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Editorial

The female employment in India is a subject of dispute as it has direct relationship with female empowerment. It has been observed that female participation rate in employment has steadily reduced over time from 36 percent to 24 percent in a decade. It has been also observed that the gender gap in labour force participation rate is more than 50 percentage points in India. The fact is that women workers often constitute the most vulnerable of the workforce as they are employed in the least secure, informal, unskilled jobs, engaged in low-productivity and low-paying work. Due to low economic empowerment of women, it is of overriding importance driving low female employment. Gender differences and consequently preference for the male child and adult has an impact on the economic capacities of women from birth. All these lead to inadequate health and education opportunities, from a very young age. Malnutrition and lack of education prevents women from being healthy contributing members of the work force. While access to education for females has increased, many scholars have theorized that as education empowers women, employment choices for them become tougher. Both social norms and lack of quality employment opportunities have an impact on the employment options for women with secondary and tertiary education. Lack of quality employment opportunities is especially valid for rural regions, employment opportunities in rural areas have not kept pace with the growth in the urban regions. The unemployment rate for women in the rural population is 47/1000 which is significantly higher when compared to male which is standing at 21/1000. While domestic duties are a major impediment to any kind of employment, few or the lack of major formal employment opportunities for rural population have particularly hurt the progress of economic empowerment for females. Even entrepreneurship opportunities for rural population are hard to come due to lack of banking infrastructure in the far-flung areas and weak market linkages in others. It is safe to say that while these factors hurt the economic interests of all population, they especially have an overwhelming impact of female employment as they are the more vulnerable gender. In spite of the various programmes of the government, the country has not made great strides in female employment or entrepreneurship, as shown by the declining trend. It is clear from the observations that policy actions, while essential,cannot be fully effective in the absence of deeper structural changes in society with regard to attitudes towards women. The country will need to formulate economic and social strategies that work parallel to overcome the challenge.

Debashis Sarkar

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Socio-Economic Impact of Protected Cultivation on Tomato Growers of Himachal Pradesh

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ABSTRACT

Agriculture occupies the most prominent position in Himachal Pradesh, as it is the mainstay of more than 69 per cent of the state's population. Since the state is exposed to constraints such as shrinking land holdings coupled with perceptible changes in weather and climate, protected cultivation has emerged as the best alternative for using land and other resources efficiently. The main aim of this technology is to enhance the socio-economic conditions of the farmers. Therefore, the present study was conducted to analyse the cropping pattern, production and productivity of major crops being cultivated under protected conditions and to study its impact in crop productivity, employment and income (farm income and total household income) generation and income variability. In order to have a better insight, the factors under consideration were compared to the open-field conditions. The study is based on primary data collected through survey method for the agricultural year 2015-16. The data had been collected from 60 tomato (30 open-field and 30 polyhouse) growers, selected through proportional allocation method from Kangra District of Himachal Pradesh. The study revealed that protected cultivation had a significant impact in enhancing the crop productivity and was approximately three times higher in comparison to the open-field conditions. The labour utilization pattern on protected cultivation was found to be almost four times higher than that of the open- field cultivation indicating a significant contribution in enhancing the employment opportunities. The average farm and household income of the protected growers was observed to be increased by about 25 and 11 per cent, respectively with the adoption of protected technology in the study area. The income variability of the protected growers was also found to be less in comparison to the open-field growers indicating lesser risk and higher stability of income generated by the protected growers in the study area. Therefore, it can be concluded that protected cultivation has a significantly positive impact in improving the socio-economic conditions of the farmers in the study area and suits well to the agro-climatic conditions prevailing in the hilly areas like Himachal Pradesh.

Highlights

- Protected cultivation had a significant impact in enhancing the crop productivity, employment and income generation.
- Protected cultivation attains more stable income than open- field cultivation.

Keywords: Employment generation, farm income, household income, income variability, open-field cultivation, productivity, protected cultivation, tomato cultivation

Agriculture occupies the most prominent position in the economy of Himachal Pradesh as it is the mainstay of more than 69 per cent of the state's population. Efforts are afoot to make Himachal Pradesh self-sufficient in agriculture production and also in improving the economy of farmers. The state has a great potential for producing horticultural crops especially vegetables in different seasons under varied conditions. Horticultural

