41	20.93
	BR	6.72	13.51	18.01	38.13	15.03	6.89	12.84	23.10	37.92	18.78
Protein	GOA	1.91	2.04	2.19	2.27	2.07	1.37	1.99	2.29	2.43	1.99
	KL	1.34	1.81	2.32	2.97	1.93	1.40	1.84	2.17	3.04	2.00
	HR	0.15	0.29	0.42	0.51	0.33	0.22	0.39	0.53	0.97	0.50
	JH	0.04	0.06	0.10	0.22	0.08	0.05	0.16	0.27	0.38	0.21
	BR	0.08	0.15	0.20	0.42	0.17	0.08	0.14	0.23	0.37	0.19
Fats	GOA	15.33	16.12	16.44	14.01	15.56	11.02	14.80	16.99	16.72	14.75
	KL	10.25	13.00	15.90	18.23	13.46	10.62	12.85	14.35	17.28	13.33
	HR	0.06	0.13	0.19	0.25	0.15	0.10	0.20	0.27	0.50	0.25
	JH	0.02	0.04	0.10	0.25	0.08	0.06	0.22	0.42	0.44	0.27
	UP	0.04	0.07	0.12	0.19	0.09	0.05	0.09	0.14	0.32	0.14
	BR	0.03	0.07	0.12	0.22	0.09	0.03	0.07	0.14	0.24	0.11

Note: HR = Haryana, JH = Jharkhand, UP =Uttar Pradesh, KL = Kerala, BR = Bihar

The per capita per day nutrient intake from all fruits is shown in Table 2 for states with highest intake and lowest intake as well as Haryana. The PCPD nutrient intake is highest in Goa then followed by Kerala in terms of calories, protein as well as fat intake from fruits. Overall, the income group Goa calorie intake is 200.8 and 191.5 cal/capita/day in rural and urban areas respectively. The states with lowest intake of calorie from fruits is in Jharkhand (7.68 cal/capita/day in rural) and Bihar (18.78 cal/capita/day in urban). The calorie intake of Haryana from fruits ranges in the average level with 28.39 and 44 cal/capita/day in rural and urban areas, respectively.

In case of PCPD protein intake, Goa is highest with 2.07 g followed by Kerala (1.93 g) in rural areas. In urban area, both Kerala and Goa are almost at the same level with 2 g/capita/day. The states with lowest protein intake from fruits was found in Jharkhand (0.08g in rural, 0.21g in urban) and Bihar (0.17g in rural and 0.19g in urban). Again, in protein intake Haryana is almost at the national average with PCPD protein intake of about 0.33g in rural and 0.50g/capita/day in urban areas.

In term of PCPD fat intake from fruits, the highest value is again seen in Goa (15.56g in rural, 14.75g in urban), which is then followed by Kerala. The states with lowest PCPD fat intake from fruits was seen in Bihar (0.09g in rural and 0.11g in urban), Uttar Pradesh and Jharkhand. The PCPD fat intake from fruits is also low in Haryana with only an overall average of 0.15 g in rural and o.25g/capita/day in urban areas.

[1]The dietary or nutrient intake conversion is based on NSS Report No.560, Nutritional Intake in India (2011-12)

The results, showed that even though Haryana is among the leading PDPD consumption of fruits like apple, guava and watermelon however these fruits have lesser amount of calories, protein and fats as compared to banana which is reflected in the result as it is seen that states with highest PCPD consumption of banana have higher value in calories, protein and fats intake, thus Haryana even though being a leading consumer of few fruits is not at the top level in case of nutrient intake from fruits.

The percentage share of nutrient intake from fruits as a proportion of total nutrient intake from all food is shown in table 3. The proportionate share value also shows that the state with highest proportionate share of nutrient intake of all three nutrients (calories, protein and fats) is found in Goa and Kerala (Table 3). Similar pattern is followed in case of the states with lowest proportionate share, which shows that again Bihar and Jharkhand are the state with least proportionate intake of nutrient from fruits. Haryana is standing in the medium level range in terms of PCPD proportionate intake of nutrients from fruits.

Table 3: Nutrient intake from fruits as a percentage share of total nutrient intake PCPD across income groups in different states (At 2011-12 Prices)

	States	Rural					Urban				
		LIG	**LMIG**	**UMIG**	**HIG**	Overall	**LIG**	**LMIG**	**UMIG**	**HIG**	**Overall**
Calorie	Goa	9.04	8.47	8.10	8.08	8.43	6.61	7.72	8.13	7.56	7.59
	KL	6.32	7.08	7.84	8.01	7.24	6.57	7.15	7.40	8.41	7.38
	HR	0.55	0.93	1.32	1.28	1.03	0.90	1.37	1.70	2.60	1.66
	JH	0.15	0.20	0.35	0.69	0.30	0.27	0.73	0.98	1.21	0.83
	BR	0.31	0.53	0.65	1.28	0.60	0.33	0.52	0.87	1.30	0.74
Protein	GOA	3.81	3.37	3.10	2.89	3.30	2.55	2.87	3.10	2.79	2.85
	KL	2.51	2.72	2.95	2.99	2.77	2.56	2.70	2.73	3.08	2.77
	HR	0.23	0.37	0.49	0.47	0.40	0.35	0.54	0.66	1.07	0.66
	JH	0.08	0.09	0.14	0.27	0.13	0.10	0.25	0.37	0.41	0.30
	BR	0.13	0.22	0.26	0.50	0.24	0.13	0.20	0.32	0.44	0.27
Fats	GOA	31.07	26.67	23.15	17.54	24.77	21.15	21.12	21.18	18.63	20.52
	KL	24.94	24.14	23.91	21.34	23.56	24.62	22.10	20.29	19.22	21.38
	HR	0.11	0.19	0.23	0.22	0.20	0.19	0.27	0.31	0.44	0.32
	UP	0.11	0.14	0.21	0.25	0.18	0.13	0.18	0.22	0.33	0.23
	BR	0.11	0.17	0.24	0.37	0.21	0.10	0.15	0.27	0.36	0.24

Note: HR = Haryana, JH = Jharkhand, UP =Uttar Pradesh, KL = Kerala, BR = Bihar

- Comparing the results of present experiment with previous year findings (TP 2020-21, Experiment no. 8, page no. 58-70), it is seen that in terms of per day per capita quantity and expenditure as well as nutrient intake the highest value is in the southern states and lowest in the eastern parts of India. However, it is interesting to note that when the PCPD consumption is quantified in terms of grams per day separately for major fruits, it is observed that the particular fruit is consumed highest state which is in the region where its production is high. Such as, banana is consumed highest in southern states whereas apple, watermelon as well as guava in the northern states especially in Haryana. From previous study it was observed that, Haryana is the only state in northern region that has a high MPCE on fruits which is around ₹10-₹15 higher than the MPCE of any other northern states.

x. Programme of work for 2021-22: Experiment concluded.

Salient findings:

- The In Haryana the consumption per capita per day of banana with 0.11 g/capita/day in rural areas is on the average level (all India average = 0.10 g/capita/day), Whereas, in urban Haryana, per capita per day of banana is on the higher side which is around 0.17 g/capita/day as compared to all India average of 0.14 g/capita/day at the overall income group level.

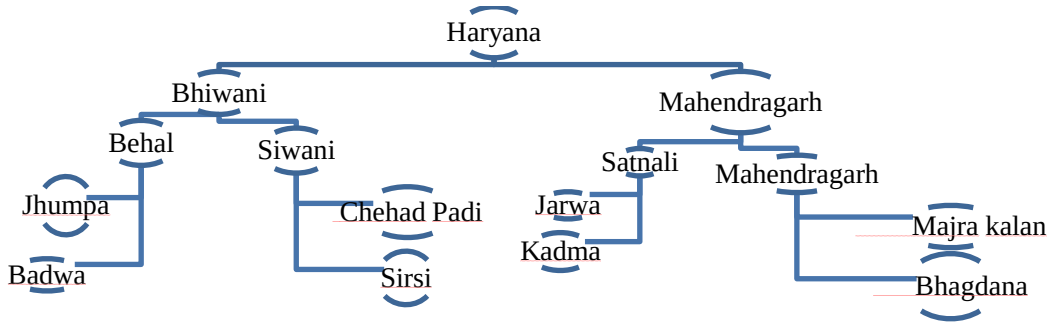
- In urban areas PCPD consumption of apple is highest in Haryana with overall average of 11.54 g/capita/day, whereas in rural areas PCPD consumption is highest in Jammu and Kashmir (6.28 g/capita/day). It is also noted that in rural areas of Haryana the consumption of apples PCPD is on the higher side which is 3.47 g/capita/day as compared to all India average of 1.96 g/capita/day.
- Haryana stands at first rank in per capita per day consumption of watermelon with an overall average of 3.68 g/capita/day in rural and 3.58 g/capita/day in urban areas for overall income group level. Haryana is then followed by Rajasthan, Kerala and Gujarat in rural areas, whereas it is followed by Kerala and Gujarat in urban areas.
- In guava, Haryana is at 2nd rank in terms of PCPD consumption which is around 4.87 g/capita/day in rural areas and 0.043 g/capita/day in urban areas at the overall income group level. The other states with highest PCPD consumption is Delhi with 5.36 g/capita/day in rural areas, however Delhi is behind Haryana in case of urban area..
- In Haryana the PCPD consumption of orange/mosami is among the top in India. The PCPD consumption for orange/mosami, is highest in Arunachal Pradesh (0.06g) in both rural and urban areas. Whereas, the states with minimum or almost negligible amount of PCPD orange/mosami consumption is in Odisha and Jharkhand.
- The calorie intake of Haryana from fruits ranges in the average level with 28.39 and 44 cal/capita/day in rural and urban areas, respectively which is among the medium range in the country. Again, in protein intake Haryana is almost at the national average with PCPD protein intake of about 0.33g in rural and 0.50g/capita/day in urban areas. The PCPD fat intake from fruits is comparatively low in Haryana as compared to other states with only an overall average of 0.15 and 0.25g/capita/day in rural and urban areas, respectively.

Conclusions:

The findings showed the high percentage share of total nutrient intake from fruits in case of Goa and Kerala. On the contrary, in Haryana fruit nutrient intake is very low as compared to Goa and Kerala, since the highest consumption and expenditure on fruits like apple, watermelon and guava is done. However, as per latest data of NHB 2020-21, Haryana stood 5th and 9th rank among all states in production of guava and watermelon, respectively. In case of mosami and other citrus fruits even though Haryana has not been able to stand among the top producers in India, however, looking into the suitability of citrus fruits like mosami and kinnow to Haryana agro-climatic zone, the state thus have ample opportunity to diversify to fruit crops like mosami and kinnow, watermelon and guava.

I	**Experiment No 11: Outreach and adoption determinants of micro irrigation system in Haryana**	
Ii	**Objectives of the experiment**	• To examine the extent of adoption among selected farmers in identified districts • To examine the system wise constraints in adoption of micro-irrigation technologies.
Iii	**Name(s) of the investigators**	• Dr. Sanjay Planning, preparation of schedule, collection, and compilation of data • Dr. Janailin S. Papang Monitoring, analysis and report writing
Iv	**Name(s) of the collaborator**	• Nil
V	**Year of start**	• 2021-22
Vi	**Duration**	• 1 year
vii	**Treatment details**	• **Locale of the experiment:** Bhiwani and Mahendergarh • **Sample:** Two blocks each from Bhiwani and Mahendergarh district were selected. Further, two villages from each of the selected block were chosen randomly. • **Number and type of respondents:** 60 adopter farmers and 60 non adopter farmers • **Statistical design/methods:** Descriptive statistics, etc.
viii	**Observations recorded**	• Data related to spread of micro irrigation among sampled farmers • Constraints faced in adoption

Figure 1:Sampling design of the study



Note: Siwani and Satnali were OE blocks whereas Behal and Mahendergarh were non-OE blocks; Adopter farmers were selected from OE blocks and non-adopters from non-OE blocks

ix Results achieved during 2020-21 and 2021-22

Status of micro irrigation in Haryana

The states with the highest area under micro irrigation as a proportion of gross irrigated area are Andhra Pradesh, Maharashtra and Karnataka(Table 1). Haryana ranked 9th position with 10.40 per cent of gross irrigated area under micro-irrigation. However, Andhra Pradesh, Karnataka and Gujarat were the top three states when seen according to share of micro irrigation in gross cultivated area and Haryana ranked fourth in this list.

Table 1: State-wise proportion of area under micro-irrigation in India (2018-19) (in per cent)

S. No.	States	Share of MI in GIA	Share of MI in GCA
1.	Andhra Pradesh	38.7	20.6
2.	Maharashtra	33.9	6.9
3.	Karnataka	31.3	10.5
4.	Gujrat	21.6	10
5.	Rajasthan	18.6	7.6
6.	Chhattisgarh	17.0	5.2
7.	Tamil Nadu	15.2	8.4
8.	Jharkhand	13.6	2.1
9.	**Haryana**	**10.4**	**9.1**
10.	Orissa	7.5	2.2
11.	Telangana	7.0	4.2
12.	Kerala	6.7	1.2
13.	Madhya Pradesh	5.3	2.2
14.	Himachal Pradesh	4.6	1.0
15.	Punjab	0.6	0.6
16.	Uttar Pradesh	0.5	0.4
17.	Others	5.6	2.8

Note: GIA: Gross irrigated area; GCA: Gross cropped area

Table 2: District-wise proportion of area under micro-irrigation in Haryana (2019-20)(in acre)

S. No.	District	Cultivated area	Area under MI	Percentage
1.	Mahendragarh	373280	193259	51.77
2.	Rewari	284580	66495	23.37
3.	Bhiwani	1015954	229397	21.16
4.	Gurugram	133750	8550	6.39
5.	Jhajjar	290500	15991	5.5
6.	Mewat	276638	15030	5.43
7.	Yamuna nagar	299610	3416	1.14
8.	Hisar	756303	6216	0.82
9.	Rohtak	337022	1274	0.38
10.	Karnal	522190	1224	0.23
11.	Sirsa	1082702	2399	0.22
12.	Panchkula	48062	99	0.21
13.	Panipat	325662	619	0.19
14.	Fatehabad	544305	929	0.17
15.	Sonipat	441205	551	0.12
16.	Faridabad	100000	93	0.09
17.	Jind	606058	546	0.09
18.	Ambala	294848	125	0.04
19.	Palwal	265762	89	0.03
20.	Kurukshetra	300972	74	0.02
21.	Kaithal	656248	79	0.01
	Total	**89,55,651**	**5,46,455**	**6.1**

The districts with highest area up to 2019 under micro irrigation (Table 2) are Bhiwani (229397 Acres), Mahendergarh (193259 Acre) and Rewari (66495 Lakh Acres). The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by Rewari (23.37 %) and Bhiwani (21.16 %). In addition to these three districts, Gurugram, Jhajhar and Mewat

had a significant area under micro irrigation. Rest of the districts of the state had less than 1.15% of their cultivated area under micro irrigation. In total, Haryana had 5.46 lakh acres of area under micro-irrigation i.e. 6.1 per cent of cultivated area.

The area under drip irrigation during the period (2006-19) has grown by a CAGR of 11.20 per cent while, the area under sprinkler irrigation has grown by a CAGR of 15.5 per cent (Table 3). The composite growth rate of micro-irrigation in the state stood at 14.40 per cent. As per the latest figures (2018-19), the share of sprinkler irrigation in the state was 78.42 per cent whereas that of drip irrigation system is 21.58 per cent.

Table 3: Physical progress of micro-irrigation in Haryana (2006-07 to 2018-19) (in ha)

Year	Drip	% of Total	Sprinkler	% of Total	Total
2006-07	812	30.34	1864	69.66	2676
2007-08	1041	13.39	6735	86.61	7776
2008-09	2139	9.59	20170	90.41	22309
2009-10	2468	75.75	790	24.25	3258
2010-11	3900	42.60	5254	57.40	9154
2011-12	2751	31.58	5961	68.42	8712
2012-13	2645	40.33	3914	59.67	6559
2013-14	2504	39.35	3860	60.65	6364
2014-15	1550	45.59	1850	54.41	3400
2015-16	1756	56.35	1360	43.65	3116
2016-17	1158	20.03	4624	79.97	5782
2017-18	2105	20.20	8315	79.80	10420
2018-19	2903	21.58	10549	78.42	13452
CAGR (%)	11.20		15.53		14.40
Total	**27732**	**26.93**	**75246**	**73.07**	**102978**

The financial progress of micro-irrigation in Haryana in terms of allocated budget, expenditure and utilization for the period is presented in Table 4. During the period2006-19, the available budget and expenditure increased by a CAGR of 24.23 per cent and 27.28 per cent, respectively (Table 4). Utilisation of the budget provided fluctuated from as low as 25.34 per cent in 2016-19 to as high as 99.4 per cent in 2011-12. Cumulatively, out of the total budget of 540.63 crores, 364.55 crores was spent that i.e. 67.43 per cent.

The highest growth in terms of number of beneficiaries/area covered/ finances was seen in the districts of Rewari, Nuh, Sirsa Bhiwani and Mahendergarh during the period 2012-19 (Table 5). There were eight districts where the CAGR of number of beneficiaries and area covered was found negative and 13 districts with negative CAGR for the growth in finances. In total, the number of beneficiaries in Haryana state grew by 18.94 per cent, area covered increased by 7.79 per cent and the finances increased by a CAGR of 12.72 per cent.

Table 4: Financial Progress of micro-irrigation in Haryana (2006-07 to 2018-19) (Rs. in Cr)

Year	Available budget	Expenditure	Utilization (%)
2006-07	5.83	2.35	40.31
2007-08	11.24	6.45	57.38
2008-09	21.13	18.91	89.49
2009-10	9.42	8.51	90.34
2010-11	26.24	25.94	98.86
2011-12	40.65	40.34	99.24

2012-13	66.48	62.60	94.16
2013-14	67.84	61.89	91.23
2014-15	30.51	30.29	99.28
2015-16	44.16	20.00	45.29
2016-17	82.21	20.83	25.34
2017-18	56.08	23.87	42.56
2018-19	78.78	42.52	53.97
CAGR (%)	24.23	27.28	2.46
Total	**540.63**	**364.55**	**67.43**

Table 5: CAGR of micro-irrigation spread in Haryana (2012-2019) (in per cent)

District	Beneficiaries	District	Area	District	Financial
Rewari	75.08	Rewari	85.72	Rewari	71.96
Nuh	44.11	Bhiwani	43.93	Bhiwani	40.61
Sirsa	38.71	Sirsa	37.08	Sirsa	31.83
Bhiwani	34.22	Nuh	35.65	Nuh	31.62
Mahendragarh	24.84	Mahendragarh	24.64	Mahendragarh	20.70
Yamunanagar	9.57	Yamunanagar	16.52	Yamunanagar	10.16
Hisar	9.00	Hisar	13.95	Hisar	7.70
Faridabad	8.32	Rohtak	7.89	Fatehabad	0.22
Panchkula	4.92	Kaithal	7.86	Jhajjar	-2.28
Palwal	4.20	Faridabad	7.40	Gurugram	-3.68
Ambala	3.66	Fatehabad	7.24	Jind	-10.70
Rohtak	3.24	Ambala	6.21	Rohtak	-10.75
Fatehabad	2.74	Jhajjar	1.96	Ambala	-12.71
Gurugram	-0.93	Palwal	-1.14	Kaithal	-14.81
Kaithal	-5.63	Gurugram	-1.24	Panchkula	-16.23
Jhajjar	-5.91	Panchkula	-3.21	Palwal	-16.30
Kurukshetra	-11.56	Jind	-3.27	Faridabad	-20.27
Jind	-15.91	Kurukshetra	-18.57	Kurukshetra	-24.16
Karnal	-18.56	Karnal	-20.81	Karnal	-27.49
Sonepat	-19.12	Sonepat	-25.18	Panipat	-34.21
Panipat	-23.46	Panipat	-28.80	Sonepat	-34.26
Total	**18.94**	**Total**	**7.79**	**Total**	**12.72**

Factors affecting adoption

The results of the logistic regression analysis of factors affecting adoption decision of farmers regarding the micro irrigation technologies are presented in the table 6. The variables such as years of schooling of household head, family type and dependency ratio were found to be negatively related with the adoption decision of the farmer. However, all three of these variables were found to be insignificant. The variable of land holding was found to be positively related but was insignificant.

The effect of the variable, HP of pump was found positive and significant at 1% level. Moreover, years of schooling household head, off farm income and Share of fruits and vegetables in the total cultivated were found to be related positively with the probability of adoption and were significant at 5% level. The variable showing the effect of any type of agriculture related "training" availed by the farmer was also found to be positive and significant at 10 % level.