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produce has high demand in the international markets in both fresh and processed forms (Kallega *et al.* 2015). With increase in economic standards, urbanization, international market integration and trade liberalization, the demand for horticultural products is expected to increase even further (Meena *et al.* 2016). The area, production and productivity of different vegetable crops in the state had shown a significant increase of about 51 per cent and 73 per cent, respectively in the last decade i.e. from the year 2005-06 to 2015-16. Moreover, the area and production under tomato in the state had also shown a significant increase by about 20 per cent and 61 per cent from 2005-06 to 2015-16, respectively (Department of Agriculture, Government of Himachal Pradesh, Shimla). There is still a vast scope for expansion of vegetables in the state as only about 10 per cent of the total cropped area has been brought under vegetable cultivation till now. The state is subjected to a great variation in agro-climatic conditions which ranges from sub-humid sub-tropical to dry temperate zone and due to the extreme climatic conditions such as heavy rainfall, long winter season, high velocity winds, snowfall, frequent dry spells etc., the farmers cannot opt for cultivation of input sensitive and highly remunerative cash crops like vegetables and mostly are constrained to grow only one crop in a year with low levels of productivity. Therefore, in the present scenario of shrinking land holdings, coupled with perceptible changes in weather and climate, protected cultivation has emerged as the best alternative for using land and other resources efficiently.

Many state sponsored schemes have been implemented for the promotion of protected cultivation. The Departments of Agriculture and Horticulture as well as 12 KVKs of 2 SAUs have worked together to make this enterprise a great success in the state besides being benefited from KVK–ATMA (Agricultural Technology Management Agency) convergence. The government is providing large scale subsidies to the farmers to popularize protected cultivation. Presently, 85 per cent project assistance (*Dr. Y.S. Parmar Kisan Swarojgar Yojna)* is being provided to the farmers. Also for the creation of water sources individually and collectively by a group of farmers (low/medium lift, pumping machinery), 50 per cent subsidy is being provided by the state. Protected cultivation technology aims at enhancing the socio-economic characteristics of the farmers and to generate a higher income, employment and a decent standard of living to the small and marginal framers of the state. Therefore, keeping in view the significance of protected cultivation in the state, the present study was conducted to analyse its socio-economic impact on the tomato growers with following specific objectives:

(i) To study the cropping pattern, production and productivity under protected cultivation and

(ii) To study its impact in crop productivity, employment and income (farm income and total household income) generation and income variability.

MATERIALS AND METHODS

The present study was conducted in Kangra district of Himachal Pradesh. This district was purposively selected for the study as among various districts of Himachal Pradesh, Kangra has vast potential for diversification and commercialization of agriculture through vegetable crops that are highly remunerative and best suited to hills and to the small sized land holdings. Moreover, the district is also having very high potential in protected farming and commands about 15 per cent of the total area under protected cultivation (259.63 ha) in the state. (Department of Agriculture, Government of Himachal Pradesh, Shimla).

Within Kangra district, the study was conducted in two blocks namely Baijnath and Bhedu Mahadev. Two-stage random sampling technique was followed to choose a sample of two development blocks in the first stage and the ultimate growers in the second and final stage of sampling. Out of these lists, random samples of 30 protected growers and 30 open-field growers were selected from the two blocks through proportional allocation method. To have a better insight, the protected growers were then post stratified into small (<250 m^2) and large (≥250 m^2) categories using cumulative cube root method. Thus, a total of 17 small and 13 large protected growers were found out of a sample of 30. The primary data collected on survey schedules were tabulated to work out averages, ratios and percentages. The socio-economic aspects of tomato growers were studied through tabular analysis technique. The tabular analysis used for the study has been described below:

Proportional allocation method

The following formula was used for the selection of tomato growers from the selected blocks:

$$n_i = \frac{N_i}{N} \times n \qquad i = 1,2$$

where,

n_i= Number of farmers to be sampled in i[th] block

N_i = Total number of farmers in i[th] block

N = Total number of open-field/ protected growers

n = Total sample size to be chosen from the open-field/ protected growers

Coefficient of variation

In probability theory and statistics, the coefficient of variation, also known as relative standard deviation (RSD), is a standardized measure of dispersion of a probability distribution or frequency distribution. The coefficient of variability was used to analyse the income variability of the sample protected and open- field growers. The following formula was used:

$$\text{C.V. (\%)} = \frac{S.D.}{\bar{Y}} * 100$$

where,

C.V. is the coefficient of variation

S.D. is the standard deviation

$\bar{Y}$ is the mean of the mean/ average

RESULTS AND DISCUSSION

Cropping pattern under protected conditions

Protected cultivation is a specialized farming activity where in high value cash crops are grown. The selection of most profitable crops and cropping system holds the key for capital intensive venture. The cropping pattern followed under protected conditions has been shown in Table 1. On an average, per farm total cropped area under protected cultivation was estimated to be 332.77 m^2. The maximum cropped area was found to be under tomato (52.59%) followed by capsicum (21.04%) and cucumber (14.83%). The total cropped area under protected conditions on large farms was 507.46 m^2 while that on small farms was 199.18 m^2. Tomato was the predominant crop on both the small (50.50 %) and large farms (53.66 %), respectively, which might be mainly due to more suitability of the crop in the study area. The overall cropping intensity was worked out to be 176.91 per cent and it varied from 172.11 per cent on large farms to 187.07 per cent on small farms, indicating towards more intensive cultivation by the small protected growers.