Table 6: Factors affecting adoption of micro-irrigation technologies in Haryana

S. No.	Variables	Description	Coefficient	Marginal effect
1.	Constant		-6.370*	–0.998
2.	Age of HH[#]	Years	-0.0027	–0.000
3.	Years of schooling of HH		1.0447**	0.163
4.	Family type	(1: Nuclear, 0: Joint)	- 0.0006	0.000
5.	Dependency ratio[$]		- 0.0022	–0.001
6.	Off farm Income	Yes= 1, No = 0	0.5569**	0.087
7.	Landholding	Acres	3.1345	0.491
8.	HP of pump		0.5342***	0.084
9.	Training	Yes= 1, No = 0	0.0545*	–0.008
10.	Share of F&V[##]	Area under F&V/ Total	0.0032**	0.001
	R^2		83.9	

*[#] Household head; * Total members in the family/Earning members; [$] Total members below 14 and above 65/Total members; [##]Area under F& V/Total cultivated area*

Coverage of micro-irrigation system among selected farmers

Among the sampled farmers of Behal and Siwani blocks of district Bhiwani more less equal coverage of the area was seen under micro irrigation i.e. (85.75 % and 88.6 %, respectively) (Table 7). However, the proportion of area under drip irrigation in Behal block was more than that of sprinkler irrigation among the sample farmers (58.78 % and 26.97 %, respectively). Whereas, in Siwani block this difference was very small (47.03 % and 41.57 %, respectively). In the case of Mahendergarh district, the proportional area covered under micro irrigation in Satnali block was higher than the Mahendergarh block among the sampled farmers (95.73 % and 81.44 %, respectively). There was a clear difference in the sense there was higher proportion of area under sprinkler irrigation (i.e. 74.70 % and 52.58 %) in both the blocks in Mahendergarh district as compared to drip irrigation system. Out of the total sampled area, 88 per cent was covered under micro irrigation of which 47.38 per cent was under sprinkler irrigation and 40.61 per cent was under drip irrigation system.

Table 7: Coverage of micro-irrigation system among selected farmers in Haryana

S. No.	District	Block	Area owned	Drip Irrigation	Sprinkler irrigation	Micro irrigation
1.	**Bhiwani**	Behal	39.3	23.1	10.6	33.7
			(100)	(58.78)	(26.97)	(85.75)
		Siwani	42.1	19.8	17.5	37.3
			(100)	(47.03)	(41.57)	(88.6)
		Sub Total	81.4	42.9	28.1	71
			(100)	(52.7)	(34.52)	(87.22)
2.	**Mahendragarh**	Satnali	32.8	6.9	24.5	31.4
			(100)	(21.04)	(74.7)	(95.73)
		Mahendragarh	29.1	8.4	15.3	23.7
			(100)	(28.87)	(52.58)	(81.44)
		Sub Total	61.9	15.3	39.8	55.1
			(100)	(24.72)	(64.3)	(89.01)
		Total	143.3	58.2	67.9	126.1
			(100)	(40.61)	(47.38)	(88)

Constraints faced by adopters

The major constraints faced by farmers adopting sprinkler irrigation (Table 9) were high dependence on erratic electricity, lack of operational and maintenance training, poor quality of product, suppliers

not honoring product warranty and lack of technical and maintenance support from the installing company. Moreover, the solution for sand filtration (hydro cyclical filter) was also expensive, delay in opening of application portal every year caused unwanted problems and increasing depth of water table posed threat to the farming system as a whole.

Table 9: Constraints faced by adopter farmers in sprinkler irrigation system in Haryana

S. No.	Particulars	Rank	Remarks
1.	High dependence on erratic electricity	1	
2.	Lack of operational and maintenance training	2	System & Crop related
3.	Poor quality of product	3	Few trustworthy brands
4.	Not honoring warranty	4	7 years product warranty
5.	Lack of technical support from supplier	5	
6.	Sand filtration system is expensive	6	Hydro cyclical filter
7.	Portal opening delayed	7	3-6 months
8.	Depth of water table	8	400-450 ft.

The key constraints faced by farmers adopting drip irrigation are presented in table 10. These were lack of operational and maintenance training, erratic electricity, heavy initial investment, poor quality of product and lack of technical support from supplier. Moreover, expensive sand filtration solutions, delayed portal opening, increasing depth of water table and blockage in drippers were also next major constraints that posed problem for adopter farmers.

Table 10: Constraints faced by adopter farmers in drip irrigation system in Haryana

S. No.	Particulars	Rank	Remarks
1.	Lack of operational and maintenance training	1	System & crop related
2.	Erratic electricity	2	2-5 hours
3.	Heavy initial investment	3	
4.	Poor quality of product	4	Few trustworthy brands
5.	Lack of technical support from supplier	5	
6.	Sand filtration is expensive	6	Hydro cyclical filter
7.	Portal opening delayed	7	3-6 months
8.	Depth of water Table	8	400-450 ft.
9.	Blockage in drippers	9	Groundwater use

Constraints faced by non-adopters

The top five constraints faced by these farmers were requirement of a large amount of money to be invested initially (98.33), unavailability of demonstration of micro irrigation technology (97.33), small land holding of farmers (90.00), most of the farmers being in either institutional or non-institutional debt (77.33) and problem relating documentation (67.33) (Table 11). Also, irregular supply of electricity (53.33) prevented farmers from adopting micro-irrigation technologies as otherwise they need to spend more capital on solar irrigation systems.

Table 11: Constraints faced by non-adopter farmers in Haryana

S. No.	Particulars	Mean % score	Rank
1	Heavy initial investment	98.33	1
2	Demonstration unavailable	97.33	2
3	Small landholding	90.00	3
4	Already in debt	77.33	4
5	Documentation problems	67.33	5
6	Irregular electricity supply	66.33	6

x. Programme of work for 2021-22: Experiment concluded

Salient findings of study:

- Haryana ranks 9th among all states in micro-irrigation coverage with 10.4 per cent of gross irrigated area under micro-irrigation and 4th when observed according to area under micro-irrigation (9.1 %) as a proportion of gross cultivated area under micro-irrigation.
- The districts with highest area under micro-irrigation were Bhiwani (229397 acres), Mahendergarh (193259 acre) and Rewari (66495 acres). The proportion of cultivated area under micro irrigation was highest in case of Mahendergarh (51.77 %) followed by Rewari (23.37 %) and Bhiwani (21.16 %). In total, Haryana had 546455 acres of area under micro-irrigation i.e. 6.1 per cent of cultivated area.
- During 2012-19, the area under drip and sprinkler irrigation has grown by a CAGR of 11.20 per cent and 15.5 per cent, respectively. Currently, the share of drip and sprinkler irrigation in the state is 21.58 per cent and 78.42 per cent, respectively.
- During 2012-19, the available budget and expenditure has grown by a CAGR of 24.23 per cent and 27.28 per cent, respectively. Cumulatively, out of the total budget of 540.63 crores 364.55 crores was utilized i.e. 67.43 per cent.
- The highest growth in terms of number of beneficiaries/area covered/ finances was seen in the districts of Rewari, Nuh, Sirsa Bhiwani and Mahendergarh. In total, the number of beneficiaries, area covered and finances grew by 18.94 per cent, 7.79 per cent and 12.72 per cent, respectively.
- Years of schooling of household head, family type and dependency ratio were found to be negatively related with the adoption decision but were insignificant. The variable of land holding was found to be positively related but was insignificant.
- Effect of HP of pump was found positive and significant ($p<0.01$). Years of schooling household head, off farm income and Share of fruits and vegetables in the total cultivated were found to be related positively and significantly ($p<0.05$). The variable of agricultural "Training" availed by the farmer affected adoption decision positively and significantly ($p<0.10$).
- The major constraints faced by farmers adopting sprinkler irrigation were high dependence on erratic electricity, lack of operational and maintenance training, poor quality of product, suppliers not honoring product warranty and lack of technical and maintenance support from the installing company.
- The key constraints faced by farmers adopting drip irrigation are presented were lack of operational and maintenance training, erratic electricity, heavy initial investment, poor quality of product and lack of technical support from supplier.The top five constraints faced by these farmers were requirement of a large amount of money to be invested initially, unavailability of demonstration of micro irrigation technology, small land holding of farmers, most of the farmers being in either institutional or non-institutional debt and problem relating documentation.

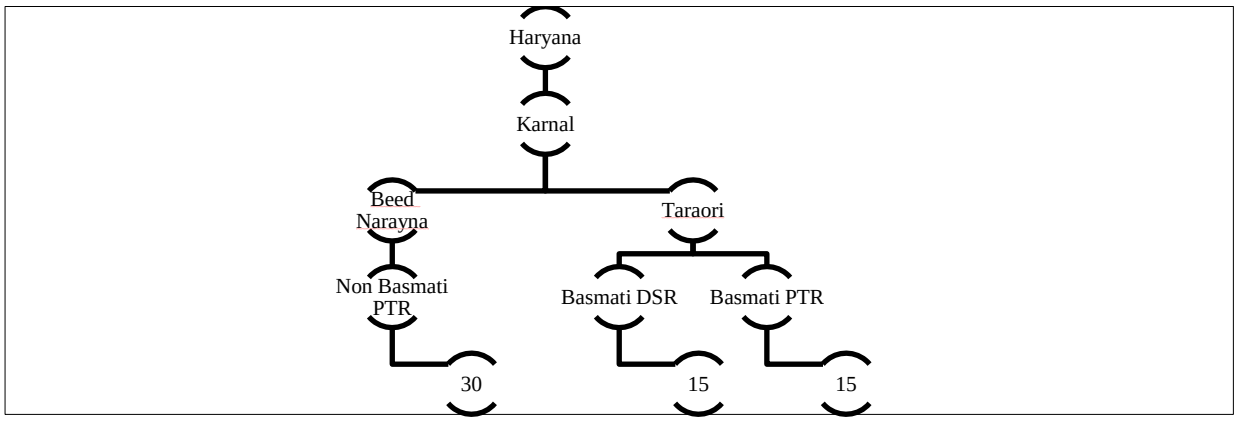
Conclusion

Bhiwani (229397 acres), Mahendergarh (193259 acre) and Rewari (66495 Lakh acres) districts has highest area under micro-irrigation in Haryana. The gap between budgets allocated and utilised needs to be narrowed as only two thirds of allocated budget utilized during the study period. Positive and highly significant effect of years of schooling of household head, share of fruits and vegetables and significant effect of training suggest that household heads may be involved in agricultural trainings promoting micro irrigation and diversification to fruits and vegetables, because decision making regarding making changes lies in their hands. Reducing the weight of heavy initial investment by way of back ended subsidy, provisions for mandatory operational and maintenance training, providing subsidy on additional hydro cyclical filter can help a long way. Also, ensuring uninterrupted electricity supply to the farms will help accelerate its adoption.

I	Experiment No. 12:Carbon footprint assessment of basmati and non-basmati rice cultivation in Haryana	
Ii	**Objectives of the experiment**	• To calculate carbon footprint of basmati rice cultivation • To work out carbon footprint of non –basmati rice cultivation
Iii	**Name(s) of the investigators**	• Dr. Sanjay Planning, preparation of schedule, collection, and compilation of data • Dr. Dalip Kumar Bishnoi Data collection
Iv	**Name(s) of the collaborator(s) with activity profile**	• NIL
V	**Year of start**	• 2021-22
Vi	**Duration**	• One year
Vii	**Treatment details**	• **Locale of the experiment:** Karnal • **Sampling design:** Purposive Multistage sampling • **Number of respondents:**60 i.e. • 15 farmers for Basmati paddy adopting "DSR" • 15 farmers for Basmati paddy adopting "Transplanting" • 15 farmers for Non-basmati paddy adopting "DSR" • 15 farmers for Non-basmati paddy adopting "Transplanting" • **Statistical design/methods:** Descriptive statistics and suitable techniques for carbon footprint calculation
viii	**Observations recorded**	• Quantity of seed/ diesel/ electricity/ agrochemicals used, power of motor, stubble management practices etc.

Results achieved during 2021-22:

Sampling design of the study



Note: PTR: Puddled-transplanted rice; DSR: Direct seeded rice

Carbon footprint of basmati and non-basmati paddy (PTR) in Karnal

In the case of basmati paddy, the top three varieties cultivated were PB 1121, PB 1509 and CSR 30. Whereas, in case of non-basmati paddy the major varieties cultivated were CR 114 and CR 126. The carbon emissions from different sources or different inputs used in the cultivation of respective varieties are presented in table 1. The highest carbon footprint per ha was observed in PB 1509 variety

which was 20584.9 Kg Co2/ha. The carbon emissions from PB 1121 were slightly higher than CSR i.e. 5548.8 Kg Co2/ha and 5240.7 Kg Co2/ha, respectively. The reason for way higher carbon emissions from PB 1509 variety was due to the fact that the residue of this variety was subjected to field burning whereas that of CSR 30 and PB 1121 was used for fodder. Also, the emissions from nitrogen were highest in case of 1509 (1317.1 Kg) followed by PB 1121(1231.9 Kg) and least in case of CSR 30 (741.9 Kg).

In case of non-basmati paddy, the carbon emissions were 23176.9 Kg Co2/ha of which the major contributor was residue burning (17660.3 Kg). However, the emissions from nitrogen in case of non-basmati paddy were lower than PB 1121 and PB1509. The carbon emissions per quintal depicted that the highest emissions were from 1509 (351.9 Kg) followed by non-basmati paddy CR 114 and CR 126 (289.7 Kg) and least in case of PB 1121 (126.1 Kg) and CSR 30 (119.8 Kg).

Table 1: Carbon footprint of Basmati paddy and Non-basmati paddy (PTR) in Karnal

S. No.	Source of emission /Variety	Basmati		Non-Basmati	
		PB- 1121	1509	CSR 30	CR 114/126
1.	N	1231.9	1317.1	741.9	809.2
2.	P	388.7	388.7	388.7	233.2
3.	K	14.0	11.6	1.4	23.3
4.	Zn	12.4	9.9	9.9	15.8
5.	Sulphur	1.6	1.2	2.0	0.0
6.	Iron	5.5	4.0	6.7	0.0
7.	Weedicide	11.1	12.9	8.8	14.9
8.	Insecticide	626.2	647.5	583.7	402.8
9.	Fungicide	26.5	28.6	25.5	23.0
10.	Diesel	283.3	214.5	286.0	283.3
11.	Electricity	220.4	167.2	211.7	220.4
12.	Residue burnt	0.0	14824.8	0.0	17660.3
13.	Ch_4 emissions	2703.7	2927.7	2951.2	3470.0
14.	Seed	5.9	5.7	5.8	2.4
	Yield ($q\ ha^{-1}$)	**17.6**	**23.4**	**17.5**	18.5
	CE ha^{-1}	**5548.8**	**20584.9**	**5240.7**	**23176.9**
	CE q^{-1}	**126.1**	**351.9**	**119.8**	**289.7**

Note: Carbon emission in Kg Co2/ha; PTR: Puddled transplanted rice.

Carbon footprint of DSR and PTR basmati paddy in Karnal

The comparison of carbon emissions from basmati paddy in case of DSR technology and PTR technology in Karnal district is presented in table 2. The emissions from nitrogen used were found higher in case of DSR paddy (1808.9 Kg) as compared to PTR paddy (1097 Kg) which indicated the higher use of nitrogenous fertilizer in DSR paddy. Moreover, the emissions from weedicide used were four times higher in case of DSR paddy (42.3 Kg) than PTR paddy (10.9 Kg). However, the carbon emissions per ha were more or less similar in the case of both the technologies i.e. 10039.4 Kg Co2/ha for DSR and 10527.3 Kg Co2/ha in PTR. Owing to the lesser yield obtained in case of DSR paddy by sampled farmers, the per quintal carbon emissions were higher in DSR (235.1 Kg) as compared to PTR (215.9 Kg).

Table 2: Carbon footprint of DSR and PTR basmati paddy in Karnal

S. No.	Source of emission/Variety	Basmati (DSR) (1121/1509)	Basmati (PTR) (1121/CSR30/1509)
1.	N	1808.9	1097.0
2.	P	194.4	388.7
3.	K	25.1	9.0

4.	Zn	18.6	10.7
5.	Sulphur	1.6	1.6
6.	Iron	4.0	5.4
7.	Weedicide	42.3	10.9
8.	Insecticide	558.6	619.1
9.	Fungicide	24.5	26.9
10.	Diesel	230.5	261.3
11.	Electricity	179.7	199.7
12.	Residue burnt	4167.3	4941.6
13.	Ch_4 emissions	2760.8	2929.0
14.	Seed	3.8	5.8
	Yield (q ha^{-1})	**19.5**	**20.5**
	CE ha^{-1}	**10039.4**	**10527.3**
	CE q^{-1}	**235.1**	**215.9**

Note: Carbon emission in Kg Co2/ha

Carbon footprint of Basmati paddy (PTR) in Sirsa

The results of carbon emissions from cultivation of basmati paddy (PTR) in Sirsa district of Haryana are presented in table 3. The major basmati rice varieties cultivated in Sirsa district were PB 6, 1401, 1692, 1509, PB 1121 and 1718. The carbon emissions per hectare was highest in case of 1692/ 1509 (11484.3 Kg) followed by 1718 (11028.5 Kg). Moreover, the carbon emissions were 10609.9 Kg Co2/ha in case of PB 6/1401 and least in case of PB 1121 i.e. 10387 Kg Co2/ha.

However, the highest carbon emissions per quintal was seen in 1718 followed by 1692/1509, PB 1121 and PB 6/1401 (208.1 Kg, 197.8 Kg, 193 Kg and 166.8 Kg, respectively). Among all the basmati varieties the highest emissions due to nitrogenous fertilizers was seen in PB 6/1401 and 1692/ 1509 (1148.6 Kg and 1083.6 Kg). The major portion of total carbon emissions per hectare came from residue burning which was highest in case of PB 6/1401. The second largest contributor to the total carbon emissions was methane emissions due to submergence.

Table 3: Carbon footprint of Basmati paddy (PTR) in Sirsa district of Haryana

S. No.	Source of emission /Variety	PB 6/1401	1692/1509	1121	1718
1.	N	1148.6	1083.6	848.7	858.0
2.	P	194.4	202.1	291.4	294.8
3.	K	14.1	14.1	11.6	11.6
4.	Zn	12.4	12.5	10.5	9.6
5.	Sulphur	0.9	0.9	1.6	1.9
6.	Iron	4.6	3.6	3.2	2.5
7.	Weedicide	20.7	20.7	20.7	20.7
8.	Insecticide	126.9	125.4	122.4	137.6
9.	Fungicide	45.9	52.0	50.0	54.1
10.	Diesel	280.5	220.0	294.3	297.0
11.	Electricity	233.3	196.8	214.1	214.8
12.	Residue burnt	6019.5	5428.2	3547.8	4477.0
13.	Ch_4 emissions	2477.5	4094.9	4943.8	4622.0
14.	Seed	5.5	5.7	5.9	5.8
	Yield (q ha^{-1})	**25.5**	**23.8**	**21.0**	**21.2**
	CE ha^{-1}	**10609.9**	**11484.3**	**10387.0**	**11028.5**
	CE q^{-1}	**166.8**	**193.0**	**197.8**	**208.1**

Note: Carbon emission in Kg Co2/ha

Carbon footprint by category of emissions in Haryana

The results of carbon footprint by category of emissions in Haryana for all the varieties and different technologies of cultivation are presented in table 4. There are four different categories of emissions first is carbon emissions i.e. due to amendments (CFA), nitrous oxide emissions (CF N_2O), methane emissions (CF CH_4) and emissions due to burning or residue (CFB). The highest emissions due to amendments (3091.8 Kg) were seen in case of basmati (DSR) paddy which was primarily due to higher use of urea by the sampled farmers. However, the highest proportional emissions due to amendments were seen in PB 1121 and CSR 30 in Karnal district of Haryana i.e. 39.58 per cent and 37.41 per cent. This was due to the fact that there was no burning of residue observed in this area in these varieties.

Table 4: Carbon footprint by category of emissions in Haryana

District	**Sirsa**				**Karnal**			**Karnal**		
Source of emission/ Variety	**Basmati**				**Basmati**			**Non basmati (PTR)**	**Basmati (DSR)**	**Basmati (PTR)**
	PB 6/1401	**1692/1509**	**PB 1121**	**1718**	**1121**	**1509**	**CSR 30**	**CR 114/126**	**PB-1121/1509**	**PB-1121/1509**
CFA	2087.5	1937.4	1874.3	1908.3	2827.5	2808.9	2272	2028.1	3091.8	2636.1
	(15.59)	(13.9)	(15.13)	(14.95)	(39.58)	(12.6)	(37.41)	(8.4)	(24.66)	(21.58)
CF N_2O	2803.3	2480	2024.4	1758.9	1613.5	1734.4	850.2	993.6	2516.3	1707.6
	(20.94)	(17.79)	(16.34)	(13.78)	(22.58)	(7.78)	(14)	(4.11)	(20.07)	(13.98)
CF Ch_4	2477.5	4094.9	4943.8	4622	2703.7	2927.7	2951.2	3470	2760.8	2929
	(18.51)	(29.37)	(39.9)	(36.21)	(37.84)	(13.13)	(48.59)	(14.37)	(22.02)	(23.98)
CF B	6019.5	5428.2	3547.8	4477	0	14824.8	0	17660.3	4167.3	4941.6
	(44.96)	(38.94)	(28.63)	(35.07)	(0)	(66.49)	(0)	(73.12)	(33.24)	(40.46)
Total	**13387.8**	**13940.5**	**12390.4**	**12766.2**	**7144.7**	**22295.8**	**6073.4**	**24151.9**	**12536.2**	**12214.4**
	(100)	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**	**(100)**

Note: Values are in Kg CO_2 /Ha

Carbon emissions due to submergence (CF CH_4) were highest in case of basmati paddy in Sirsa district of Haryana i.e. 1692/1509 variety. The emissions due to burning of residue was highest in case of non-basmati (PTR) rice in Karnal district of Haryana followed by basmati 1509 variety in Karnal district. In the Sirsa district, the share of burning to the total carbon emissions was ranging from 28.63 per cent in case of PB 1121 to as high as 44.96 per cent in case of PB 6/1401variety.

The total emissions were seen highest in case of non-basmati (PTR) rice (24151.9 Kg Co2/ha) in Karnal district. The lowest emissions were seen in PB 1121 and CSR 30 in Karnal district (7144.7 Kg Co2/ha and 6073.4 Kg Co2/ha). Among the varieties cultivated in Sirsa district of Haryana the highest emissions were seen in 1692/1509 followed by PB 6/1401, 1718, PB 1121 (13940.5 Kg Co2/ha, 13387.8 Kg Co2/ha, 12766.2 Kg Co2/ha, 12390.4Kg Co2/ha, respectively).

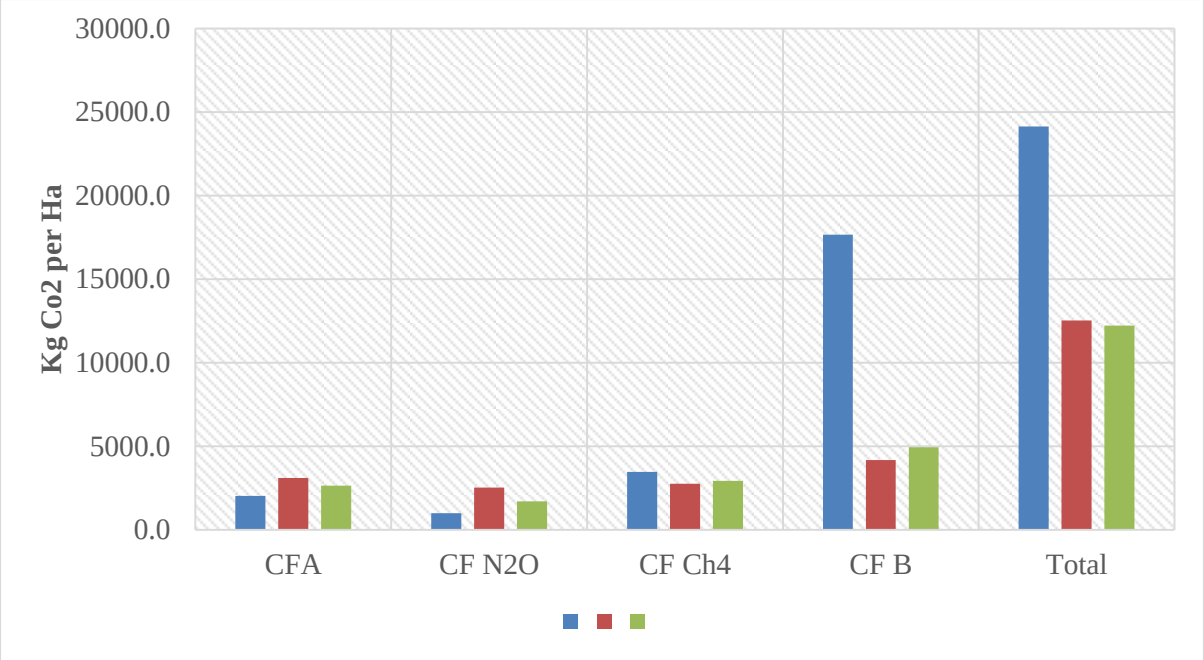


Figure 1: Carbon footprint of Paddy in Karnal district of Haryana (Kg Co2/ha)

x. Programme of work for 2021-22: Experiment Concluded

Salient findings of the study:

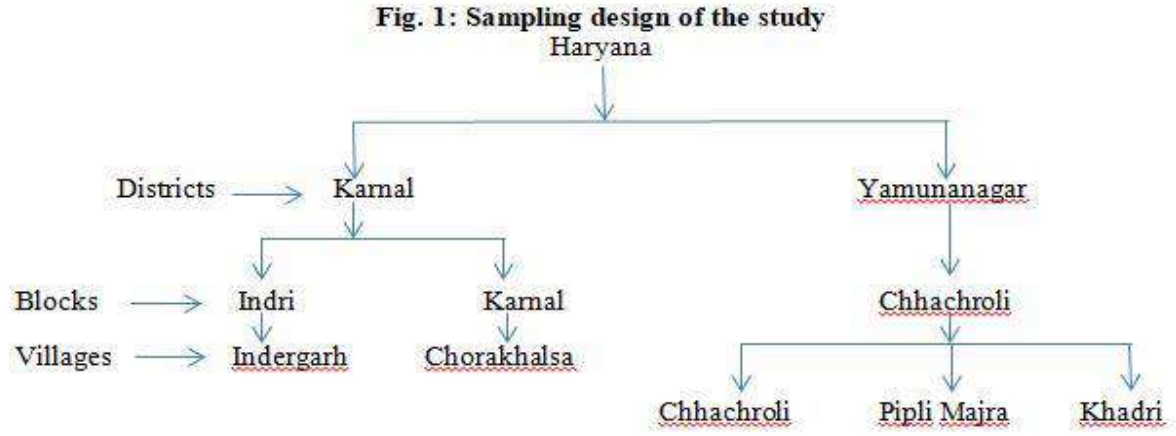
- In Karnal district, the highest carbon footprint among basmati paddy varieties per hectare was observed in 1509 variety which was 20584.9 Kg followed by PB 1121(5548.8 Kg) and least was seen in CSR 30 i.e. (5240.7 Kg), respectively.
- In case of non-basmati paddy in Karnal district, the carbon emissions were 23176.9 Kg Co2/ha of which the major contributor was residue burning (17660.3 Kg).
- The emissions from nitrogen used were found higher in case of DSR basmati paddy (1808.9 Kg) as compared to PTR basmati paddy (1097 Kg) which indicates the higher ongoing use of nitrogenous fertilizer in DSR paddy.
- The carbon emissions per hectare were more or less similar in the case of both the technologies used in basmati paddy i.e. 10039.4 Kg Co2/ha for DSR and 10527.3 Kg Co_2/ha in PTR.
- In Sirsa district, the carbon emissions per hectare was highest in case of 1692/1509 (11484.3 Kg) followed by 1718 (11028.5 Kg), 10609.9 Kg Co2/ha in case of PB 6/1401 and least in case of PB 1121 i.e. 10387 Kg Co2/ha.
- The total emissions were seen highest in case of non-basmati (PTR) rice (24151.9 Kg Co2/ha) in Karnal district. Also, the lowest emissions were seen in PB 1121 and CSR 30 cultivated in Karnal (7144.7 Kg Co2/ha and 6073.4 Kg Co2/ha).

Conclusion

The study concluded that in Karnal district, the highest carbon footprint among basmati paddy varieties per hectare was observed in 1509 variety which was 20584.9 Kg followed by PB 1121(5548.8 Kg) and least was seen in CSR 30 i.e. (5240.7 Kg), respectively. In case of non-basmati paddy in Karnal district, the carbon emissions were 23176.9 Kg Co2/ha of which the major contributor was residue burning (17660.3 Kg). The emissions from nitrogen used were found higher in case of DSR basmati paddy (1808.9 Kg) as compared to PTR basmati paddy (1097 Kg) which indicates the higher on-going use of nitrogenous fertilizer in DSR paddy. In Sirsa district, the carbon emissions per hectare was highest in case of 1692/1509 (11484.3 Kg) followed by 1718 (11028.5 Kg), 10609.9 Kg Co2/ha in case of PB 6/1401 and least in case of PB 1121 i.e. 10387 Kg Co2/ha. The total emissions were seen highest in case of non-basmati (PTR) rice (24151.9 Kg Co2/ha) in Karnal district. Also, the lowest emissions were seen in PB 1121 and CSR 30 cultivated in Karnal (7144.7 Kg Co2/ha and 6073.4 Kg Co2/ha).

I	Experiment No. 13: Economic evaluation of garlic and turmeric cultivation in Haryana	
ii	**Objectives of the experiment**	• To work out the costs and returns of garlic and turmeric cultivation. • To analyze the marketing pattern of garlic and turmeric cultivation. • To study the constraints impeding the cultivation and marketing of garlic and turmeric.
iii	**Name of the investigators**	• Dr. Sumit Finalization of schedule, compilation and analysis of data. • Dr. K.K. Kundu Report writing
iv	**Name of the collaborator with activity profile**	• Nil
V	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Karnal for garlic and Yamunanagar for turmeric • **Blocks & Villages covered:** Indergarh village from Indri block and Chorakhalsa from Karnal block were selected. From each village 15 farmers were selected for garlic crop. Whereas, Chhachroli, Pipli Majra and Khadri village were selected from Chhachroli block. From each village, 10 farmers were selected from turmeric crop. • **Statistical design/Method:** Mean, percentage, appropriate production function was used.
viii	**Observations recorded**	• Inputs used i.e. seeds, agro-chemicals, labour used etc. • Costs and prices of inputs and output • Marketing costs and margins • Constraints in cultivation of garlic and turmeric

ix. Results achieved during 2021-22



Cost and returns of garlic and turmeric crops

The costs and returns of garlic and turmeric per hectare on selected farms presented in Table 1.The per hectare gross returns from garlic was estimated at Rs. 426341, while the total cost of

cultivation was Rs. 316770. The net return from garlic was Rs. 109571 per hectare. The average production from garlic was found to be 109.23 quintals per hectare. The most important cost component in garlic was the rental value of land which accounted for 20.14 per cent of total cost followed by seed (18.51%) and management charges + risk factor (13.31%). The total plant protection + intercultural operation in garlic was (11.32%), sowing (7.93%), harvesting (7.76%) and total fertilizers (6.16%). The B: C ratio of garlic was found to be 1.35.

Table 1: Cost and returns from garlic and turmeric crops during 2021-22 (Rs./ha)

S. No.	Particulars	Garlic		Turmeric	
		Qty	Value	Qty	Value
1	Field preparation	6.91	15624 (4.93)	6.67	14683 (3.65)
2	Sowing		25124 (7.93)		10136 (2.52)
3	Seed (q)	8.38	58625 (18.51)		72480 (18.00)
4	Total fertilizers		19508 (6.16)		26828 (6.66)
5	Irrigation	9.79	7340 (2.32)	26.96	16854 (4.19)
6	Total plant protection + intercultural operation		35872 (11.32)		49203 (12.22)
7	Harvesting		24583 (7.76)		33485 (8.32)
8	Cutting		7107 (2.24)		-
9	Boiling of rhizomes		-		13726 (3.41)
10	Transportation		8752 (2.76)		9625 (2.39)
11	Miscellaneous		1155 (0.36)		1623 (0.40)
	Total (1 to 11)		203690 (64.30)		248643 (61.76)
12	Interest on working Capital		7129 (2.25)		8703 (2.16)
11	**Variable cost**		**210819 (66.55)**		**257346 (63.93)**
12	Management charges + Risk factor		42164 (13.31)		51469 (12.79)
15	Rental value of land		63787 (20.14)		93750 (23.29)
16	**Total cost**		**316770 (100.00)**		**402565 (100.00)**
	Total yield & price per quintal	109.23	3903.15	250.26	2145.75
17	**Gross returns (q)**		**426341**		**536995**
18	**Net returns**		**109571**		**134431**
19	**B: C ratio**		**1.35**		**1.33**

Similarly in turmeric, per hectare gross return was estimated to be Rs. 536995, while the total cost of cultivation was Rs. 402565. The net return was Rs. 134431 per hectare. The average production was found to be 250.26 quintals per hectare. The most important cost component in turmeric was the rental value of land which accounted for 23.29 per cent of total cost followed by seed cost (18.00%) as they brought seed from Punjab state @ Rs. 40/kg and management charges+

risk factor of 12.79 per cent. Plant protection + intercultural operation cost were 12.22 per cent; harvesting cost (8.32%), total fertilizers (6.66%) and irrigation were 4.19 per cent. The B: C ratio of turmeric was found to be 1.33.

Marketing costs and margins of garlic and turmeric crops

Marketing channels of garlic

I. Producer → Consumer

II. Producer → Retailer → Consumer

III. Producer → Wholesaler/commission agent → Retailer → Consumer

Marketing channels of turmeric

I. Producer → Consumer

II. Producer → Retailer → Consumer

III. Producer → Processor → Retailer → Consumer

IV. Producer → Wholesaler/commission agent → Processor → Retailer → Consumer

Channel I: Producer Consumer

This is the shortest channel in garlic and turmeric marketing. In this channel, no intermediaries between producer and consumer were involved. The producer sold their produce directly to consumers. The result presented in the Table 2 revealed that producer received a net price of Rs. 3699.21 per quintal, accounting for 94.77 per cent of consumer price. The major cost items incurred by producers were transportation, cleaning, storage losses and loading accounting for Rs. 80.13, 65.07, 53.61 and Rs. 5.30 per quintal, respectively.

Similarly in turmeric, producer received a net price of Rs. 1931.71 per quintal, accounting for 89.85 per cent of consumer price. The major cost items incurred by producers were storage losses, boiling and drying, transportation, cleaning and loading accounting for Rs. 89.36, 54.85, 38.46 and Rs. 5.65 per quintal, respectively.

Table 2: Price spread of garlic and turmeric in channel-I during 2021-22 (Rs./q)

S. No.	Particulars	Garlic		Turmeric	
		Value	Percentage	Value	Percentage
1	Net Price received by producer	3699.21	94.77	1931.71	89.85
2	Cost incurred by the producer	204.11		218.29	
	Transportation	80.13	2.05	38.46	1.79
	Loading charges	5.30	0.14	5.65	0.26
	Cleaning	65.07	1.67	29.97	1.39
	Boiling and drying	-	-	54.85	2.55
	Storage losses	53.61	1.37	89.36	4.16
	Sub total	204.11	5.23	218.29	10.15
3	Sale price of producer/purchase price of consumer	3903.32	100.00	2150.00	100.00

Table 3 shows the marketing margins, price spread and cost of garlic and turmeric in the channel-II. The producer brings their produce in the market. Thus, only one intermediaries *i.e*., the retailer are involved between the producer and consumer. In garlic, the producer's share of consumer's price was 71.85 per cent. The marketing cost incurred by the producer was Rs. 204.11 per quintal and the sale price of producer/purchase price at retailer for the produce was Rs. 3150.00 per quintal. Therefore, net price received by the producer was Rs. 2945.89 per quintal. Marketing cost incurred by the retailer was Rs. 320.35 per quintal, sale price of retailer or purchase prices of

consumer was Rs. 4100.00 per quintal. The net margin received by retailer was Rs. 629.65 per quintal and accounted for 16.36 per cent of the sale price of the retailer/purchase price of consumer.

Similarly in turmeric, the producer's share of consumer's price was 70.85 per cent. The marketing cost incurred by the producer was Rs. 218.29 per quintal and the sale price of producer/purchase price at retailer for the produce was Rs. 2025.00 per quintal. Therefore, net price receive by the producer was Rs. 1806.71 per quintal. Marketing cost incurred by the retailer was Rs. 87.35 per quintal, sale price of retailer or purchase prices of consumer was Rs. 2550.00 per quintal. The net margin received by retailer was Rs. 437.65 per quintal and accounted for 17.16 per cent of the sale price of the retailer/purchase price of consumer.

Table 3: Price spread of garlic and turmeric in channel-II during 2021-22 (Rs./q)

S. No.	Particulars	Garlic		Turmeric	
		Value	Percentage	Value	Percentage
1	Net Price received by producer	2945.89	71.85	1806.71	70.85
2	Cost incurred by the producer	204.11		218.29	
	Transportation	80.13	1.95	38.46	1.51
	Loading charges	5.30	0.13	5.65	0.22
	Cleaning	65.07	1.59	29.97	1.18
	Boiling and drying	-	-	54.85	2.15
	Storage losses	53.61	1.31	89.36	3.50
	Sub total	204.11	4.98	218.29	8.56
3	Sale price of Producer/purchase price of retailer	3150.00	76.83	2025.00	79.41
4	Cost incurred by the retailer				
	Loading and unloading charges	4.80	0.12	5.50	0.22
	Transportation	75.15	1.83	36.85	1.45
	Spoilage	205	5.00	-	-
	Storage	35.4	0.86	45.00	1.76
	Sub total	320.35	7.81	87.35	3.43
5	Net margin of retailer	629.65	15.36	437.65	17.16
6	Sale price of retailer/purchase price of consumer	4100	100.00	2550.00	100.00

In channel-III, two intermediaries namely wholesaler/commission agent and retailer was involved between producers and ultimate consumers in the marketing of garlic. Whereas, processor and retailer were involved between producers and ultimate consumers in the marketing of turmeric. In case of garlic, farmer sold the produce to the wholesaler. The marketing margins, price spread and cost in this channel are given in Table 4. The results revealed that producers received a net price of Rs. 2795.89 per quintal accounting for 53.77 per cent of consumer's price in garlic.

Table 4: Price spread of garlic and turmeric in channel-III during 2021-22 (Rs./q)

S. No.	Particulars	Garlic		Particulars	Turmeric	
		Value	%		Value	%
1	**Net Price received by producer (3-2)**	**2795.89**	**53.77**	**Net Price received by producer (3-2)**	**1831.71**	**20.24**
2	Cost incurred by the producer	204.11		Cost incurred by the producer	218.29	
	Transportation	80.13	1.54	i. Transportation	38.46	0.42
	Loading charges	5.30	0.10	ii. Loading charges	5.65	0.06
	Cleaning	65.07	1.25	iii. Cleaning	29.97	0.33
	Boiling and drying	-	-	iv. Boiling and drying	54.85	2.15

	Storage losses	53.61	1.03	v. Storage losses	89.36	0.99
	Sub total	204.11	3.93	Sub-total (i to v)	218.29	2.41
3	Sale price of producer/purchase price of wholesaler	3000.00	57.69	Sale price of producer/purchase price of processor	2050.00	22.65
4	**Cost incurred by the wholesaler/commission agent**			**Cost incurred by the processor**		
	Commission (1%) + Market fees (1%)	85	1.63	Curing, drying, utensils (nets), polishing	250.00	2.76
	storage charge	32.35	0.62	Mill charges	2250.00	24.86
	Spoilage	160	3.08	Sorting	350.00	3.87
	Packaging	-	-	Packaging	125.20	1.38
	Storage and marketing	-	-	Storage and marketing	175.60	1.94
	Sub-total	277.37	5.33	Sub-total (i to v)	3150.80	34.82
5	Net margin of wholesaler	972.65	18.73	Net margin of processor	2379.20	26.29
6	Sale price of wholesaler/purchase price of retailer	4250	81.73	Sale price of processor/purchase price of retailer	7580.00	83.76
7	Cost incurred by the retailer			Cost incurred by the retailer		
	Loading unloading	4.5	0.09	Loading unloading	5.60	0.06
	Transportation	72.3	1.39	Transportation	42.80	0.47
	Spoilage	260	5.00	Spoilage	-	-
	Storage	30.5	0.59	Storage	200.00	2.21
	Sub total	367.3	7.06	Sub-total (i to iii)	248.40	2.74
8	Net margin of retailer	582.7	11.21	Net margin of retailer	1221.60	13.50
9	Sale price of retailer/purchase price of consumer	5200	100.00	Sale price of retailer/purchase price of consumer	9050.00	100.00

The cost incurred by the producer in the marketing of the garlic produce was Rs. 204.11 per quintal. Purchase price of wholesaler was Rs. 3000.00 per quintal and it was worked out on the basis of sale price offered to the farmers marketed their surplus produce. Wholesaler sold the produce to the retailer and cost incurred by wholesaler was Rs. 277.37 per quintal. The sale price of wholesaler was Rs. 4250.00 per quintal. The net margin of wholesaler was Rs. 972.65 per quintal and accounted for the 18.70 per cent of consumer's price. Sale price of retailer or purchase price of consumer was Rs. 5200.00 per quintal. The retailer received net margin of Rs. 582.70 per quintal sharing about 11.21 per cent of the consumer's price.