Table 1: Cropping pattern on sample farms under protected conditions (m^2/farm)

Sl. No.	Crop	Small	Large	Overall
1	Capsicum	35.00 (17.57)	115.85 (22.83)	70.03 (21.04)
2	Tomato	100.59 (50.50)	272.31 (53.66)	175.00 (52.59)
3	Cucumber	30.65 (15.39)	73.77 (14.54)	49.34 (14.83)
4	Beans	22.35 (11.22)	26.15 (5.15)	24.00 (7.21)
5	Others	10.59 (5.32)	19.38 (3.82)	14.40 (4.33)
	Total cropped area	199.18 (100.00)	507.46 (100.00)	332.77 (100.00)
	Net cultivated area	106.47	294.85	188.10
	Cropping intensity (%)	187.07	172.11	176.91

Note: *Figures in parentheses indicate percentages to the total in each category.*

Production and productivity under protected conditions

Table 2 shows the production and productivity levels of major crops being cultivated under protected conditions in the study area. On an overall basis, cucumber gave the highest yield (38.07 q/400 m^2) followed by tomato (31.17 q/400 m^2) and capsicum (21.92q/100 m^2). In case of small farms, the productivity per 400 m^2 for capsicum, tomato, cucumber and beans was estimated to be 25.83q, 33.84q, 37.20q and 3.76q, respectively, while for large farms, it was 16.80q, 27.68q, 39.20q and 4.88q, respectively. Sharma *et al.* (2013) also reported higher productivity for small polyhouse units in comparison to the large polyhouse units.

Table 3 reveals that protected conditions are having a significant impact in increasing the crop productivity by a minimum of 41.20 per cent (beans) and a maximum of 415.16 per cent (cucumber) as compared to the open-field conditions. On an average, the productivity obtained under protected conditions was approximately three times higher than that of the open-field conditions. Kumar and Arumugam (2010) and Kumar *et al.* (2016) also observed that the growth and yield parameters of different vegetables were significantly enhanced under protected over open- field. Similar results were also observed by Sethi *et al* (2003). Parvej *et al.* (2010) found that microclimatic variability inside polyhouse favoured the growth and development of tomato plant through increased plant height, number of branches per plant, rate of leaf area expansion and leaf area index over the plants grown in open field.

Labourutilization pattern

Protected cultivation is both capital and labour intensive avocation. Trained and skilled labour is one of the most important and critical resource for protected cultivation. Table 4 gives an overview of the operation-wise labour utilization pattern for tomato cultivation under sample protected units.

Table 4: Operation-wise labour utilization pattern for tomato cultivation under protected conditions (man days/400 m^2)

Sl. No.	Particulars	Small	Large	Overall
1	Nursery sowing	2.28 (1.75)	2.56 (2.23)	2.4 (1.94)
2	Field preparation	6.64 (5.09)	5.52 (4.82)	6.16 (4.99)
3	Transplanting	7.2 (5.52)	4.92 (4.29)	6.2 (5.02)
4	Irrigation/ Fertigation	27.48 (21.07)	28.56 (24.93)	27.92 (22.60)
5	Intercultural operations	33.28 (25.52)	31.16 (27.20)	32.36 (26.20)
6	Plant protection measures (spraying)	14.36 (11.02)	6.68 (5.83)	11.04 (8.94)
7	Earthing up	1.8 (1.38)	2.08 (1.82)	1.92 (1.55)
8	Harvesting/ Picking	37.36 (28.65)	33.08 (28.88)	35.52 (28.76)
	Total labour days	130.4 (100.00)	114.56 (100.00)	123.52 (100.00)

Note: *Figures in parentheses indicate percentages to the total in each category.*

Table reveals that on an overall basis, the total labor usage was 123.52 man days/400 m^2. The labour usage on an overall basis was highest in case of intercultural operations (32.36 man days/400 m^2), accounting for 26.20 per cent to the total and varied from 31.16 man days in large polyhouse units to 33.28 man days in small units, respectively. The

Table 2: Production and productivity of different crops under protected conditions

	Small		Large		Overall	
Crop	**Production (q/farm)**	**Productivity (q/400 m^2)**	**Production (q/farm)**	**Productivity (q/400 m^2)**	**Production (q/farm)**	**Productivity (q/400 m^2)**
Capsicum	2.26	25.83	4.87	16.80	3.39	21.92
Tomato	8.51	33.84	18.85	27.68	13.28	31.17
Cucumber	2.85	37.20	7.23	39.20	4.75	38.07
Beans	0.21	3.76	0.32	4.88	0.26	4.25

Table 3: Comparative productivity of major crops under protected and open-field conditions (q/400 m^2)

			Difference between protected and open-field conditions	
Crop	**Protected conditions**	**Open-field conditions**	**Absolute**	**%**
Capsicum	21.92	8.95	12.97	144.92
Tomato	31.17	11.88	19.29	162.37
Cucumber	38.07	7.39	30.68	415.16
Beans	4.25	3.01	1.24	41.20
Total	95.41	31.23	64.18	205.51

next highest labour usage was found to be on irrigation/fertigation purpose (27.92 man days/400 m^2), accounting for 22.60 per cent, on an overall basis. The labour employed on irrigation/fertigation operations was found to be higher in case of large polyhouse units (28.56 man days/400 m^2) as compared to the small units (27.48 man days/400 m^2), respectively. The table further revealed that the total labour usage for tomato cultivation was more on the small polyhouse units (130.40 man days/400 m^2) as compared to that of the large units (114.56 man days/400 m^2). Sharma (2012) also found high labour utilization for tomato cultivation under protected conditions.

Table 5: Comparative labour utilization pattern for tomato cultivation under protected and open-field conditions (man days/ 400 m^2)

Sl. No.	Particulars	Protected conditions	Open-field conditions
1	Nursery Sowing	2.40	1.64
2	Field preparation	6.16	2.91
3	Transplanting	6.20	1.63
4	Irriagation/ fertigation	27.92	6.65
5	Intercultural operations	32.36	10.42
6	Plant protection measures	11.04	2.83
7	Earthing up	1.92	1.61
8	Harvesting/picking	35.52	4.97
9	Total labour days	123.52	32.66

Table 5 gives a comparative analysis of the operation-wise-labour utilization pattern for tomato crop under sample protected and open-field conditions. The table reveals that the labourutilization under protected conditions was almost four times higher than that of the open- field conditions. This clearly reveals that besides increasing the productivity, it is also expected to provide employment opportunities to the unemployed sector (at farmers' and service provider's level), thereby giving additional income to the farmers and their families. Spehia (2015) found high labor utilization for tomato cultivation under protected conditions. Kaur (2009) observed that human labour had a major share in total cost in all enterprise combinations in high-tech polyhouse. Sharma (2012) also observed that the protected cultivation generates on-farm employment to the extent of 126 days on small and 236 days on large category.

Contribution of protected cultivation in gross farm income

Table 6 reveals the contribution of protected cultivation on farm income and total household income of the sample polyhouse growers in the study area.

It can be seen from the table that average annual gross farm income of protected growers was ₹ 2,51,005, at the overall level. Among the two categories, large protected growers had higher farm income (₹ 3,00,572) than small protected growers (₹ 2,10,732). Protected cultivation contributed about 19 per cent towards enhancing the gross farm income of small polyhouse growers and about 30 per cent in case of large growers, respectively. To sum up, it can be concluded that on an overall basis, the average farm income of the polyhouse growers was

Table 6: Contribution of protected cultivation in gross farm income of polyhouse growers

Sl. No.	Particulars	Small		Large		Overall	
		₹/ farm	% to total	₹/ farm	% to total	₹/ farm	% to total
1	Field crops	25,738	12.21	28,744	9.56	27,041	10.77
2	Dairy	76,015	36.07	1,10,382	36.72	90,907	36.22
3	Vegetables (excluding protected cultivation)	69,779	33.12	70,696	23.53	70,176	27.96
3	Protected cultivation						
(i)	Capsicum	7,910	3.75	17,045	5.67	11,865	4.73
(ii)	Tomato	22,005	10.44	50,895	16.93	35,856	14.28
(iii)	Cucumber	8,550	4.06	21,690	7.22	14,250	5.68
(iv)	Beans	735	0.35	1,120	0.37	910	0.36
	Sub total	39,200	18.60	90,750	30.19	62,881	25.05
	Total farm income	2,10,732	100.00	3,00,572	100.00	2,51,005	100.00

Source wise annual gross household income.