Similarly in marketing of turmeric showed that there were two intermediaries namely processor and retailer were involved between producers and ultimate consumers. The results (Table 4) revealed that producers received a net price of Rs. 1831.71 per quintal accounting for 20.24 per cent of consumer's price. The cost incurred by the producer in the marketing of the turmeric produce was Rs. 218.29 per quintal. Purchase price of processor was Rs. 2050.00 per quintal. The processor incurred marketing cost of Rs. 3150.80 per quintal. The net margin of processor was Rs. 2379.20 per quintal and accounted of 26.29 per cent of consumer's price. The retailer incurred marketing cost of Rs. 248.40 per quintal. Sale price of retailer or purchase price of consumer was Rs. 9050.00 per quintal. The retailer received a net margin of Rs. 1221.60 per quintal sharing about 13.50 per cent of the consumer's price.

In channel-IV, three intermediaries namely wholesaler/commission agent, processor and retailer were involved between producers and ultimate consumers in the marketing of turmeric. Farmer sold the produce to the wholesaler/commission agent. The marketing margins, price spread and cost in this channel are given in Table 5. The results revealed that producers received a net price of Rs. 1641.71 per quintal accounting of 14.76 per cent of consumer's price. The cost incurred by the producer in the marketing of the produce was Rs. 218.29 per quintal. Purchase price of wholesaler was Rs. 1860.00 per quintal. Wholesaler sold the produce to the processor and cost incurred by wholesaler was Rs. 462.88 per quintal. The sale price of wholesaler was Rs. 4520.00 per quintal. The

net margin of wholesaler was Rs. 2197.12 per quintal and accounted of 19.75 per cent of consumer's price. The processor incurred marketing cost of Rs. 3150.80 per quintal.

The net margin of processor was Rs. 2089.20 per quintal and accounted of 18.78 per cent of consumer's price. The retailer incurred marketing cost of Rs. 248.40 per quintal. Sale price of retailer or purchase price of consumer was Rs. 11125.00 per quintal. The retailer received net margin of Rs. 1116.60 per quintal sharing about 10.04 per cent of the consumer's price.

Marketing efficiency of garlic and turmeric

The marketing efficiency of garlic and turmeric in different marketing channels for the year 2021-22 are presented in Table 6. Marketing efficiency according to Acharya's method (Modified Measure of Marketing Efficiency) under different marketing channels *i.e.* channel I, II and channel III in garlic were 18.12, 2.55 and 1.66, respectively for garlic. Similarly in case of turmeric, marketing efficiency according to Acharya's method under different marketing channels i.e. channel-I, II, III and channel-IV were 8.85, 2.43, 0.25 and 0.17, respectively. From this efficiency index, it was observed that channel-I was the most efficient among all marketing channels in both the crops. This was because of the fact that in channel-I, intermediaries were not involved and hence this channel was most efficient than all other channels. Moreover, marketing efficiency increased with the decrease in number of market intermediaries between producer and consumer.

Table 5: Price spread of turmeric in channel-IV during 2021-22 **(Rs./q)**

S. No.	Particulars	Value	Percentage
1	Net Price received by producer (3-2)	1641.71	14.76
2	Cost incurred by the producer	218.29	
	i. Transportation	38.46	0.35
	ii. Loading charges	5.65	0.05
	iii. Cleaning	29.97	0.27
	iv Boiling and drying	54.85	0.49
	v. Storage losses @ 0.5%	89.36	0.80
	Sub-total (i to v)	218.29	1.96
3	Sale price of producer/ purchase price of wholesaler	1860.00	16.72
4	Cost incurred by the wholesaler cum commission agent		
	i. Commission (1%) + Market fees (1%)	70.03	0.63
	ii Storage	195.00	1.75
	iii. Packing	122.50	1.10
	iv. Spoilage during storage	75.35	0.68
	Sub-total (i to iv)	462.88	4.16
5	Net margin of wholesaler	2197.12	19.75
6	Sale price of wholesaler/purchase price of processor	4520.00	40.63
7	Cost incurred by the processor		
	i Curing, drying, utensils(nets), polishing	250	2.25
	ii. Mill charges	2250	20.22
	iii. Sorting	350	3.15
	iv. Packaging	125.2	1.13
	v. Storage and marketing	175.6	1.58
	Sub-total (i to v)	3150.8	28.32
8	Net margin of processor	2089.20	18.78
9	Sale price of processor/purchase price of retailer	9760	87.73
10	Cost incurred by the retailer		
	i. Transportation	42.8	0.38
	ii. Loading and unloading	5.6	0.05
	iii. Storage	200	1.80
	Sub-total (i to iii)	248.4	2.23
11	Net margin of retailer	1116.6	10.04
12	Sale price of retailer/purchase price of consumer	11125	100.00

Table 6: Marketing efficiency of garlic and turmeric through different marketing channels in Karnal and Yamunanagar districts during 2021-22 (Value in Rs./qtl)

		Garlic (Karnal)			Turmeric (Yamunanagar)			
S. No.	**Particulars**	**Channel I**	**Channel II**	**Channel III**	**Channel I**	**Channe l II**	**Channel III**	**Channel IV**
1	Consumer purchase price(RP)	3903.32	4100	5200	2150.00	2550.00	9050	11125
2	Total marketing cost (MC)	204.11	524.46	848.76	218.29	305.64	3617.49	4080.37
3	Total net margin of intermediaries (MM)	-	629.65	1554.35	-	437.65	3600.80	5402.92
4	Net price received by farmers	3699.21	2945.89	2795.89	1931.71	1806.71	1831.71	1641.71
5	Value added (1-4)	204.11	1154.11	2404.11	218.29	743.29	7218.29	9483.39
	Marketing efficiency							
A	Conventional method (5÷2)	1.00	2.20	1.83	1.00	2.43	2.00	2.11
B	Shepherds method (ME) 1÷2	19.12	7.82	3.95	9.85	8.34	2.50	2.47
C	**Acharya's method (MME) 4÷(2+3)**	**18.12**	**2.55**	**1.16**	**8.85**	**2.43**	**0.25**	**0.17**

Constraints in production and marketing of garlic and turmeric

At present farmers has encountered a lot of problems in production and marketing of garlic and turmeric. Based on the opinion of the surveyed growers of garlic and turmeric, an attempt has been made to critically examine the problems faced by farmers in production and marketing of garlic and turmeric (Table 7). The study revealed that the major production constraints faced by the garlic growers were high cost of seed & shortage of labour during peak time (73.33%) followed by less information about seed treatment (60.00%), non-availability of good quality seed of high yielding varieties & shortage in supply of electricity (43.33%), shortage of inputs and their quality (23.33%) and marketing constraints were high fluctuation in market price (76.67%) followed by lack of grading (60.00%), lack of market information (56.67%) lack of storage (53.33%) and less number of buyers/monopoly/cartel of buyers (46.67%).

Similarly in turmeric, major production constraints faced by the growers were high cost of post-harvest technology (86.67%) followed by high cost of rhizomes (83.33%), less information about seed treatment (70.00%), less area under tree and fruit plantation for shed (63.33%) and marketing constraints were high fluctuation in market price (90.00%) followed by lack of grading (83.33%), long chain of middlemen (73.33%) number of buyers/monopoly/cartel of buyers (74.00%) and lack of storage (63.33%).

Table 7: Production and marketing constraints faced by garlic and turmeric growers during 2021-22 (N = 30)

S. No.	**Production constraints**	**Garlic**		**Turmeric**	
A.		**No. of farmers**	**Percen tage**	**No. of farmers**	**Percen tage**
1	Non-availability of good quality seeds of high yielding varieties	13	43.33	16	53.33
2	High cost of seed/rhizomes	22	73.33	25	83.33
3	Erratic/short supply of electricity	13	43.33	11	36.67
4	Shortage of labour during peak time (inter-culture, harvesting and other operations)	22	73.33	19	63.33
5	Shortage of inputs and their quality (fertilizers and pesticides etc.)	7	23.33	5	16.67

6	Unfavourable climatic conditions	10	33.33	9	30.00
7	Less information about seed treatment	18	60.00	21	70.00
8	Higher cost of post-harvest technology	0	0.00	26	86.67
9	Less area under tree and fruit plantation for shed	0	0.00	19	63.33
B.	**Marketing constraints**				
1	High fluctuation in market price	23	76.67	27	90.00
2	Poor quality of produce	5	16.67	12	40.00
3	Lack of storage	16	53.33	19	63.33
4	Long chain of middlemen	12	40.00	22	73.33
5	Lack of Market Information	17	56.67	15	50.00
6	Lack of Grading	18	60.00	25	83.33
7	Less number of buyers/Monopoly/cartel of buyers	14	46.67	21	70.00

x. Programme of work for 2022-23: Experiment Concluded

Salient findings of the study

- The costs and returns analysis revealed that the expenses incurred on rental value of land (20.14%), seed cost (18.51%), plant protection + intercultural operation (11.32%) and sowing (7.93%) contributes the major components in total cost (Rs. 316770) of garlic production in Karnal.
- Similarly from Yamuna Nagar, expenses incurred on rental value of land (25.08%), seed cost (18.73%), plant protection + intercultural operation (14.01%) and harvesting (7.02%) contributes the major components in total cost (Rs. 373823) of turmeric production in Yamuna Nagar.
- A gross return of garlic per hectare was Rs. 426341 whereas; in turmeric the return was Rs. 456875. B: C of garlic and turmeric was found 1.35 and 1.22, respectively.
- The producer's share in the consumer's rupee was highest in channel-I in both the crops i.e. producer to consumer, which accounted 94.77 and 90.84 per cent in garlic and turmeric, respectively.
- The study revealed that the major production and marketing constraints faced by the garlic growers were high cost of seed (73.33%) followed by less information about seed treatment (60.00%), non-availability of good quality seed of high yielding varieties & shortage supply of electricity (43.33%), shortage of inputs and their quality (23.33%) and marketing constraints were high fluctuation in market price (76.67%) followed by lack of grading (60.00%), lack of market information (56.67%)lack of storage (53.33%) and less number of buyers/monopoly/cartel of buyers (46.67%).
- The study revealed that the major production constraints faced by the turmeric growers were high cost of post-harvest technology (86.67%) followed by high cost of rhizomes (83.33%), less information about seed treatment (70.00%), less area under tree and fruit plantation for shed (63.33%) and marketing constraints were high fluctuation in market price (90.00%) followed by lack of grading (83.33%), long chain of middlemen (73.33%) number of buyers/monopoly/cartel of buyers (74.00%) and less lack of storage (63.33%)

Conclusion

A gross return of garlic per hectare was Rs. 426341 whereas; in turmeric the return was Rs. 596605. B: C of garlic and turmeric was found 1.35 and 1.40, respectively. The producer's share in the consumer's rupee was founds more than 90 per cent of consumer's rupee in channel-I in both the crops i.e. producer to consumer. The major production and marketing constraints faced by the garlic growers were high cost of seed (73.33%) followed by less information about seed treatment(60.00%) and marketing constraints were high fluctuation in market price(76.67%) followed by lack of grading(60.00%) . The study revealed that the major production constraints faced by the turmeric growers were high cost of post-harvest technology (86.67%) followed by high cost of seed (83.33%) and marketing constraints were high fluctuation in market price(90.00%) followed by lack of, long chain of middlemen (63.33%)

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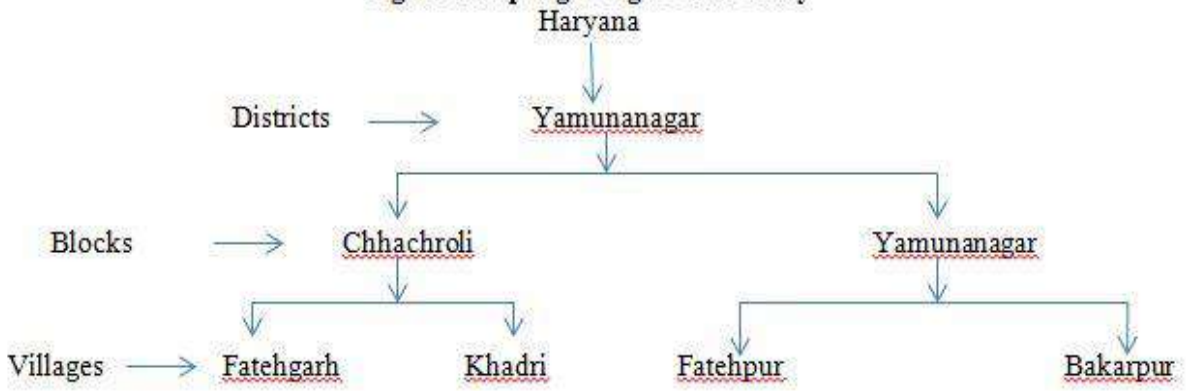
i	**Experiment No. 14: Assessment of cost and returns of poplar (*populusdeltoides*) based cropping system in Haryana**	
ii	**Objectives of the experiment**	• To work out the cost and returns of poplar based cropping system • To study the disposal pattern of poplar • To identify the constraints faced by the farmers in cultivation and marketing of poplar
iii	**Name(s) of the Investigator**	• Dr. Sumit Planning, finalization of interview schedule and data collection • Dr. Neeraj Pawar Data collection and Report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• NIL
v	**Year of start**	• 2021-22
vi	**Duration of study**	• 1 year
vii	**Treatment details**	• **Locale of experiment:** Yamunanagar • **Blocks & Villages covered:** Fatehgarh and Khadri villages from Chhachroli block and Fatehpur and Bakarpur villages from Yamunanagar block were selected. A total of 40 farmers were selected and from each village 10 farmers were selected. From selected 40 farmers 18 farmers were also growing sugarcane in initial two years of poplar plantation • **Statistical design/methods:** The statistical tools like mean, percentage were used.
viii	**Observations recorded**	• Inputs used i.e. seeds, agro-chemicals and labour used etc. • Quantity and prices of inputs and output • Constraints hindering the cultivation of poplar based cropping system.

ix. Results achieved during 2021-22

Fig. 1: Sampling design of the study



Establishment cost of poplar plantation

The results presented in Table 1, indicated that the average total cost for establishing poplar field in Yamunanagar district was Rs. 55514 per hectare. The highest cost incurred by plant seedling in establishing poplar field *i.e.* Rs. 20048 per hectare (36.11% of total cost), followed by cost of

preparation of land which was Rs. 11506 per hectare (20.73% of total cost). Whereas, cost of tools (12.45%), cost of filling material (11.10%), cost of digging and filling of pits (7.22%) and cost of irrigation (6.70%) were also considered the other major component of the establishment cost.

Operational cost of poplar field with wheat and sugarcane as intercrop

It is obvious from the data (Table 2) that the operating costs of poplar crop increased over the years with wheat as intercrop. It was due to higher expenses incurred on various inputs and rise in plant cutting cost. This increase may be attributed to the direct relationship between the physical input requirement and age of the plants. The data revealed that the operational cost of poplar field increased from Rs. 44457 in first year to Rs. 146209 per hectare in seventh year. The operational cost per hectare per annum from first to seventh years were found to be Rs. 14194 on cutting of plants (21.29%), followed by manures and fertilizers (19.50%), intercultural operation (13.89%), irrigation (13.87 %) and watch & ward (13.49%) were the major constituents of operational cost of a poplar field with wheat as intercrop.

Similarly operational cost of poplar with sugarcane as intercrop is presented in Table 3. The operational cost of poplar field increased from Rs. 48838 in first year to Rs. 146209 per hectare in seventh year. The operational cost per hectare per annum from first to seventh years were found to be Rs. 14194 on cutting of plants (20.94%), followed by manures and fertilizers (19.51%), intercultural operation (14.83%), irrigation (13.78%) and watch & ward (13.27%) were the major constituents of operational cost of a poplar field with sugarcane as intercrop.

Table 1: Establishment cost of poplar plantation in Yamunanagar district

S. No	Particular	Rs./ha	Per cent
1	Preparation of land	11506	20.73
2	Digging and pits filling	4010	7.22
3	Cost of filling material (manures, fertilizers and insecticide)	6159	11.10
4	Irrigation cost	3719	6.70
5	Plant seedling	20048	36.11
6	Tools	6913	12.45
7	Miscellaneous	3159	5.69
8	**Total cost**	**55514**	**100.00**

Table 2: Operational cost of poplar plantation with wheat as intercrop (Rs./ha)

S. No	Particulars	1	2	3	4	5	6	7	Total cost	Average cost per annum
1	Manures and fertilizer	10001	10859	12350	13163	14250	14750	15613	90985	12998 (19.50)
2	Intercultural operations	6631	7541	8538	9538	10513	10938	11113	64809	9258 (13.89)
3	Irrigation	8038	8988	9163	9238	9663	9694	9938	64719	9246 (13.87)
4	Plant protection	5863	6525	7788	9025	9275	9763	10188	58425	8346 (12.52)
5	Pruning and cutting	0	0	6225	8150	11050	0	0	25425	3632 (5.45)
6	Watch and ward /replacement cost	13925	16200	16075	16750	0	0	0	62950	8993 (13.49)
7	Cutting of plant	0	0	0	0	0	0	99359	99359	14194 (21.29)
8	**Total operational cost**	**44457**	**50113**	**60138**	**65863**	**54750**	**45144**	**146209**	**466673**	**66668 (100.00)**

Figures in parentheses are percentage to the total average cost per annum

Table 3: Operational cost of poplar plantation with sugarcane as intercrop (Rs./ha)

S. No	Particulars	1	2	3	4	5	6	7	Total cost/ha	Average cost/ha./annum
1	Manures and fertilizer	10713	11725	12350	13163	14250	14750	15613	92563	13223 (19.51)
2	Intercultural operations	9650	10088	8538	9538	10513	10938	11113	70375	10054 (14.83)
3	Irrigation	8688	8988	9163	9238	9663	9694	9938	65369	9338 (13.78)
4	Plant protection	5863	6525	7788	9025	9275	9763	10188	58425	8346 (12.31)
5	Pruning and cutting	0	0	6225	8150	11050	0	0	25425	3632 (5.36)
6	Watch and ward /replacement cost	13925	16200	16075	16750	0	0	0	62950	8993 (13.27)
7	Cutting of plant	0	0	0	0	0	0	99359	99359	14194 (20.94)
8	**Total operational cost**	**48838**	**53525**	**60138**	**65863**	**54750**	**45144**	**146209**	**474466**	**67781 (100.00)**

Figures in parentheses are percentage to the average cost per annum

Cost and returns from poplar field with wheat and sugarcane as intercrop

The total annual cost of poplar cultivation does not vary much with the age of plant. Gross and net returns from poplar cultivation with wheat and sugarcane as an intercrop are presented in the Table 4. The rental value of the land is assumed to different to offset the price fluctuation. It is evident from the table that sugarcane crop generates positive returns during the initial two years after that sugarcane cultivation was not possible as intercrop with poplar. After sugarcane farmers started to grow wheat as intercrop with poplar from third year to fifth year and negative returns were obtained from third to fifth years and starts giving positive returns in seventh year. The gross returns per hectare from poplar plantation worked out to be Rs. 1589750 in the seventh year *i.e.* full growing trees. Taking into account the rental value of land, operational cost, expected depreciation on fixed investment and interest on operational cost, the net returns per hectare have been worked out over time. The returns from sugarcane intercrop with poplar were positive in the initial two years i.e. Rs. 102467 and Rs. 33452 per hectare, respectively. After that negative returns were obtained from third to fifth years because farmers were grow wheat as intercrop and bear a loss of Rs. 98079, Rs. 119124 and Rs. 117540 per hectare, respectively. During the seventh year the net returns become positive from poplar plantation and worked out to be Rs. 1170839 per hectare.

Net present value (NPV) and internal rate of return (IRR) of poplar with wheat and sugarcane as intercrop

Net present value is defined as the present value of all future cash flows associated with the investment which includes the outlay. The net present value of poplar with intercrop thus computed and presented in Tables 5. The net present values (NPVs) for poplar plantation with wheat and sugarcane as an intercrop was found to be Rs. 281808. The positive NPV showed that poplar plantation is a profitable enterprise in the Yamunanagar district. Beside this high the positive NPV on farm more the profit of that farms.