Table 7: Contribution of protected cultivation in total gross household income of polyhouse growers (₹/ farm)

Sl. No	Particulars	Protected growers	Open-field growers	Difference between protected and Open-field conditions: Absolute	%
1	Farm income (excluding polyhouse income)	188,124	224,514	-36390	-16.21
2	Polyhouse income	62,881	—	—	—
3	Off-farm income				
(i)	Service	186,154	115,264	70890	61.50
(ii)	Business (shop-keeping)	77,400	40,967	36433	88.93
(iii)	Pension	70,800	45,322	25478	56.22
(iv)	Artisans	—	5,833	—	—
(v)	Daily wage	3,460	6,267	-2807	-44.79
	Sub total	337,814	213,653	124161	58.11
	Total household income	588,819	438,167	150652	34.38

Table 8: Source-wise income variability on sample farms (₹/farm)

Sl. No.	Particulars	Polyhouse growers (including polyhouse income)		Open-field growers	
		Farm income	Total household income	Farm income	Total household income
1	Mean	251005	588818.99	224513.93	438166.83
2	Standard deviation	59067.49	247727.68	111728.17	223438.93
3	Coefficient of variation (%)	23.53	42.07	49.76	50.99

increased by nearly 25 per cent with the adoption of polyhouse technology in the study area.

Income level on the sample farms clearly depicts their socio-economic status. Thus, it is very important to know the contribution of each one activity undertaken by family members to the household income. The annual gross household income of tomato growers under protected and open-field conditions has been divided into two major segments comprising farm income and off-farm income. The results are shown in Table 7. The total annual gross household income of the open-field and protected growers was found to be ₹ 4,38,167 and 588,819, respectively.

Field crops, vegetables and dairying together termed as farm-income were the most important contributor in the gross household income of open-field growers. The contribution of protected cultivation in total household income from all the sources was found to be about 11 per cent. The table further revealed that the total household income of protected growers was 34.38 per cent higher than that of the open-field growers. Similar results were also observed by Mwangi (2012), Singh *et al.* (2011) and Singh and Sirohi (2006). Therefore, it can be concluded that the protected cultivation had a significant impact in enhancing the total household income of tomato growers in the study area.

Income variability

In this section, an attempt has been made to identify the impact of protected cultivation in the stability of farm income and total household income. In order to have a better understanding, a comparative analysis was done for both the open-field and protected growers and the results have been presented in Table 8. The results revealed that the income variability on farm income and total household income was higher in case of open-field growers in comparison to that of the protected growers. This is quite evident from the higher values of coefficient of variation in case of open-field growers (49.76% and 50.99%) in comparison to the polyhouse growers (23.53% and 42.07%).

To sum up, the income variability of protected growers was found to be less in comparison to the open-field growers indicating lesser risk and higher-stability of income generated by the protected growers in the study area.

CONCLUSION

Protected cultivation technology aims at enhancing the socio-economic characteristics of the farmers and to generate a higher income, employment and a decent standard of living to the small and marginal framers of the state. Therefore, the present study pertains to analyse the socio-economic impact of protected cultivation on tomato growers of Himachal Pradesh. The study was based on the field level information collected from protected and open-field growers. The study revealed that protected cultivation had a significant impact in enhancing the crop productivity and was approximately three times higher in comparison to the open-field conditions. The labour utilization pattern on protected cultivation was found to be almost four times higher than that of the open-field cultivation indicating a significant contribution in enhancing the employment opportunities. The average farm and household income of the protected growers was observed to be increased by about 25 and 11 per cent, respectively with the adoption of protected technology in the study area. The income variability of the protected growers was also found to be less in comparison to the open-field growers indicating lesser risk and higher-stability of income generated by the protected growers in the study area. The total household income of polyhouse growers was 34.38 per cent more than that of the open-field growers. The study also observed less income variability of polyhouse growers in comparison to the open-field growers and therefore, it can be concluded that the risk in polyhouse income was low, having a positive effect in the stability of income generated by the polyhouse growers in the study area. Therefore, it can be concluded that protected cultivation has a significantly positive impact in improving the socio-economic conditions of the farmers in the study area and suits well to the agro-climatic conditions prevailing in the hilly areas like Himachal Pradesh.

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An analysis of Market Arrival and Price Behavior of Potato in India

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ABSTRACT

Potato is an integral part of the global food system and the world's number one non food grain commodity. During 2018-19 potato acreage in India was 21.84 lakh ha with a production of 52.58 million tonnes. Major potato growing states are Uttar Pradesh, West Bengal, Bihar, Gujarat, Madhya Pradesh and Punjab. Prices of potato exhibit both inter-year and intra-year variations. This price fluctuation in potato is a major concern among farmers, consumers and policy makers. The current study is an attempt to analyze the behavior of prices and arrivals of potato in the major markets of India. The time series data on the price and arrivals of potato in the major markets of leading producing states were collected from Agmarknet. The data corresponding to the potato prices in future market were collected from MCX (Multi Commodity Exchange of India Ltd.) where it has been traded till 2014. The prices of potato significantly increased over the last ten years compounded annually in all the selected markets. Significant positive growth rate of arrivals was found in Agra and Ahmadabad markets and negative growth rate was found in Jalandhar market. The price and arrivals series have shown significant negative correlation in all the markets. Seasonal indices depict that prices of potato are usually high during the months of October to December and starts declining till April which is in par with the post harvest period of the crop. Price discovery of potato is a complex process and is affected by a number of factors like production, total arrivals, lagged price, future prices, which have been quantified here and other factors like transportation, storage, weather uncertainties and pests and disease attack.

Highlights

- There is huge inter and intra year instability in the prices of potato in India
- Price discovery of potato is affected by a number of factors like production, total arrivals, lagged price, future prices

Keywords: Price behavior, arrivals, prices, potato, seasonality

Potato is an integral part of the global food system and the world's number one non food grain commodity. The crop plays an important role in ensuring food security of present and future generation. Keeping in view the potential of potato in the food security of developing nations, FAO has rightly declared it as 'Future Food Crop'. Considering its importance, United Nations (UN) had declared 2008 as the International Year of Potato. Globally India stands third in terms of area and second in terms of production (52.58 million tonnes) after China. During 2018-19 potato acreage in India was 21.84 lakh ha with a production of 52.58 million tonnes (Indiastat, 2019). Major potato growing states are Uttar Pradesh (30%), West Bengal (24.31%), Bihar (14.15%), Gujarat (7.31%), Madhya Pradesh (6.30%) and Punjab (5.17%) (Indiastat, 2019).

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Prices of potato exhibit both inter-year and intra-year variations. The seasonal variations are caused by changes in area under cultivation in the major growing areas, unexpected weather conditions or outbreak of pests or diseases, price of other vegetables, demand of potato from the major cities and food processing industries, seasonality, transportation charges from one place to another, hoarding, regional concentration of cold storage facilities etc. Harvesting season in important potato producing states in the country comes in between November- December to March-April. Total arrivals of the crop during the year determine to a large extend the intra-year seasonality of prices of potato. Prices of potato starts increasing from April as harvesting season comes to an end in most of the producing centres. During peak arrival period, farmers and traders store potatoes in cold stores in anticipation of selling at higher prices during lean season of April-November. This price fluctuation in potato is a major concern among farmers, consumers and policy makers. The timely and reliable market intelligence is yet to come up to the expectations to meet the growing needs of the potato economy. Market intelligence on aspects like potential markets, pattern of market arrivals and prices in important regional and national markets in different months of a year assumes major significance as the potato production is spread across many states in India (Kumar *et al*. 2006). The current study is an attempt to analyze the behavior of prices and arrivals of potato in the major markets of India.

MATERIALS AND METHODS

Data Collection

The study was undertaken on a macro framework based on secondary data from the leading potato producing states of India i.e., Uttar Pradesh, West Bengal, Bihar, Madhya Pradesh, Punjab and Gujarat. Agra, Burdwan, Patna, Indore, Jalandhar and Ahmadabad were the markets selected from these states respectively for the study. The data on the price and arrivals of potato in the major markets of leading producing states were collected from Agmarknet. The data corresponding to the potato prices in future market were collected from MCX (Multi Commodity Exchange of India Ltd.) where it has been traded till 2014.

Trend analysis

Growth trends for the price series and the arrivals were also worked out using the monthly wholesale price and arrivals data from 2005 to 2014,

$$Y = ae^{bt}$$

$$\text{Or } Ln\ Y = Ln\ a + bt$$

Where, LnY = Real price, arrivals

t = Time (Years)

a = intercept

b = growth rate to be estimated

Intra year trend in prices and arrivals of potato was analyzed by working out the seasonal indices by using twelve year centered moving averages.

Relation between market arrivals and prices

The relation between market arrivals and prices of potato in the major potato producing states was analyzed using Karl Pearson correlation coefficient using monthly data from 2005 to 2014. The degree of relationship for different years was studied.

The correlation coefficient has been computed using the following formula,

$$rxy = \frac{Cov(x,y)}{\sqrt{Var(x).Var(y)}}$$

Factors influencing price of potato

The variation in the prices of potato is caused by a number of factors. To investigate the factors determining the prices of potato in India, multiple regression analysis using linear equation was carried out using time series data of variables from 2006 to 2014. Yearly data of prices and arrivals were used for the analysis.

$$Y_1 = a + b_1\, x_1 + b_3 x_2 + b_4 x_3 + \ldots. + b_n\, x_n + u_2$$

Where,

Y_1 = Prices of potato

a = Constant terms

u = Error term

$b_1, b_2, b_3 \ldots b_n$ =Coefficients of different explanatory variables.

$x_1, x_2, x_3 \ldots x_n$ = Explanatory variables i.e.

x_1 = Production of potato,

x_2 = lagged prices of potato

x_3 = Future prices of potato

x_4 = Arrivals of potato

RESULTS AND DISCUSSION

Potato like other agricultural commodities is seasonal. Accordingly, its arrivals in markets vary over the months. Cold storage operations of potato also determine the pattern of arrivals which is ultimately reflected with the pattern of its prices. The trends in these behaviors of arrivals and prices were examined and presented in this section.