For estimating the internal rate of return, the investment costs, gross returns from first to seventh year of poplar plantation with wheat and sugarcane as an intercrop have been depicted in Tables 6. The net cash flow was obtained by using these single values which may have negative and positive signs depending on the quantum of costs and benefits or returns in each year. To find out the present value, the discounted rate was estimated by different discount rate at random until the difference between the sum of discounted streams of positive and negative values is reduced either to zero or to a lowest minimum value. The data indicates internal rate of return of 19.25 per cent for poplar plantation. This indicates that investment on poplar plantation is highly profitable and internal rate of return was more than the present market interest rate *i.e.* 9.0 per cent per annum. Finally, it is concluded that poplar plantation in the study area is highly remunerative and paying proposition.

Table 4: Cost and return from poplar plantation with wheat and sugarcane as intercrop (Rs./ha)

S. No.	Particulars	Age of plants in years						
		1	**2**	**3**	**4**	**5**	**6**	**7**
1	Rental value of land	87500	96250	105000	116250	125000	137500	150000
2	Operational cost	48838	53525	60138	65863	54750	45144	146209
3	Expected deprecation on fixed investment @10 %	5551	5551	5551	5551	5551	5551	5551
4	Interest on operational cost @ 7 % per annum	3419	3747	4210	4610	3833	3160	10235
5	Marketing cost	0	0	0	0	0	0	53458
6	Total cost with sugarcane as intercrop	145308	159073	-	-	-	-	-
7	Total cost with wheat as intercrop	140620	155422	174899	192274	189134	191355	365453
9	Production (q)	0	0	0	0	0	0	1987.19
10	Gross return	-	-	-	-	-	-	1589750
11	Net return (GR-TC-MC)	-	-	-	-	-	-	1170839
12	Net return from sugarcane as intercrop (for 1st & 2nd year)	247775	192525	-	-	-	-	-
13	Net return from wheat as intercrop (1st to 5th years)	78305	77208	76820	73150	71594	-	-
14	Total net returns from sugarcane as intercrop	102467	33452	-	-	-	-	-
15	Total net returns from wheat as intercrop	-62315	-78214	-98079	-119124	-117540	-	-
16	Total net returns from poplar as sole crop	-	-	-	-	-	-	1170839

Table 5: Per hectare net present value of poplar plantation with intercropping as wheat and sugarcane (Rs./ha)

Years	**Cost (Rs.)**	**Returns (Rs.)**	**Discount coefficient 1/(1+r)^n**	**Present Value**	
				Cost	Net returns (Rs.)
1	102467	0	0.9174	94006	
2	33452	0	0.8417	28156	
3	98079	0	0.7722	75735	
4	119124	0	0.7084	84391	
5	117540	0	0.6499	76393	
6	0	0	0.5963	0	
7		1170839	0.5470	0	640489
Total	470662.1	1170839		358681	
Net present value (NPV)	**640489**	**358681**	**281808**		

Net present value (NPV) = 640489-358681 = 281808

Table 6: Internal rate of return from poplar plantation with wheat and sugarcane as an intercrop

(Rs./ha.)

Years	Net cash flow	Present value coefficient r= 19% (1/(1+r)^n	Corresponding present value	Present value coefficient r= 20% (1/1+r)^n	Corresponding present value
1	-102467	0.8403	-86106.7	0.8333	-85389.2
2	-33452	0.7062	-23622.6	0.6944	-23230.6
3	-98079	0.5934	-58201.4	0.5787	-56758.4
4	-119124	0.4987	-59403.6	0.4823	-57448.1
5	-117540	0.4190	-49255.1	0.4019	-47236.8
6	-191355	0.3521	-67384.2	0.3349	-64084.4
7	1170839	0.2959	346472.2	0.2791	326759.7
Total	**508822**		**2498.6**		**-7387.7**

IRR = 19+1 (2498.6)/{2498.6-(-7387.7)} = 19 + 0.25 = 19.25

Benefit-cost ratio

The benefit cost ratio is the ratio between the sum of discounted benefits or returns (R) and sum of discounted cost (K) which is presented in Table 7. At discount rate of 9.0 per cent, the benefit cost ratio with wheat and sugarcane as intercrop with poplar was obtained equal to 1.79. It indicates that at the prevailing rate of interest 9.0 per cent per annum as investment of Rs. 1.00 would fetch a return of Rs. 1.79 with wheat and sugarcane as intercrop with poplar plantation. Since this ratio is greater than unity. It showed that the investment in poplar plantation is considered to be economically viable.

Table 7: Benefit cost ratio, internal rate of return and payback period with intercropping

(Rs./ha.)

S. No.	Particulars	
1	**Return**	640489
2	**Cost**	358681
3	**B : C**	1.79
4	**IRR**	19.25
5	**Payback Period**	**7**

Marketing Costs and Margins of poplar plantation

To find out the producer's share in the consumer's rupee in the marketing of poplar, the different costs and margins incurred by various functionaries involved in the process of marketing in Yamunanagar market have been worked out through two most common channels *i.e.* direct sale by producer in the market and sale through the contractor in the market (Table 8).

The study indicates that through direct sale by producer, the price received by the producer was only Rs. 773 per quintal (73.63%) out of the price as high as Rs. 1050 per quintal paid by the consumer. The major items of the marketing costs and margins through the channels were retailer's net margins of Rs. 225.50 per quintal (21.48%), cost incurred by retailer 24.50 per quintal (2.33%) and cost incurred by producer 8.66 per cent of the consumers paid price through contract sale. The share of the producer further reduces to Rs. 659.10 per quintal or 62.77 per cent of the price paid by consumers due to the 6.09 per cent margins charged by pre-harvest contractor.

Table 8: Marketing cost and margin of poplar plantation

S. No.	Particulars	Direct sale		Contract sale	
		Rs./q	Per cent	Rs./q	Per cent
1	Farmer sale price	800	76.19	750	71.43
2	Expenses incurred by producer/pre-harvest contractor				
a	Transportation	21.90	2.09	21.9	2.09
b	Labour charges for loading and unloading	5.00	0.48	5	0.48
c	commission @ 6%	0		48.00	4.57
d	Marketing fees @ 2%	0		16.00	1.52
	Sub total	**26.90**	**2.56**	**90.9**	**8.66**
3	Net price received by producers	773	73.63	659.1	62.77
4	Contractor margins	0		250	23.81
5	Market cost incurred by retailer				
a	Labour charges for loading and unloading	4.5	0.43	4.5	0.43
b	Transportation	20	1.90	20	1.90
	Total	24.5	2.33	24.5	2.33
6	Retailer's net margin	225.5	21.48	275.5	26.24
7	**Retailer sale price/consumer's purchase price**	**1050**	**100.00**	**1050**	**100.00**

Constraints in production and marketing of poplar

The production and marketing constraints faced by poplar growers are presented in Table 9. The major production constrains reported by growers were income after long period (95.00%) followed by shed effect on crops in nearby fields (85.00%), low yield level of other crops grown as intercrop (80.00%), survival/host of insect-pest harmful for other crops (77.50%), possibility of intercropping of *rabi* crop only (72.50%) and shortage of labour (70.00%).

Similarly in marketing of poplar major constraints faced by growers were high price fluctuation (82.50%) followed by lack of support price to growers (77.50%), high marketing cost (65.00%), lack of mechanism to supply regular market information (55.00%) and Monopoly or cartel among buyers (47.50%).

Table 9: Production and marketing constraints faced by poplar growers (N = 40)

S. No.	Particulars	No. of farmers	Percentage
A.	**Production constraints**		
1	Income after long gestation period	38	95.00
2	Shed effect on crops in nearby fields	34	85.00
3	Low yield level of other crops grown as intercrop	32	80.00
4	Survival/host of insect-pests harmful for other crops	31	77.50
5	Possibility of intercropping of *rabi* crop only	29	72.50
6	Shortage of Labour (Cutting of plants)	28	70.00
7	High incidence of insects-pests	27	67.50
8	Lack of technical knowledge for nursery raising	18	45.00
9	Damage due to high wind	16	40.00
10	Lack of knowledge about quality planting material	15	37.50

B.	Marketing constraints		
1	High price fluctuation	33	82.50
2	Lack of support price to growers	31	77.50
3	High marketing cost (transportation, commission, loading, unloading)	26	65.00
4	Lack of mechanism to supply regular market Information	22	55.00
5	Monopoly or cartel among buyers	19	47.50

x. Programme of work for 2022-23: Concluded

Salient findings of the study

- The average total annual cost ranges were Rs. 145308 and Rs. 191355 in the first to sixth year with wheat and sugarcane as an intercrop. However, the growers received no returns during first six years from poplar plantation. Positive net returns were found in initial two years *i.e.* Rs. 102467 and Rs. 33452 from sugarcane as intercrop and negative net returns were found from wheat as intercrop from 1st to 5th year *i.e.* Rs. 62315, 78214, 98079, 119124 and 117540, respectively. In the seventh year the farmer got the net profit of Rs. 1170839 from poplar plantation.
- The net discounted return and internal rate of return for one hectare poplar plantation came to be Rs. 281808 with wheat and sugarcane as an intercrop and IRR was 19.25 per cent for poplar plantation in the seventh year. The benefit-cost ratio was calculated 1.79 with wheat and sugarcane as intercrop.
- The marketing cost incurred by producer was about Rs. 26.90 per quintal of product. The producer share was found to be 73.63 per cent by direct sale and 62.77 per cent by contract sale. The retailer margin was 23.81 per cent of consumer price.
- The major production constrains reported by growers were income after long period (95.00%) followed by shed effect on crops in nearby fields (85.00%) and low yield level of other crops grown as intercrop (80.00%).
- In marketing of poplar major constraints faced by growers were high price fluctuation (82.50%) followed by lack of support price to growers (77.50%) and high marketing cost (65.00%).

Conclusion

Keeping in the view, the following conclusion emerged from present study: The economics of poplar plantation during 2021-22 in Yamunanagar district showed that the growers had to incur average total annual cost with wheat and sugarcane as an intercrop were Rs. 145308, 159073, 174899, 192274, 189134 and Rs. 191355 in the first to sixth year, respectively. However, the growers received no returns during first six years from poplar plantation. Positive net returns were found in initial two years *i.e.* Rs. 102467 and Rs. 33452 from sugarcane as intercrop and negative net returns were found from wheat as intercrop from 1st to 5th year *i.e.* Rs. 62315, 78214, 98079, 119124 and 117540, respectively. In the seventh year the farmer got the net profit of Rs. 1170839 from poplar plantation.

The net discounted return for one hectare poplar plantation came to be Rs. 281808 with wheat and sugarcane as an intercrop for the seventh year. The benefit-cost ratio was calculated 1.79 with wheat

and sugarcane as an intercrop. The marketing cost incurred by producer was about Rs. 26.90 per quintal of product. The producer share was found to be 73.63 per cent by direct sale and 62.77 per cent by contract sale. The retailer margin was 23.81 per cent of consumer price. The study revealed that the major problems faced by the poplar growers were income after long gestation period (95.00%) followed by shed effect on crops in nearby field (85.00%), Low yield level of other crops grown as intercrop (80.00%) and survival/host of insect-pest harmful for other crops (77.50%). Regarding the marketing problems faced by the farmers i.e. high price fluctuation (82.50%) followed by lack of support price to growers (77.50%) and high marketing cost (65.00%). From the foregoing discussion it may be concluded that poplar plantation is economically viable proposition. To make this enterprise more remunerative cooperative marketing should be encouraged. This will increase producer's share in consumer's rupee through elimination of middlemen. Market infrastructure facilities needs to be established to avoid distress sale by the producers during the glut in the market.

i	**Experiment No. 15: Economic evaluation of mechanical transplantation of paddy in Haryana**.	
ii	**Objectives of the experiment**	• To estimate cost and returns of mechanical transplanted paddy vis-a-vis conventional transplanted paddy • To analyze the resource use efficiency of mechanical transplantation of paddy • To identify the constraints in adoption of mechanical transplantation of paddy
iii	**Name(s) of the Investigator**	• Dr Vinay Mehala Preparation of schedule, compilation of data and report writing • Dr Monika Devi Analysis of data
iv	**Name(s) of the collaborator(s) with activity profile**	
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Sonipat • **Sampling design:** Purposive multistage sampling • **Sample size:** 60 farmers from Sonipat district were interviewed • **Statistical design/methods:** Descriptive statistics, resource use efficiency and other suitable tools related to the study were used.
viii	**Observations recorded**	• Cost and prices of various inputs and outputs • Perception related constraints in adoption of mechanical transplantation of paddy.

ix. Results achieved during 2021-22

Cost and returns of paddy under mechanical and conventional methods

The costs and returns of paddy under mechanical and conventional methodsare presented in table 1.The gross returns from paddy under mechanical and conventional method was estimated at Rs. 168637.50 and Rs. 147525 per hectare, while the total cost of cultivation was Rs. 133675 and Rs. 127345 , respectively. The net return from paddy under mechanical and conventional method was Rs. 34962.50 and Rs. 20180 per hectare, respectively. The average production from paddy under mechanical and conventional methods was found to be 46.50 and 40.75 quintals per hectare, respectively.

The most important cost component under mechanical methods were the rental value of land which accounted for 33.94 per cent of total cost followed by harvesting (10.47%) and irrigation (10.44%) and field preparation (9.74%). Similarly, under conventional method the rental value of land which accounted for 33.85 per cent of total cost followed by irrigation (10.60%) and harvesting (10.08%) and field preparation (9.30%). In comparison of both the methods the main difference was found under sowing i.e. almost 40% more and seed cost i.e. almost double in mechanical method. Net return was also founded higher in mechanical as compare to conventional method due to higher yield. The B: C ratio of mechanical method was found 1.26 higher as compare to conventional method i.e. found 1.16.

Table 1: Cost and returns of paddy under mechanical and conventional methods (Rs/ha)

Particulars	Mechanical		Conventional	
	Qty	Value	Qty	Value
Field preparation (no.)	6.7	13022.50 (9.74)	6.4	12437.50 (9.30)
Sowing		**11055.00 (8.27)**		**7775.00 (5.82)**
Seed (Rs.)	**23.50**	1562.50 (1.17)	**11.00**	802.50 (0.60)
Total fertilizers (Rs.)	300.50	9655.00 (7.22)	289.50	9232.50 (6.91)
Total plant protection (Rs.)		10825.00 (8.10)		10737.50 (8.03)
Irrigation (Rs.)	18.6	13950.00 (10.44)	18.9	14175.00 (10.60)
Harvesting (Rs.)		14000.00 (10.47)		13470.00 (10.08)
Total (Rs.)		74067.50 (55.41)		68630.00 (51.34)
Interest on working capital (Rs.)		2592.50 (1.94)		2402.50 (1.80)
Total variable cost (Rs.)		76660.00 (57.35)		71032.50 (53.14)
Management + Risk (Rs.)		9450.00 (7.07)		8887.50 (6.65)
Rental value of land (Rs.)		45375.00 (33.94)		45250.00 (33.85)
Transportation (Rs.)		2187.50 (1.64)		2175.00 (1.63)
Total Cost (Rs.)		133675.00 (100.00)		127345.00 (100.00)
Gross returns (Rs.)	46.50	168637.50	40.75	147525.00
Net returns (Rs.)		34962.50		20180.00
B: C		1.26		1.16

Figures in parentheses are the percentage to the total cost.

Marginal value productivity

The efficiency level of individual resource used under mechanical and conventional methods of transplanting are presented in Table 2. The efficiency of resources was determined with the help of Cobb Douglas production function based on the collected data for mechanical and conventional methods of paddy transplanted. The resources like human labour, machine hours, and fertilizer, seed and plant protection chemicals were the major contributing variables in cultivation of paddy under both the methods of transplanting. The production function analysis fitted for resource use under mechanical method showed that the regression co-efficient of human labour, seed, plant protection and irrigation cost were positive and machine hours and fertiliser were found to be negative. Similarly, under conventional method the regression co-efficient of machine hours, seed, and irrigation cost were positive and human labour, fertiliser and plant protection were found to be negative.

Table 2: Resource use efficiency of mechanical and conventional transplanting method of paddy

Particulars	Mechanical transplanting						
	Gross return	**H.L.**	**M.L.**	**Seed cost**	**Fertilizer**	**Plant protection**	**Irrigation**
GM	11.1	8.4	8.8	6.3	8.2	8.2	8.6
B		0.0	-1.0	0.3	-0.9	-0.3	0.4
MVP		0.0	-1.2	0.5	-1.2	-0.3	0.6
MFC		1.0	1.0	1.0	1.0	1.0	1.0
MVP/MFC		0.0	-1.2	0.5	-1.2	-0.3	0.6
R^2	0.47076						
	Conventional transplanting						
GM	10.99	8.78	8.62	5.57	8.14	8.23	8.64
B		-0.37	0.09	0.44	-0.30	-0.13	0.17
MVP		-0.46	0.12	0.87	-0.40	-0.17	0.21
MFC		1.00	1.00	1.00	1.00	1.00	1.00
MVP/MFC		-0.46	0.12	0.87	-0.40	-0.17	0.21
R^2	0.709202						

The ratio of MVP over MFC in both the methods of transplanting were less than unity which indicates that all these inputs were over utilized and use of these inputs needs to be curtailed for higher returns. As compared in both the methods machine hrs., seed cost, fertilizer and plant protection were more over utilised. The reduction in the use of over utilized inputs will help in reduction of expenses incurred.

Constraints faced by paddy growers in adoption of mechanical transplantation method

Major constraints in adoption of mechanical transplanting methods highlighted by the growers (Table. 3) werelack of local manufacturer (93%) rank I followed by Increase in total cost (90.00%) rank II, High Cost of purchasing and maintaining technology (87%) rank III, Non Availability of training centres (83%) rank IV and Lack of fellow farmers (80%) rank V.

Table 3: Constraints in adoption of mechanical transplantation method in paddy (N=30)

S. No.	Particulars	No. of farmers	Percentage	Rank
1	Proper awareness/knowledge of technology	23	77	VI
2	Inadequate and untimely availability of farm machinery and implements on hire basis	20	67	VIII
3	Small size holdings	22	73	VII
4	Non Availability of training centres	25	83	IV
5	Lack of credit facilities	2	7	XI

6	High Cost of purchasing and maintaining technology	26	87	III
7	Lack of local manufacturer	28	93	I
8	Problem in weed Management	5	17	IX
9	Difficulty in intercultural operation	3	10	X
10	Lack of fellow farmers	24	80	V
11	Increase in total cost	27	90	II

x. Programme of Work for 2022-23: Experiment concluded

Salient finding of the study

- Per net returns from paddy under mechanical and conventional method worked out to be Rs. 34962.50 and Rs. 20180 , respectively. Inadequate local manufacturer (93%), higher total cost of cultivation (90.00%) and more initial investment maintenance cost (87%) were some of the major constraints.

- The per hectare gross returns from paddy under mechanical and conventional method was estimated at Rs. 168637.50 and Rs. 147525 per hectare, while the total cost of cultivation was Rs. 133675 and Rs. 127345 per hectare, respectively.

- Net return was also found to be higher in mechanical as compare to conventional method. Whereas, B: C ratios of mechanical method were estimated to be 1.26 higher as compare to conventional method *i.e.* 1.16.

- Major constraints in adoption of mechanical transplanting methods highlighted by the growers were in adequate local manufacturer (93%), increasing total cost of cultivation (90.00%) and high cost of purchasing and maintaining technology (87%).