Analysis of trend component in price series involves ascertaining the general direction of movement of prices over several years. Simple regression models like linear regression model, quadratic regression model and exponential regression model were tried. Considering the multiple regression coefficient and standard error, exponential regression model was found to be best and hence the results of the same were considered for discussion. Compound growth rates of arrivals and prices and prices of potato were also calculated.

Overall, the prices of potato significantly increased over the last ten years compounded annually in all the selected markets. The prices exhibited significant positive exponential trend over the years. Prices in Agra market have shown highest growth rate (11.50%) followed by Ahmadabad (10.50%), Patna (9.70%), Indore (9.0%), Burdwan (8.90%) followed by Jalandhar (6.10%).

Positive exponential trend in the arrivals of potato was seen in Agra, Patna, Indore and Ahmadabad. Significant growth rate of 49 per cent in the arrivals of potato was seen in Agra market followed by 3.50 per cent in Ahmadabad market. A significant negative growth rate of 7.20 per cent was seen in Jalandhar market. Burdwan market also showed negative growth rate in potato arrivals during the ten year period.

The phenomenon of inverse relationship between market arrivals and prices is well known in agricultural commodities. Nevertheless, factors like availability of cold storage facilities, the increased opportunities for export and import of these commodities due to trade liberalization, the value-addition through agro-processing etc not only weaken this negative relationship, but also in many cases, may turn it positive. This is more true for potato as it uses about 80 percent of total cold storage facilities that exist in our country (Khurana *et al*, 2002). The degree of relationship for different years from 2005 to 2014 was studied by computing correlation coefficients between market arrivals and prices of potato as shown in Table 2.

It can be observed from the table that most of the time period considered, the price and arrivals series

Table 1: Trend component in prices and arrivals of potato (₹/ton) in potato markets

Month	Intercept	Coefficient	t-value	SE	R^2	CAGR (%)
Prices						
Agra	3202.53	0.11	2.23	0.32	0.55	11.50***
Patna	4201.77	0.09	2.79	0.30	0.49	9.70**
Burdwan	4129.27	0.09	2.05	0.38	0.35	8.90*
Indore	4095.18	0.08	3.844	0.2	0.649	9.0*
Jalandhar	3242.33	0.06	1.57	0.34	0.24	6.10(NS)
Ahmadabad	4950.40	0.10	5.20	0.17	0.78	10.50***
Arrivals						
Agra	21267.50	0.34	3.35	0.36	0.67	49.00***
Patna	997.50	0.02	0.27	0.60	0.01	1.80(NS)
Burdwan	121403.20	-0.06	-2.39	0.32	0.29	-6.20(NS)
Indore	52991.07	0.04	1.19	0.274	0.15	3.60(NS)
Jalandhar	55658.60	-0.08	-2.09	0.33	0.35	-7.20**
Ahmadabad	141688.00	0.04	2.64	0.09	0.47	3.50**

****-significant at 1% level**-significant at 5%, *-significant at 10%.*

Table 2: Relationship between Market Arrivals and Wholesale Prices of Potato in major potato markets in India from 2005-2014-Correlation Coefficients

Year	Agra	Patna	Burdwan	Indore	Jalandar	Ahmadabad
2005	-0.68**	-0.27	-0.56*	-0.66**	0.12	-0.11
2006	0.19	0.80***	-0.82***	-0.64**	-0.76***	-0.05
2007	0.03	0.23	-0.38	-0.50	-0.66**	-0.38
2008	-0.534*	0.50	-0.06	-0.24	0.01	-0.30
2009	-0.70**	-0.67**	-0.40	-0.76***	-0.43	-0.3 0
2010	-0.94***	0.37	-0.68**	0.03	-0.09	0.20
2011	0.10	0.26	0.01	0.50	-0.24	-0.47
2012	0.11	-0.58*	-0.12	-0.84***	-0.37	-0.58**
2013	-0.90***	0.79***	-0.55*	0.07	-0.17	0.12
2014	-0.68**	-0.30	-0.45	-0.80***	-0.39	-0.05

****-significant at 1% level**-significant at 5%,*-significant at 10%.*

Table 3: Seasonal Indices of arrivals and prices of potato in Ahmadabad market from 2005 through 2014