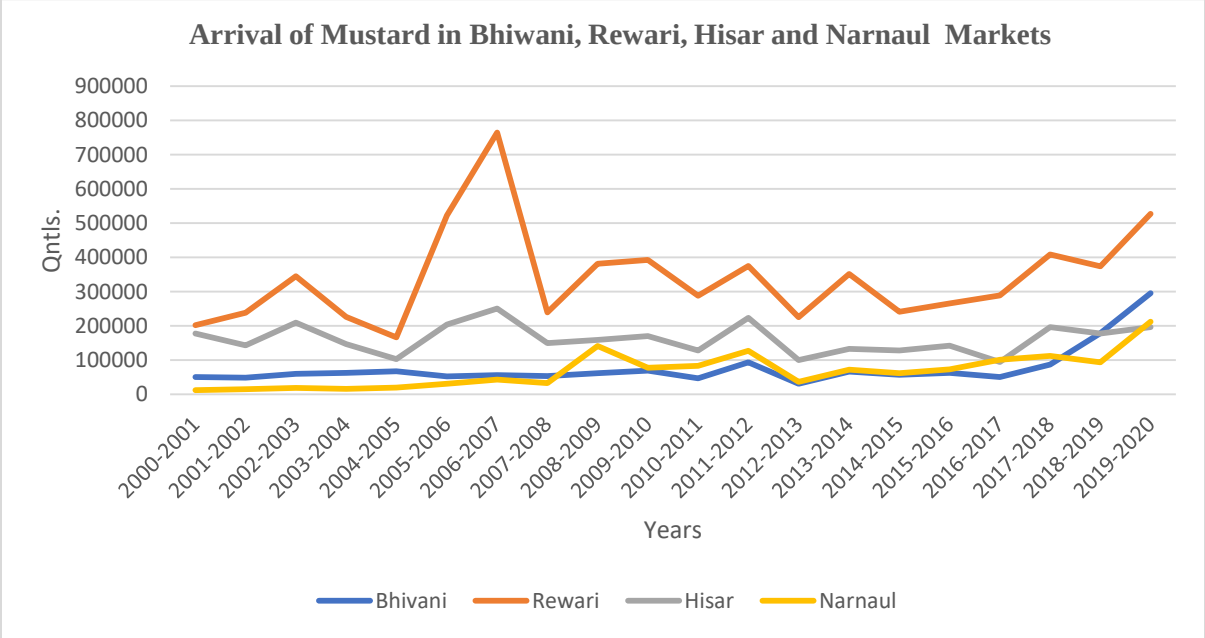
Conclusion

- Per hectare net return from paddy under mechanical and conventional method was Rs. 34962.50 and Rs. 20180 per hectare, respectively. Comparing both methods, expenses incurred transplanting method indicated 40 per cent higher cost involved in transplanting of paddy and almost double cost of seed used in mechanical method. Major constraints in adoption of mechanical transplanting method as highlighted by the growers were lack of local manufacturer (93%) rank I followed by Increase in total cost (90.00%) rank II, High Cost of purchasing and maintaining technology (87%) rank III.

i	**Experiment No. 16: An economic analysis of arrival and price behaviour of mustard in Haryana**	
ii	**Objectives of the experiment**	• To work out trends in price and arrivals of mustard • To analyze seasonal variation of the prices and arrivals of mustard • To suggest appropriate policy measures
iii	**Name(s) of the Investigator**	• Dr Vinay Mehala Data collection and compilation • Dr. Dalip Kumar Bishnoi Report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Monika Devi Analysis of data
v	**Year of start**	• 2021-22
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Hisar, Bhiwani, Mahendergarh, Rewari districts as well as state as whole. • **Time period:** 1999-00 to 2020-21 • **Statistical design/methods:** Descriptive statistics, trend analysis and moving average were used.
viii	**Observations recorded**	• Data related to annual arrivals and prices of mustard were collected.

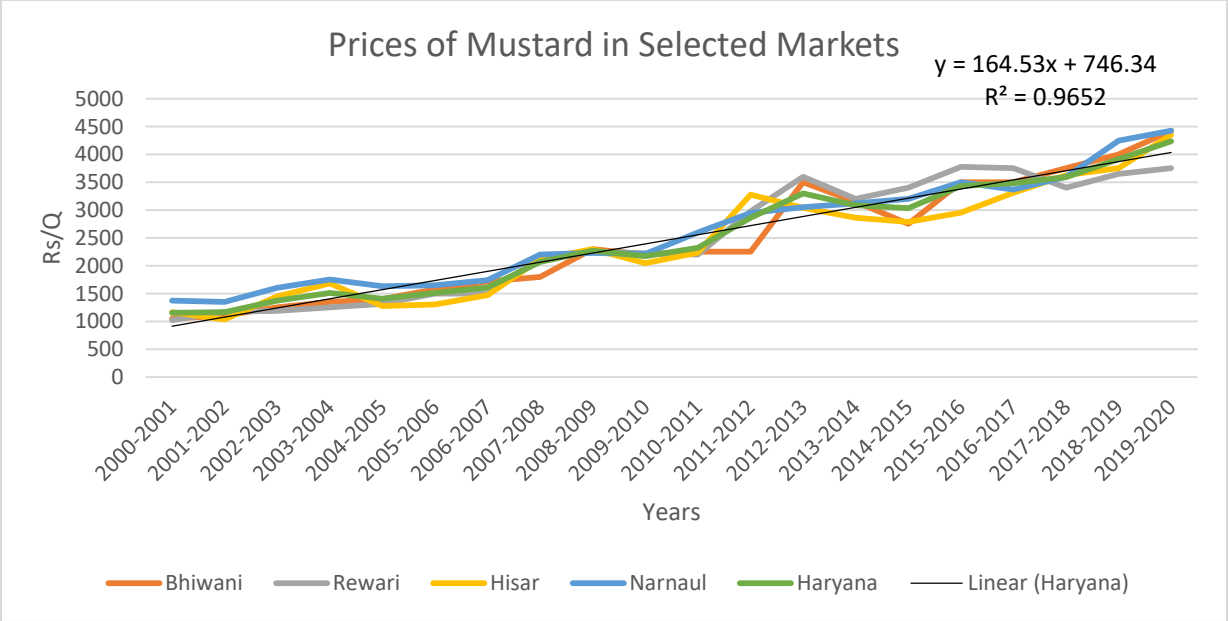
ix Result achieved during the year 2021-22

Trends in arrival of mustard in selected grain markets from 2001 to 2020



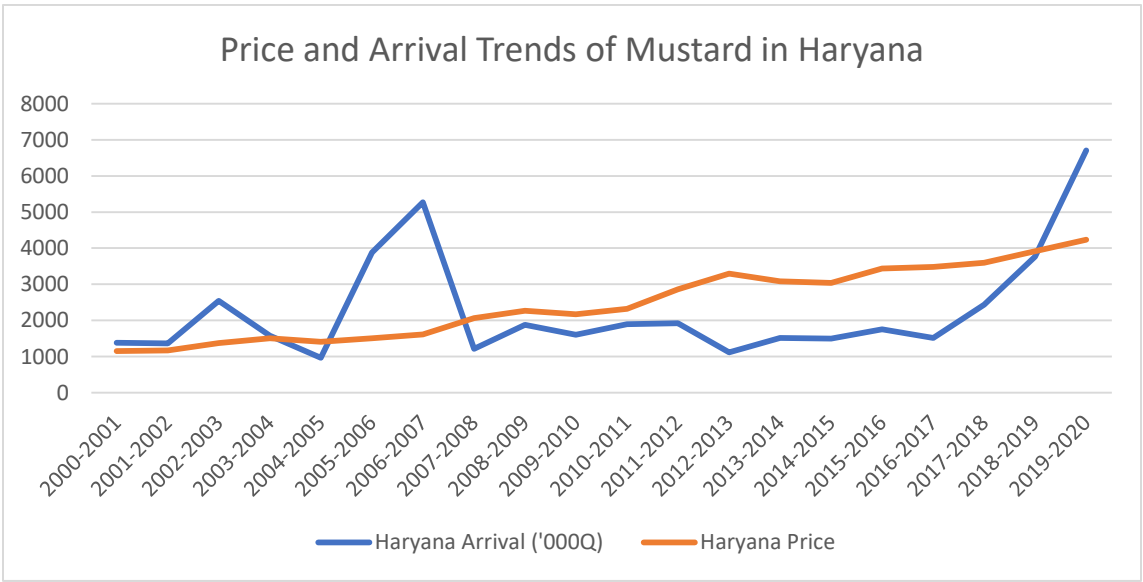
Arrivals of mustard showed almost constant trend from 2001 to 2017. While after year 2017 to 2020, it showed increasing trend. Mustard arrival was observed highest in Rewari market as compared to Hisar, Bhiwani and Narnaul markets in the study area.

Trends in prices of mustard in selected grain markets from 2001 to 2020



Prices of mustard showed an increasing trend from 2001 to 2020 for all four selected markets *i.e.* Rewari, Bhiwani, Hisar and Narnaul as well as in Haryana with high R^2 value *i.e.* 0.96.

Trends in Prices Arrival of Mustard in Haryana from 2000 to 2001



The trend in price of mustard showed increasing from 2001 to 2020 at overall level in Haryana. While, the trend in arrival was found to be constant up to year 2017 and increased after 2017 onwards. Whereas, during the period 2004-2008, wide fluctuations were observed in arrivals of mustard in Haryana.

Table 1: Compound annual growth rate of prices and arrival of mustard in selected grain markets

Sr. No.	Particular	CGR Arrivals	CGR Prices
1	Bhiwani	4.4	7.9
2	Rewari	1.8	8.0
3	Hisar	-0.6	7.3
4	Narnaul	12.9	6.5
5	Haryana	2.7	7.4

It represents one of the most accurate ways to calculate and determine returns for individual assets, investment portfolios and anything that can rise or fall over time. The arrival shows a positive rate for all districts accept Hisar. Whereas, maximum growth rate was observed in Narnaul market *i.e.* 12.9.Similarly, price of mustard also showed positive rate return in all the selected markets over the last 20 years as well as in case of Haryana *i.e.* 7.4and 2.7 per cent in prices and arrivals, respectively (table 1).

Seasonal variation in arrivals of mustard

The positive seasonal trend in mustard arrivals during the month of March to June, showing the maximum arrivals of mustard. In contrast, the season July-October and November-February showed negative variation as the arrival is low compared to the average arrivals (Table 2).

Table 2: Seasonal variation in arrivals of mustard during the year 2000-2020

Year	Season	Variation	Year	Season	Variation
2000-01	Mar-June		2010-11	Mar-June	73.6
	July-Oct	-24.7		July-Oct	-32.0
	Nov-Feb	-33.7		Nov-Feb	-64.5
2001-02	Mar-June	60.5	2011-12	Mar-June	115.8
	July-Oct	-26.1		July-Oct	-51.8
	Nov-Feb	-49.9		Nov-Feb	-29.2
2002-03	Mar-June	89.3	2012-13	Mar-June	50.0
	July-Oct	-40.0		July-Oct	-21.9
	Nov-Feb	-33.0		Nov-Feb	-46.6
2003-04	Mar-June	58.2	2013-14	Mar-June	85.3
	July-Oct	-25.2		July-Oct	-36.5
	Nov-Feb	-27.2		Nov-Feb	-40.4
2004-05	Mar-June	48.1	2014-15	Mar-June	68.8
	July-Oct	-20.9		July-Oct	-30.8
	Nov-Feb	-62.5		Nov-Feb	-39.3
2005-06	Mar-June	114.7	2015-16	Mar-June	70.8
	July-Oct	-51.3		July-Oct	-30.4
	Nov-Feb	-80.3		Nov-Feb	-40.5
2006-07	Mar-June	145.6	2016-17	Mar-June	72.6
	July-Oct	-62.2		July-Oct	-31.3
	Nov-Feb	-37.6		Nov-Feb	-63.3
2007-08	Mar-June	62.3	2017-18	Mar-June	113.7
	July-Oct	-27.8		July-Oct	-50.9
	Nov-Feb	-58.3		Nov-Feb	-59.7

2008-09	Mar-June	105.1	2018-19	Mar-June	107.2
	July-Oct	-47.0		July-Oct	-46.0
	Nov-Feb	-51.4		Nov-Feb	-92.3
2009-10	Mar-June	92.1	2019-20	Mar-June	168.4
	July-Oct	-39.6		July-Oct	-72.1
	Nov-Feb	-41.8		Nov-Feb	

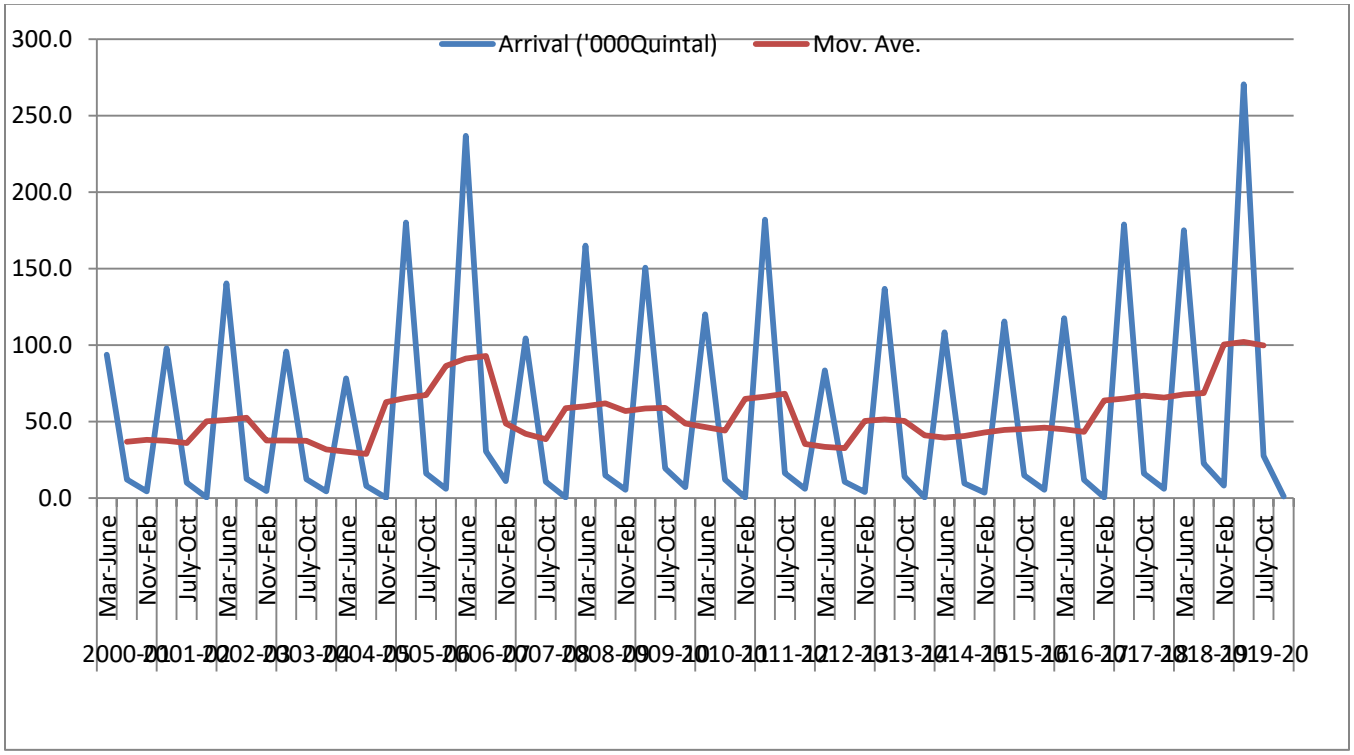
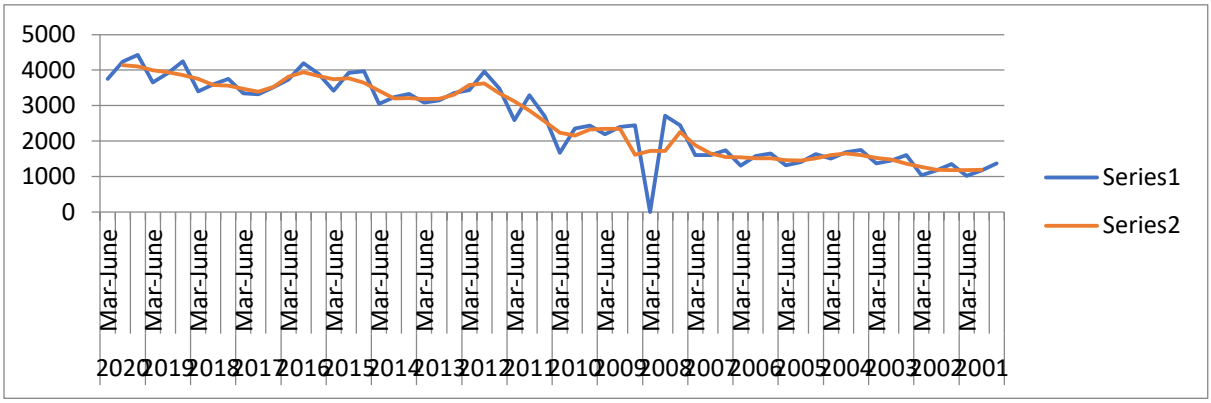


Table 3: Seasonal variation in price of mustard during the year 2000 to 2020

Year	Season	Seasonal Variation	Year	Season	Seasonal Variation
2020	Mar-June		2010	Mar-June	-571.0
	July-Oct	100.0		July-Oct	202.6
	Nov-Feb	320.8		Nov-Feb	104.7
2019	Mar-June	-345.8	2009	Mar-June	-147.8
	July-Oct	-25.0		July-Oct	55.0
	Nov-Feb	395.8		Nov-Feb	827.0
2018	Mar-June	-348.0	2008	Mar-June	-1718.3
	July-Oct	12.6		July-Oct	995.7
	Nov-Feb	187.8		Nov-Feb	190.8
2017	Mar-June	-127.4	2007	Mar-June	-283.4
	July-Oct	-73.5		July-Oct	-42.5
	Nov-Feb	-9.3		Nov-Feb	189.4
2016	Mar-June	-77.9	2006	Mar-June	-234.7
	July-Oct	253.2		July-Oct	64.8
	Nov-Feb	57.3		Nov-Feb	136.7
2015	Mar-June	-326.0	2005	Mar-June	-141.8
	July-Oct	151.8		July-Oct	-44.7
	Nov-Feb	323.5		Nov-Feb	115.5
2014	Mar-June	-369.7	2004	Mar-June	-98.6
	July-Oct	32.0		July-Oct	35.0
	Nov-Feb	111.9		Nov-Feb	148.7
2013	Mar-June	-104.5	2003	Mar-June	-151.6
	July-Oct	-46.7		July-Oct	-24.5
	Nov-Feb	44.1		Nov-Feb	238.2
2012	Mar-June	-148.5	2002	Mar-June	-232.7
	July-Oct	331.5		July-Oct	-15.3
	Nov-Feb	139.2		Nov-Feb	170.0
2011	Mar-June	-530.2	2001	Mar-June	-158.3
	July-Oct	431.7		July-Oct	-20.0
	Nov-Feb	144.3		Nov-Feb	



Policy measures:

- There is need to strengthen rural warehouses/ godowns, along with proper implementation of pledge finance scheme to stabilize the arrival and price volatility
- Dissemination of market information related to arrivals and prices of mustard towards farmers
- To boost up processing of mustard, there is need to create the oil extraction facilities in mustard crop dominated area
- Need to create awareness regarding uses of the mustard oil as edible oil for better health benefits.

x. Programme of Work for 2022-23: Experiment concluded

Salient finding of the study

- Arrivals trend of mustard showed almost constant from year 2001 to 2017. While after year 2017 to 2020, it showed increasing trend. Mustard arrivals were observed highest in Rewari market as compared to Hisar, Bhiwani and Narnaul markets in the study area.
- Prices of mustard showed an increasing trend from 2001 to 2020 for all four selected markets *i.e.* Rewari, Bhiwani, Hisar and Narnaul as well as in Haryana with high R^2 value *i.e.* 0.96.
- The positive seasonal trend in arrivals of mustard during the month of March to June, showing the maximum arrival of mustard in this season.
- The CGRs of arrivals of mustard exhibited positive sign in Bhiwani (4.4%), Rewari(1.8%), Narnaul (12.9%) and state as whole (2.7%) except Hisar (-0.6%) during the period 2001-20.The CGRs for mustard market price over period reflected positive sign.
- There is need to strengthen rural warehouses/ godowns for storage of produce to get higher prices in lean period.

Conclusion

Study concluded that arrivals trend of mustard showed almost constant from year 2001 to 2017. While after year 2017 to 2020, it showed increasing trend as area shifted from less remunerating crops like barley, gram. While, Prices of mustard showed an increasing trend from 2001 to 2020 for all four selected markets *i.e.* Rewari, Bhiwani, Hisar and Narnaul as well as in Haryana. The seasonal trend in arrivals of mustard showed that maximum arrival of mustard was observed during the month of March to June.

II. New Experiments planned for the 2022-23

i	**Experiment No. 1: Economic evaluation of peach cultivation in Haryana.**	
ii	**Objectives of the Experiment**	• To work out cost and returns of peach cultivation • To identify the production constraints in peach cultivation
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Planning, finalization of interview schedule • Dr. Sumit Data collection and report writing
iv	**Name (s) of the collaborators with activity profile**	• Dr. Monika Devi Tabulation and analysis of data • Dr. Rajpal Dalal Technical assistance in preparation of interview schedule and survey
v	**Year of start**	• **2022-23**
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of the experiment**: Eastern & Western zone of Haryana • **Number and types of respondents:** 30 peach growers from each selected zone will be surveyed randomly. • **Statistical design/methods:** The statistical tools like mean, percentage, Pay-back period and NPV etc. will be used
viii	**Observations to be recorded**	• Data related seed, agro-chemicals, human labour, inputs and output prices will be collected. • Information related to production constraints of peach cultivation will be recorded.

i	**Experiment No. 2: Assessment of pink bollworm damage on productivity of Bt. cotton in Haryana**	
ii	**Objectives of the Experiment**	• To estimate the damage of pink bollworm on cotton productivity • To study technological gap related to pink bollworm control strategies among cotton growers • To identify the constraints in implementation of pink bollworm control strategies.
iii	**Name (s) of the investigators**	• Dr. Dalip Kumar Bishnoi Data collection and report writing • Dr. DP Malik Planning, finalization of interview schedule
iv	**Name (s) of the collaborators with activity profile**	• Dr. Dr Anil Jakhar Technological evaluation of effect of pink bollworm on cotton productivity
v	**Year of start**	• **2022-23**
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of the experiment**: Bhiwani, Hisar, Fatehabad and Sirsa districts • **Number and types of respondents:** 15 cotton growers one from control and rest 14 from farmers' practices from each selected district, total 60 respondents will be surveyed randomly. • **Statistical design/methods:** The statistical tools like mean, percentage, etc. will be used
viii	**Observations to be recorded**	• Data related seed, agro-chemicals, human labour, inputs and output prices will be collected. • Information related to constraints perceived in implementation of pink bollworm control strategies will be recorded.

i	**Experiment 3: Climate change and wheat yield in Sirsa district**	
ii	**Objectives of the experiment**	• To study the trends in area, production and productivity of wheat • To explore the trend pattern of weather parameters • To analyse the effect of weather parameters on wheat yield
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Compilation and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. D.P. Malik Technical report writing • Dr. ML Khichar Technical assistance in data compilation and report writing
v	**Year of start**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Sirsa • **Crop:** Wheat • **Period:**1990-2020 • **Statistical design/methods:** Descriptive and explorative data analysis, weather indices, time series models and some other suitable statistical techniques subject to need of study will be used.
viii	**Observations to be recorded**	• Time series data on area, production and yield of wheat crop will be collected. Weather data on rainfall, minimum and maximum temperature will be collected.

i	**Experiment 4: An assessment of crop diversification in Haryana**	
ii	**Objectives of the experiment**	• To study the trends and variation in area covering major crops in Haryana • To analyse the extent of crop diversification at district level in Haryana
iii	**Name(s) of the Investigator**	• Dr. Monika Devi Planning and analysis of data • Dr. Joginder Collection and Compilation of data
iv	**Name(s) of the collaborator(s) with activity profile**	• Dr. Dalip Kumar Bishnoi Technical report writing
v	**Year of start**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Crop:** Major crops of Haryana • **Period:** 2000-2021 • **Statistical design/methods:** Descriptive and explorative data analysis, Herfindahl Index, Entropy Index and Simpson's Diversification Index(SDI) will be used.
viii	**Observations to be recorded**	• District wise time series data on crop acreages will be collected.

i	**Experiment 5 : Economic analysis of solar photovoltaic system and diesel unit system for irrigation of crops in Haryana**	
ii	**Objectives of the experiment**	• To work out the economics of solar photovoltaic system and diesel unit system for irrigation • To understand constraints in adoption of solar water pump sets for irrigation
iii	**Name(s) of the investigators**	• Dr. Neeraj Pawar Planning, monitoring, finalization of interview schedule, Collection and compilation of data • Dr. Sumit Report writing
iv	**Name(s) of the collaborator**	-
v	**Year of start**	2022-23
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Districts covered:** Hisar, Bhiwani and Jhajhar • **Statistical design/methods:** Purposive multistage sampling, Descriptive statistics etc. will be used
viii	**Observations to be recorded**	• 60 farmers (20 from each district) will be interviewed regarding fixed and variable expenses involved in the installation of diesel and solar irrigation pump i.e. cost of solar module, cost of pump, cost of mounting structure and cost of accessories etc. • Opinion of farmers will be collated for the constraints to be identified in installation of solar photovoltaic system

i	**Experiment 6 : Economics and determinants of fish production in Haryana**	
ii	**Objectives of the experiment**	• To study the cost and returns structure of fish production. • To find out the determinants of fish production in the study area. • To identify constraints faced by fish farmers in fish production.
iii	**Name(s) of the investigators**	• Dr. Neeraj Pawar Finalization of interview schedule, collection and compilation of data • Dr. Sumit Report writing
iv	**Name(s) of the collaborator**	Dr. Monika Devi (Stat.) (Analysis of data)
v	**Year of start**	2022-23
vi	**Duration of study**	One Year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Districts to be covered:** Rohtak and Hisar, • **Statistical design/methods:** Purposive multistage sampling, Descriptive statistics, linear regression analysis will be used
viii	**Observations to be recorded**	• 50 farmers will be interviewed to collect information regarding various input used, output prices, explanatory variables (Pond area, pond age etc.) • Opinion of farmers will be collated for the constraints to be identified in fish production

i	**Experiment No. 07 : Economic analysis of direct seeded rice (DSR) vis-à-vis transplanted rice in Haryana**	
ii	**Objectives of the experiment**	• To work out the costs and returns of direct seeded rice and transplanted rice cultivation • To analyse the resource use efficiency in direct seeded rice • To study the constraints impeding the cultivation of direct seeded rice.
iii	**Name of the investigators**	• Dr. Sumit Finalization of schedule, compilation and analysis of data. • Dr. D.P. Malik Report writing
iv	**Name of the collaborator with activity profile**	• Nil
v	**Year of study**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Karnal, Kurukshetra and Yamunanagar • **Sampling design:** Purposive multistage sampling • **Number of respondents:** 60 farmers i.e. 30 farmers each from direct seeded rice (DSR) and 30 farmers from transplanted rice. • **Statistical design/Method:** Descriptive statistics, appropriate production function technique will be used.
viii	**Observations to be recorded**	• Inputs used i.e. seeds, agro-chemicals, labour used etc. • Costs and prices of inputs and output • Constraints in cultivation of direct seeded rice

i	**Experiment No. 08: Economic analysis of hybrid vis-à-vis high yielding varieties of vegetables in Haryana**	
ii	**Objectives of the experiment**	• To work out the costs and returns of hybrid and high yielding varieties of vegetable cultivation • To analyses the resource use efficiency in hybrid and HYVs of vegetables • To study the opinion of vegetable growers in cultivation of hybrid/HYVs of vegetables.
iii	**Name of the investigators**	• Dr. Sumit Finalization of schedule, compilation and analysis of data. • Dr. Neeraj Pawar Report writing
iv	**Name of the collaborator with activity profile**	• Nil
v	**Year of study**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Nuh (Mewat) and Panipat district • **Sampling design:** Purposive multistage sampling • **Number of respondents:** From Nuh and Panipat districts, okra and bottle gourd vegetables will be selected. 40 farmers i.e. 20 farmers from each district further 10 farmers from hybrid and 10 farmers from high yielding varieties will be selected. • **Statistical design/Method:** Descriptive statistics and appropriate production function technique will be used
viii	**Observations to be recorded**	• Inputs used i.e. seeds, agro-chemicals, labour used etc. • Costs and prices of inputs and output • Opinion of growers in cultivation of vegetables

i	**Experiment No. 9: Forecasting of prices of mustard in Haryana: An application of Time Series Model**	
ii	**Objectives of the experiment**	• To study the status of production and price of mustard crop in Haryana • To develop price forecast models of mustard crop
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, execution and analysis of data • Dr. Monika Devi Data analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Nil
v	**Year of start**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment:** Haryana • **Crop: Mustard** • **Period:** 2010-2021 • **Statistical design/methods:** Explorative data analysis, time series models and some suitable statistical techniques subject to need of the study will be used.
viii	**Observations to be recorded**	• Monthly time series data of prices and yearly production of mustard crop will be collected from statistical abstract of Haryana

i	**Experiment No. 10: An application of hybrid time series models in forecasting of prices of vegetable crops in Haryana**	
ii	**Objectives of the experiment**	• To develop forecast models for price of vegetable crops • To check predictive performances of developed models
iii	**Name(s) of the Investigator**	• Dr. Joginder Planning, execution and data collection Dr. Monika Devi Data analysis and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	Dr. DP Malik Technical report writing
v	**Year of start**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment: Haryana** • **Crop: Tomato, Potato, Onion, Cauliflower** • **Period:** 2010-2021 • **Statistical design/methods:** Explorative data analysis, time series models and some suitable statistical techniques subject to need of the study will be used.
viii	**Observations to be recorded**	• Monthly time series data of prices and arrivals of vegetable crops will be collected APMC markets of Haryana

i	**Experiment No. 11 : Assessment of Pradhan Mantri Fasal Bima Yojna in Haryana**	
ii	**Objectives of the Experiment**	• To examine the status and determinants of crop insurance scheme in Haryana • To assess the constraints faced by farmers in insurance of crops
iii	**Name (s) of the investigators**	• Dr. Janailin S. Papang: Data collection, extraction, compilation, processing, analysis of data, report writing • Dr Sanjay: • Data collection, analysis of data and report writing.
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2022-23
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• Locale of experiment: Haryana • Data: NSS data (77^{th} round, 2019) for 1^{st} objective, Primary data with sample size of 60 farmers for 2^{nd} objective • Statistical design/methods: Descriptive statistics and logit regression model will be applied.
viii	**Observations to be recorded**	• From the secondary data, the information will be extracted to evaluate the status of crop insurance and other determinants at farmers' level. • From primary data, issues related to awareness, procedure, documentation and various constraints faced by farmers in availing crop insurance will be studied.

i	**Experiment12: Production and marketing of guava in Haryana**	
ii	**Objectives of the experiment**	• To estimate cost and return of Guava. • To examine price spread in Guava • To identify constraints faced by farmer in production and marketing of Guava
iii	**Name of the investigators**	• Dr. Vinay Mehala Preparation of schedule, compilation, analysis of data and Report writing
iv	**Name of the collaborator with activity profile**	• Nil
v	**Year of study**	• 2022-23
Vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of the experiment:** Hisar, Mewat and Yamunanagar • **Sampling design:** Purposive multistage sampling • **Number of respondents:** 20farmers for each district • **Statistical design/Method:** Descriptive statistics, appropriate production function technique will be used.
viii	**Observations to be recorded**	• Inputs used i.e. seeds, agro-chemicals, preparatory tillage, labour used etc. • Costs and prices of inputs and output • Marketing costs, margins and price-spread • Constraints in production and marketing of Guava

i	Experiment No. 13: An economic study on alternative cropping system in eastern Haryana	
ii	**Objectives of the Experiment**	• To examine the cost and returns of various alternative crops in eastern Haryana • To assess the constraints faced by farmers in growing the selected alternative crops
iii	**Name (s) of the investigators**	• Dr. Sanjay Data collection, compilation, analysis of data, and report writing • Dr Dalip Kumar Bishnoi Data collection, compilation and analysis of data
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2022-23
vi	**Duration of study**	• 1 Year

vii	**Treatment details**	• **Locale of experiment:** Eastern Haryana
		• **Crops selected:**
		  • Conventional cropping systems of field crops i.e. Rice-Wheat, Sugarcane.
		  • Summer Moong, Maize will be selected as alternative Kharif crops and Spring Maize, Sunflower will be selected as alternative to Rabi crops.
		  • Guava and muskmelon as alternative fruit crops.
		  • Marigold and Gerbera as alternative floricultural crops
		  • Lady finger and Tomato as alternative vegetable crops
		• **Data:** Secondary data collected by DES in case of Rice, Wheat and Sugarcane will be used. Primary data will be collected from 20 respondents for each remaining crop.
		• **Statistical design/methods:** Cost concepts and descriptive statistics will be used.

viii	**Observations to be recorded**	• Cost and returns on selected crops will be collected from the sample farmers in respective district and various constraints face by farmers in production will be studied.

i	**Experiment No.14 : An economic study on alternative cropping system in western Haryana**	
ii	**Objectives of the Experiment**	• To examine the cost and returns of various alternative crops in western Haryana • To assess the constraints faced by farmers in growing the selected alternative crops
iii	**Name (s) of the investigators**	• Dr. Janailin S. Papang: Analysis of data and report writing • Dr Neeraj Pawar: Data collection and compilation of data
iv	**Name (s) of the collaborators with activity profile**	• Nil
v	**Year of start**	• 2022-23
vi	**Duration of study**	• 1 Year
vii	**Treatment details**	• Locale of experiment: Western Haryana • Pearl millet, *kharif* moong and cluster bean will be selected as alternative *kharif* crops, mustard, barley and carrot (vegetable) as alternative *rabi* crops in Mahendergarh district. • Kinnow, guava, ber and mustard as alternative crops in Hisar, Sirsa, and Fatehabad districts. • Primary data with sample size of 20 farmers for each crop will be selected. • Statistical design/methods: Cost concepts and descriptive statistics will be used.
viii	**Observations to be recorded**	• Cost and returns on selected crops will be collected from the sample farmers in respective district and various constraints face by farmers in production will be studied.

i	**Experiment No. 15: To study income and expenditure pattern of farm income in Haryana**.	
ii	**Objectives of the experiment**	• To workout the farm income of household from different enterprises • To study expenditure pattern of farm income of household
iii	**Name(s) of the Investigator**	• Dr Vinay Mehala Preparation of schedule, Data collection, compilation of data and report writing
iv	**Name(s) of the collaborator(s) with activity profile**	• Nil
v	**Year of start**	• 2022-23
vi	**Duration of study**	• One year
vii	**Treatment details**	• **Locale of experiment: Haryana** • **Sampling design:** Purposive multistage sampling • **Sample size:** 40 farmers from Eastern and 40 from western zone of Haryana will be selected randomly • **Statistical design/methods:** Descriptive statistics will be used to dram the inference of the experiment.
viii	**Observations to be recorded**	• Data related to income and expenditure of farm household will be collected

Other Agencies

Comprehensive Scheme for studying the Cost of Cultivation of Principal Crops in India-Haryana

(Funded by Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Govt. of India)

1. **Scheme No:** 3066-C(c) Econ.-I. (CS)
2. **Year of start**: 1970
3. **Location** : Haryana
4. **Objectives of scheme**: To provide representative and quality data on cost of cultivation of principal crops in Haryana. The detailed objectives are as under:
   - To facilitate data entry at Tehsil / Village level, making the process of data collection, validation and compilation efficient through ICT enabled Web based System.
   - To facilitate processing of data and generation of query based report at Central level.
   - To monitor the functioning of field men, field supervisors and Field Officers at different levels through workflow based system.
   - To scrutinize and validate the data entered by field men at the level of field supervisor and field officer through the envisaged workflow based system.
   - To reduce the time lag in reporting of data.
5. **Any need to modify the objectives as per need of the state**: Nil
6. **Constraints, if any :** Post of Field Officer lying vacant and shortage of Agriculture Inspectors
7. **Name of investigators with activity profile:**

Name of Scientist	**Name of cluster allotted**
Dr. D.P. Malik Honorary Director	Monitoring and supervision of all 30 clusters selected in different zones of Haryana
Field Officer (Vacant)	All 30 cluster selected in different zones of Haryana.
Dr.Sumit RRS Kaul	Dhakal, Mundhri, Bhagal, Sarsa, Ameen, Harnaul, Gaduali, Gogripur, Salwan, Bhambhewa (10).
Dr.NeerajPawar, RRS Rohtak	Alawalpur, Dipalpur, Kheri Damkan, Samar Gopalpur, SisarKhas, Silani, NayaGaon, Mandola, Mahrana, Kinnana (10).
Dr.VinayMehla Deptt. Agril. Economics	Sawant Khera, Sarsana, Ladwi, Dhamana, Phangal, Dulheri, Beeran, Sohasra, Akanwali, KharaKheri (10).
Dr. Joginder	Checking and scrutinized RT-wise data for both *kharif* and *rabi* seasons in computer lab, removal of discrepancies in data as reported by funding agency. Exporting the data in excel and checking the all outliers in online data entries and resolution of queries raised by agriculture inspectors.

8. Budget for the year 2021-22 (head wise sanction and expenditure details) (Rs.)

S. N.	Particulars	Allotment	Fund received	Expenditure	Over expenditure to allocation	Over expenditure to funds received
1	Pay	18030000	9000000	12243690	NIL	NIL
2.	ADA	2900000	3000000	2892659	NIL	NIL
3.	GPF	2200000	3000000	1202880	NIL	NIL
4.	TA	1150000	4700000	90973	NIL	NIL
5.	Gratuity	1749000		1702992	NIL	NIL
6.	Medical	400000		282374	NIL	NIL
7.	LTC	400000		0	NIL	NIL
8.	OE(O)	70000		0	NIL	NIL
9.	PSS	7500000		3990550	NIL	NIL
	OE(NR)	30000		0	NIL	NIL
10.	Other Charges	511000		478416	NIL	NIL
11.	M & S	10000		7979	NIL	NIL
12.	POL	50000		21143	NIL	NIL
	Sub-Total	**35000000**	**19700000**	**22913656**	Nil	Nil
	Deficit for 2020-21			**1129864**		
	Total	**35000000**	**19700000**	**24043520**	**Nil**	**4343520**

Meeting/training of Agriculture Inspectors conducted by respective supervisors/statistician during 2021-22

Name of supervisor	Date and month	Venue of meeting/ training	No of AIs present	Issues discussed
Dr. NeerajPawar RRS, Rohtak	17.08.2021, 03.11.2021, 21&22.12.2021, 13.06.2022	RRS/KVK RTK RRS Bawal RRS/KVK RTK RRS/KVK RTK	10 04 09 09	Technical issues related to collection of quality data and regarding discrepancies in online data
Dr. VinayMehala Deptt.Agril. Economics	27.12.2021	Deptt. Agril. Economics	09	Technical issues related to collection of quality data and regarding discrepancies in online data
Dr. Sumit RRS Kaul	21.01.2021, 06.07.2021, 21.08.2021, 16.12.2021, 05.04.2022	RRS, Kaul RRS, Kaul RRS, Kaul RRS, Kaul RRS, Kaul	08 09 09 06 09	Final checking of online data entries & data discrepancies in schedule and online data, issue related to collection of *Kharif* and *Rabi* data and issues related to online data entries in FARMAP 2.0 software.
Dr. Joginder Deptt.Agril. Economics	17.08.2021, 03.11.2021, 21&22.12.2021, 13.06.2022	RRS/KVK RTK RRS Bawal RRS/KVK RTK RRS/KVK RTK	10 04 09 10	Technical issues related to collection of quality data and regarding discrepancies in online data

i	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of *kharif* crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data. **Dr.NeerajPawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.VinayMehala** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Joginder** Validation, rectification, RT wise check list, corrections in online data.
iv	**Names of Collaborators with activity profile**	Nil
v	**Year of start**	2021-22
vi	**Locale of experiment**	**Haryana**
vii	**Observations recorded**	• Information was collected on daily basis by A.I.s. • Data was recorded in schedules and data entries were done in software by agriculture inspectors. • Monthly checking of data at each cluster in physical record and software was done by supervisors/scientists.

ix. Results achieved during *Kharif* 2021-22

- The cost of cultivation data of *kharif* crops grown in Haryana state namely paddy, cotton, pearl millet, cluster bean, jowar, maize, mungbean, pigeon pea etc. was collected from 30 centres/clusters located in different agro-climatic zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers of thirty (30) clusters were contacted daily by agriculture inspectors to extract relevant information during *kharif* season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	Name of supervisor	Clusters visited (No.)	Farmers interacted (No.)	Schedules checked (No.)	Remarks
July	Dr. NeerajPawar	05	14	12	
	Dr. VinayMehala	03	06	00	
	Dr. Sumit	-	30	25	Contacted on telephone
August	Dr. NeerajPawar	05	11	16	
	Dr. VinayMehala	07	11	21	
	Dr. Sumit	06	21	15	
September	Dr. NeerajPawar	06	12	18	
	Dr. VinayMehala	02	11	20	
	Dr. Sumit	05	20	28	
October	Dr. NeerajPawar	06	16	21	
	Dr. VinayMehala	02	07	19	
	Dr. Sumit	04	14	21	
November	Dr. NeerajPawar	05	10	22	
	Dr. VinayMehala	03	14	30	
	Dr. Sumit	08	18	36	
December	Dr. NeerajPawar	05	15	10	
	Dr. VinayMehala	01	03	10	
	Dr. Sumit	10	25	23	

- Supervisors visited regularly and check data in records as collected by A.Is from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.
- The information recorded by A.Is was also crossed checked from the farmers by supervisors, field officer and Hon. Director through interaction during visit at cluster.
- At the end of the season, the online data entries were forwarded to supervisor by A.Is and the data was thoroughly checked in the software with physical records.
- During *kharif* season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- The online data entries in new software (FARMAP 2.0) for *kharif* season of year 2021-22 have been completed in the month of January, 2022 and data were submitted to funded agency in the month of February, 2022.

i	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of *Rabi* crops. • Supervision and cross check of data. • Regular monitoring of work of agriculture inspectors. • Timely submission of data to funding agency.
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data. **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO.

		Dr. Vinay Mehala Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr.Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Joginder** Validation, rectification, RT wise check list, corrections in online data.
iv	**Names of Collaborators with activity profile**	Nil
v	**Year of start**	2021-22
vi	**Locale of experiment**	**Haryana**
vii	**Observations recorded**	• Information was collected on daily basis by A.I.s. • Data was recorded in schedules and a data entry was done in software by agriculture inspectors on monthly basis. • Monthly checking of data at each cluster in physical record and software was done by supervisors/scientists.

viii. Results achieved during *Rabi* 2021-22

- The cost of cultivation data of *rabi* crops of Haryana state namely wheat, gram, rapeseed & mustard, sugarcane, summer mungbean, onion etc. were collected from 30 centres /clusters located in different agro-climatic zones of Haryana state by cost accounting method. 10 farmers from each cluster were selected and in total 300 farmers were contacted for collection of data related cost of cultivation of crops during *Rabi* season.
- Three supervisors are working in the scheme and 10 clusters were monitored by each supervisor.
- The detail of visits under taken by supervisors for monitoring of work of Agriculture Inspectors is given under as:

Month	**Name of supervisor**	**Clusters visited (No.)**	**(Farmers interacted (No.)**	**schedules checked (No.)**	**Remarks**
January	Dr. NeerajPawar	07	21	08	
	Dr. VinayMehala	03	07	20	
	Dr. Sumit	04	12	10	
February	Dr. NeerajPawar	07	26	21	
	Dr. VinayMehala	-	-	-	On leave
	Dr. Sumit	06	21	20	
March	Dr. NeerajPawar	09	28	23	
	Dr. VinayMehala	-	-	-	On leave
	Dr. Sumit	10	35	22	
April	Dr. NeerajPawar	07	20	14	
	Dr. VinayMehala	06	07	32	
	Dr. Sumit	07	17	24	
May	Dr. NeerajPawar	06	28	15	
	Dr. VinayMehala	05	14	34	
	Dr. Sumit	10	29	18	

June	Dr. NeerajPawar	07	28	35	
	Dr. VinayMehala				
	Dr. Sumit	07	25	32	

- Supervisors visited regularly and checked data in records as collected by A.I.s from ten (10) identified farmers of each cluster.
- Online data entries made by A.I.s were also checked by supervisors on monthly basis.
- The information recorded by A.Is was also crossed checked supervisors, field officer and Hon. Director from the farmers through interaction during visit at cluster.
- At the end of the season, the online data entries were forwarded to supervisor by A.I.s and the data was thoroughly checked in the software with physical records.
- During *rabi* season, trainings/meeting at supervisor level were organised for updating of the data record to reduce the discrepancies and to improve quality of data.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.

Submission of data

- Final submission of data for *rabi* season will be done to funding agency in the month of July, 2022 as data for *Kharif* of season has submitted to funding agency in the month of February, 2022.
- Validation of data for *kharif* and *rabi* seasons for the year 2021-22 will be done in the month of July, 2022.
- Weighing diagram as required by funding agency was also prepared and will be submitted in due course of time.
- The online data entries in new software (FARMAP2.0) for *rabi* season of year 2021-22 is in progress for submission to the funding agency.

Trainings/Meetings proposed

- The computer trainings about online data entries in new software were imparted to Agriculture inspectors 2021-22 and resolved problems of online data entries.
- Meetings of A.Is were organized by supervisors during 2021-22 to discuss about data discrepancies, coding of items**,** proper maintenance of data records, new codes of some items, keeping daily operation record etc.

Work done in computer lab

- The discrepancies in unit level data for all *Rabi* crops as reported by funding agency in May-June, 2020 were checked, corrected and re-submitted again well in time.
- Doubtful cost items of sugarcane crop for the year 2019-20 and 2020-21 were rechecked, corrected and re-submitted again well in time.
- Doubtful items of irrigation cost and insecticides cost of gram crop for the year 201-20 and 2020-21 were rechecked, corrected and re-submitted again well in time.
- Doubtful cost items of *Rabi* crops (wheat, gram, rapeseed & mustard and sugarcane) for the year 2020-21 were rechecked, corrected and re-submitted again well in time.
- The online data entries for *Kharif* season have already submitted to the funding agency and for *Rabi* season, it will be submitted by the end of July, 2022.

- Checking and scrutinized the RT-wise data for both *Kharif* and *Rabi* seasons, data entries in new software FARMAP 2.0 and exporting the data in excel for checking the all outliers in online data entries was done regularly.
- Various queries raised by agriculture inspectors in online data entries for 2021-22 have been resolved.

9. Justification for continuation of scheme:

The scheme was started in 1970 with an objective to collect quality data from farmers for various *kharif* and *rabi* crops in each season of every year to provide basis for fixation of MSP at national Level. The scheme is to be continued taking into consideration-increased use of purchased inputs, mechanization of farm operations etc. to work out cost of cultivation of principal crops by providing farm level information for fixation of MSP to benefit farmers for sustainable production of crops in India including Haryana state.

10. Salient Achievements during 2021-22

- The cost of cultivation of nine important crops of Haryana state namely, paddy, cotton, pearl millet, sugarcane, wheat, gram, rapeseed & mustard, summer mungbean and onion were collected from clusters located in different agro-climatic zones of Haryana state by cost accounting method.
- To maintain the accuracy in the field data, strict supervision of data collection work was done and collected data were checked at random.
- The data entries in FARMAP 2.0 software for the *rabi* and *kharif* seasons for the year 2020-21 have been submitted in August, 2021, to Ministry of Agriculture and Farmers Welfare, Govt. of India, New Delhi for further analysis. The results of which are used by the Commission for Agricultural Costs and Prices (CACP) for fixing the Minimum Support Prices of *Kharif* and *Rabi* crops at national level.
- The online data entries in new software (FARMAP 2.0) for *Kharif* season of year 2021-22 have been submitted in the month of February, 2022. The submission of online data entries for *rabi* season is in progress and will be completed by the end of July 2022.
- The work of data entry operators, progress of online data etc. in computer lab of cost of cultivation scheme was closely monitored to ensure timely submission of data to funding agency.
- The discrepancies in data as reported by funding agency were rechecked, corrected and re-submitted again well in time.
- The Kharif data for the year 2021-22 have been sent after validating the same on online portal to COC/DES.
- Doubtful cost items received from DES, Delhi of the crops Bajra, Cotton, Paddy and Moong for the year 2020-21 have been corrected/updated on online portal and the same has been sent to DES through mail.
- Crop Complex Selection for the year 2023-26 has been sent after validating the same to COC/DES through mail.
- Zone Wise Area Estimates of Crop Complex for year 2020-23 has been completed and the same has been submitted to DES.
- After consulting with field men, all discrepancies received form funding Agency have been corrected and sent back to the funding agency.

New experiments planned for the year 2022-23

i	**Experiment No:1**	**Studying the cost of cultivation of *Kharif* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of kharif crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data. **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Vinay Mehala** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Joginder** Validation, rectification, RT wise check list, corrections in online data.
iv	**Names of collaborators**	Nil
v	**Year of start**	2022-23
vi	**Locale of experiment**	**Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisor • Random checking of data by SRO/field officer
i	**Experiment No: 2**	**Studying the cost of cultivation of *Rabi* crops in Haryana**
ii	**Objectives**	• Collection of data on cost of cultivation of rabi crops • Supervision and cross check of data • Regular monitoring of work of agriculture inspectors • Timely submission of data to funding agency
iii	**Name of Investigators with Activity Profile:**	**Dr. D.P. Malik** Planning, execution, monitoring, overall supervision **Vacant (Field officer)** Monitoring, supervision, checking & verification and submission of data. **Dr. Neeraj Pawar** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Vinay Mehala** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Sumit** Supervision, checking, verification of data in interview schedules and online submission to field officer/SRO. **Dr. Joginder** Validation, rectification, RT wise check list, corrections in online data.
iv	**Namesof collaborators**	Nil
v	**Year of start**	2022-23
vi	**Locale of experiment:**	**Haryana**
vii	**Observations to be recorded**	• Collection of information on daily basis by A.I.s • Monthly checking of data at each cluster in record and software by supervisors • Random checking of data by SRO/field officer

A. LIST OF PG STUDENTS OF DEPARTMENT

S.N.	Name of Student	Adm. No.	Title of Research Problem	Major Advisor
Ph.D. students				
1.	SadhanalaSwetha	2015A02D	Dynamic of major oilseeds and pulses in India	Dr. V.P. Mehta
2.	Sunita	2016A02D	A study to develop optimum combination of farm enterprises in Haryana	Dr. V.P.Mehta
4.	Davinder Pal Singh	2017A06D	Contract farming in Haryana and Punjab: An Economic prospective	Dr.K.K.Kundu
6.	Nitin Sharma	2018A04D	Economic analysis of chemical fertilizers in India.	Dr.R.S.Pannu
7.	HarshitBansal	2019A06D	Extent of land and water degradation in Haryana-An economic analysis	Dr.NeerajPawar
8.	ManpreetKaur	2019A07D	Economic Evaluation of Climate smart agriculture technologies in Haryana	Dr. D.P. Malik
9.	Nisha	2019A08D	Assessment of socio-economic impact of Agro-Metrological Advisory Services in Haryana	Dr. K.K. Kundu
10.	Ritu	2019A09D	Comparative economic analysis of major floricultural crops in Sonepat and Gurgaon districts of Haryana	Dr. J.K. Bhatia
11.	Ajay Singh	2020A02D	Production efficiency and farming systems in Haryana	Dr. U.K. Sharma
12.	ChenavaliKarnakar	2020A03D	Production, marketing and value chain analysis of nutri-cereals in India	Dr. D.P. Malik
13.	Dinesh Kumar	2020A04D	Production, utilization and value addition in coarse cereals and oilseeds in Haryana	Dr. K.K. Kundu
14.	MohitSehal	2020A05D	An economic analysis of residue management of paddy-wheat in Haryana	Dr. Dalip Bishnoi
15.	SambhuSindhuja	2021A03D	Growth and instability analysis of crop production in India	Dr. D.P. Malik
16	Sonia	2021A04D	Profitability and sustainability of peri-urban agriculture in National Capital Region of Haryana	Dr.K.K.Kundu
Foreign Ph.D. students				
1.	KabirAbdulaziz	2018A01D	Value chain analysis of staple foods and dairy Products in Haryana	Dr.K.K.Kundu
M.Sc. students				
1.	Mandeep Kumar	2019A03M	An Economic Analysis of spring maize cultivation in Haryana	Dr. R.S. Pannu
2.	Manoj Kumar	2019A04M	An economic analysis of nutria-millets cultivation in India	Dr.NeerajPawar
3.	Pooja Rani	2019A06M	Assessing the economic viability of solar photovoltaic water pumping system in agriculture in Haryana	Dr. D.K. Bishnoi
4.	Raj RatanPandey	2019A07M	An economic analysis of production and marketing sweet corn in Sonipat district in Haryana	Dr.Parminder Singh
6.	SagarRawal	2019A08M	A study on the effect of custom hiring centres on paddy and wheat cultivation in Haryana	Dr. Ashok Kumar
7.	Sonia	2019A010M	Assessment of Kisan Credit Card Scheme in Haryana	Dr. D.P. Malik

8.	Aarti	2020A01M	Economic analysis of production and processing of cluster bean (cymopsis tetragonoloba) in Southern Haryana	Dr.Gulab Singh
9.	Indu	2020A03M	An economic analysis of sprinkler irrigation in Southern Haryana	Dr. Sanjay Kumar
10.	Manasa M S	2020A04M	An economic analysis of carrot cultivation in Haryana	Dr.Janailin S Papang
11.	Raveena Bishnoi	2020A05M	An economic analysis of super seeder technology of wheat cultivation in Haryana	Dr. Vijay Kumar
12.	Sahil	2020A06M	Performance of Agriculture in different districts of Haryana	Dr.VinayMehla
13.	Aakashdeep	2021A01M	An economic analysis of muskmelon production and marketing in Haryana	Dr.Parminder Singh
14.	Jinkle	2021A03M	An economic analysis of sugarcane based intercropping systems in Yamunanagar district of Haryana	Dr. Veer Sain
15.	Mafi	2021A04M	An economic analysis of structural changes and growth in Haryana agriculture	Dr. K.K. Kundu
16.	NaseebChaudhary	2021A05M	Farmers perception of climate change and adaptation strategies in Haryana	Dr. U.K. Sharma
17.	Nisha	2021A06M	An economic analysis of production and processing of groundnut in Haryana	Dr.NeerajPawar
18.	ShankrolJagadesh	2021A133M	Comparative economic analysis of watermelon cultivation in Haryana and Karnataka	Dr. Ashok Dhillon
Foreign M.Sc. students				
1	JawidRahman	2019A02M	An Economic Analysis of potato cultivation in India and Afghanistan	Dr. J.K. Bhatia
2	Nyein Aye Khine	2019A05M	An Economic analysis of production and trade performance of pulses in India vis-à-vis Myanmar	Dr. K.K. Kundu
3	SediquallahZahid	2019A09M	Export and import performance of major fruits and dry fruits in India vis-à-vis Afghanistan	Dr. D.K. Bishnoi
4	Syed Bahaudin	2019A011M	A study on economics of wheat cultivation in Afghanistan and India	Dr.Nirmal Kumar
5	SayadSanaullahHabibi	2020A134M	Production and export performance of spices in India	Dr.Kavita
6	MohmmadHussain	2020A135M	Production and export scenario of major fruits in India vis-à-vis Afghanistan	Dr.Sumit

B. List of Publications: 2021-22

Sr. No.	Particulars	NAAS Rating (2022)	Source
Research Papers			
1.	Abdulaziz, K., Kundu, K.K. and Malik, D.P. (2021). Growth and economic profitability of rice cultivation in Haryana. *Asian Journal of Extension, Economics & Sociology*,39(11): 20-27.	4.86	Student Thesis
2.	Baljit Kaur, Kundu, K.K. and Nitin Sharma (2021). Constraints in the diffusion of e-NAM and the policy measures. *Asian Journal of Extension, Economics & Sociology* 39(11): 20-27.	4.86	Student Thesis
3.	Devi, M., Kumar, J., Malik, D.P. and Mishra, P. (2021).An inter-district analysis of instability and sustainability for major crops in Haryana, *Economic Affairs*, 66 (2): 217-223.	5.08	TP
4.	Kumar, D., Bishnoi, D.K., Kumar, R., Sumit and Dhaka, A.K. (2021). Quantification of incremental benefits and change in input use pattern under laser land levelling in comparison with conventional land levelling in Haryana. *Economic Affairs*, 66(2): 259-263.	5.08	Student Thesis
5.	Kumar, D., Bishnoi, D.K., Kumar, V., Godara, A. and Singh, A. (2021). Comparative analysis of land levelling technology and conventional land levelling in cotton-wheat cropping pattern with respect to irrigation and water productivity in Haryana. *The Pharma Innovation Journal*, SP-10(4): 263-265.	5.23	Student Thesis
6.	Kumar, D., Bishnoi, D.K. and Mehla, V. (2021). Comparative analysis of laser land levellingvis-a1vis conventional land levelling in Karnal district of Haryana. *Asian Journal of Extension, Economics & Sociology*, 39(3): 135-144.	4.86	Student Thesis
7.	Kumar, D., Bishnoi, D.K., Mehla, V. and Malik, A.K. (2021). Comparative analysis of resource use efficiency under laser land levelling and conventional land levelling in cotton-wheat cropping pattern of Sirsa. *Journal of Soils and Crops*, 31(1):63-68.	4.50	Student Thesis
8.	Kumar, N., Kumar, J., Bishnoi, D.K., Bhatia, J.K. and Baskaur (2021). Assessment of Farm Level Post-harvest Losses in Wheat in Haryana, *Economic Affairs*, 66(04): 593-598.	5.08	TP
9.	Mahajan, S., Papang, J.S., Indu and Sharanagouda B. (2021). Impact of rising food prices on food security in Rajasthan and Gujarat. *Indian Journal of Agricultural Sciences*, 91(4): 559–562.	6.37	Review
10.	Mahajan, S., Papang, J.S., Panchal, Indu, Sharanagouda B. and Singh, Man (2021). Consumption pattern of livestock products and their nutritional contribution in northern hill states of India. *Indian Journal of Animal Sciences* 91(9):780-785.	6.32	Review
11.	Malik D.P. (.2021).Global Chickpea Production and Instability with Special Reference to India for Trade and Policy Options. *African-Asian Journal of Rural Development*, 54(1): 07-52.	----	Review
12.	Malik, D.P., Pawar, N., Devi, M., and Sanjay (2021). Trailing towards Self-Reliance in Pulses. *Agricultural Situation in India* (7): 10-24.	___	Review
13.	Nisha, Malik, D.P. and Kundu, K.K. (2021). "Inclusive growth in India and its elements: A Review. *Journal of community Mobilization and Sustainable Development*, 16(3): 833-843.	5.67	Credit Seminar
14.	Nyein Aye Khine, Kundu, K.K., Malik, D.P. and Devi, M. (2021). "Production and trade performance of Blackgram (Vignamungo) and greengram (Vigna radiate) in India and Myanmar", *Asian Journal of Extension, Economics & Sociology*, 39(10): 213-243.	4.86	Student Thesis
15.	Singh, J., Pawar, N., Sangwan, M., Siwach, M., Panghal, V., Duhan, D.S. and Gaur, R.K. (2021). Enhancing the Productivity of summer moong through cluster front line demonstration in Rohtak, Haryana. *Green Farming*, 12(5&6): 240-243.	3.85	Extension

16.	Abdulaziz,K., Kundu K.K. and Malik, D.P.(2022). Rice value chain systems in Haryana: an economic analysis. *Economic Affairs*. 67(01-Spl.): 133-142.	5.08	Student Thesis
17.	Bhatia, J.K., Bishnoi, D.K., Dhingra, A. and Nimbrayan, P.K. (2022). Arrival and price behaviour of major mustard markets in Haryana. *Indian Journal of Extension Education,* 58(2):177-180.	5.95	NASF Project
18.	Deep, V., Girdhar, A., Goyal, S.K., Bishnoi, D.K., Kumar, M. and Sehrawat, P.S. (2022) Study of potato growers in Haryana with special reference to production constraints. *Economic Affairs*, 67(01): 71-74.	5.08	Student Thesis
19.	Devi, M., Kumar, J. and Malik, D.P. (2022). Statistical Evaluation of regional Level Agricultural and socio- economic development in Haryana. *Indian Journal of Ecology*, 49(3): 938-944.	5.79	TP
20.	Devi, M. and Mehla, V. (2022). Trends and growth pattern of major pulses crops in Haryana. *International Journal of Education & Management Studies*, 12(2): 84-86.	4.58	Review
21.	Kumar, V. and D.P. Malik. (2022). Trends and economic analysis of chickpea (*cicerarietinum*) cultivation in India with special reference to Haryana. *Legume Research- An International Journal*, 45 (2):189-195.	6.59	Review
22.	Malik,D.P., Devi, M. and Reddy, A.A.(2022).Global status of lentil production with special reference to India. *Indian Journal of Agricultural Sciences*, 92 (4):474-479.	6.37	Review
23.	Amita Mor, Jatesh Kathpalia, Vinod Kumari, Ashok Godara, **Dalip Kumar Bishnoi** and Sangeeta C Sandhu (2022) Health problems of elderly women in urban and rural areas of Haryana: a sociological study. *The Pharma Innovation Journal*, SP-11(2): 1099-1104.	5.23	Student Thesis
24.	Mehla, V., Devi, M., Supriya and Ray, S. (2022). Constraints faced by farmers and intermediaries to getting minimum support price (MSP) in Haryana. *International Archive of Applied Sciences and Technology,* 13(1):16-18.	4.36	TP
25.	Mehla, V., Devi, M., Supriya and Das, S.S. (2022). Gap analysis of MSP and harvest price of principal crops in Hisar district of Haryana. *International Archive of Applied Sciences and Technology* 13(1):12-15.	4.36	TP
Book Chapter			
1.	Mahajan, S., Papang, J.S., Indu and Sharanagouda B. (2021). Role of Livestock Products in Food Security of Northern Hill States of India. In: *Vulnerability to Food and Nutrition Insecurity in Mountain Regions: Unique Challenges and Niche Opportunities* (Bhagat, D. and Singh, R., (eds.), New Delhi Publishers, India.	ISBN 978-93-91012-36-6	Review