Month	Agra	Patna	Burdwan	Indore	Jalandar	Ahamadabad
			Arrivals			
January	134.30	170.00	78.00	124.75	142.41	143.45
February	116.35	78.00	103.00	196.82	126.26	103.77
March	116.98	67.00	290.00	160.47	132.65	125.66
April	118.54	71.00	265.00	130.32	119.99	102.72
May	96.03	74.80	79.20	82.38	67.69	80.48
June	87.38	92.00	35.16	77.03	46.85	75.60
July	81.67	96.00	21.19	90.59	60.33	78.90
August	89.89	108.70	18.21	59.35	56.37	79.87
September	89.96	90.00	25.25	51.34	51.97	74.36
October	83.22	84.00	44.28	55.73	62.89	84.62
November	84.24	105.00	32.00	71.91	137.44	96.16
December	101.39	161.00	25.75	99.27	195.33	154.63
			Prices			
January	66.17	77.00	72.00	85.89	73.18	82.36
February	65.21	68.70	62.00	82.81	71.93	74.61
March	77.33	77.00	75.00	89.54	79.84	78.00
April	85.47	89.00	91.00	98.12	93.27	90.64
May	101.05	98.00	109.00	102.59	96.12	95.18
June	109.48	103.00	108.00	101.22	104.75	98.88
July	120.26	105.00	111.00	102.93	113.79	105.2
August	119.13	105.00	108.00	104.72	117.3	105.9
September	118.95	113.00	114.00	104.46	114.33	111.05
October	122.57	120.00	120.00	107.35	132.65	122.05
November	121.34	132.00	120.00	112.86	121.11	129.61
December	93.00	107.00	108.00	107.47	81.7	106.46

has shown significant negative correlation in all the markets. The positive correlation coefficients shown in some of the markets in some years were found to be non significant. The results are in agreement with the study conducted solely in Agra market by Singh *et al.* (2017).

The seasonal variation indices (Table 3) clearly depict an inverse relation between the prices and arrivals of potato during the year. The wide seasonal fluctuation in arrivals has consequential unfavorable impact on prices in regulated market over different months of the year. The huge quantity of arrivals during post harvest months of the year lead to the decline in prices (Dhakre and Bhattachariya, 2014). As the harvesting season comes to an end the excess produce stored in the cold storages released in the market at reasonable prices from the months of July to November.

It can be clearly seen from Figs. 1 to 6 that prices of potato are usually high during the months of October to December and starts declining till April which is in par with the post harvest period of the crop.

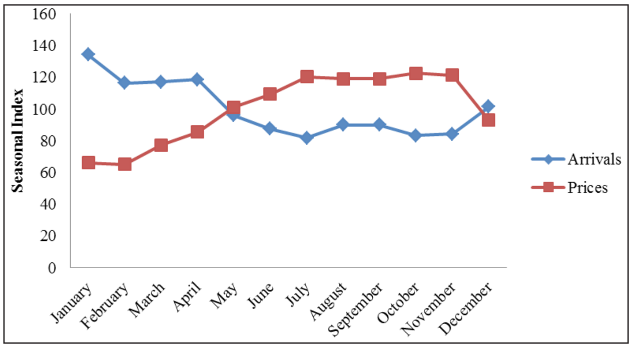

Fig. 1: Seasonal Indices of arrivals and prices of potato in Agra market from 2005 through 2014

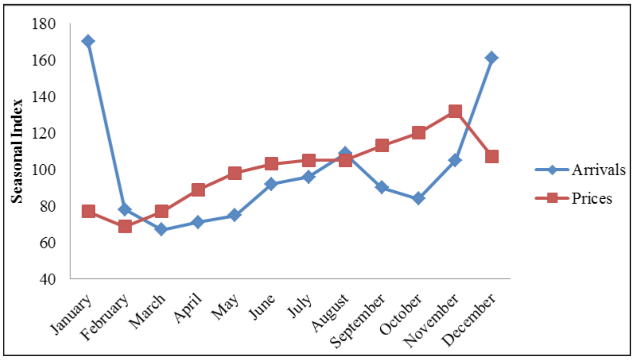

Fig. 2: Seasonal Indices of arrivals and prices of potato in Patna market from 2005 through 2014

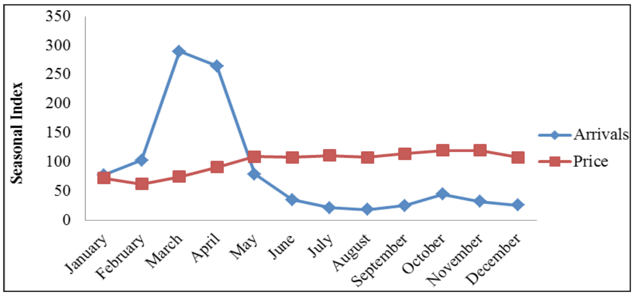

Fig. 3: Seasonal Indices of arrivals and prices of potato in Burdwan market from 2005 through 2014

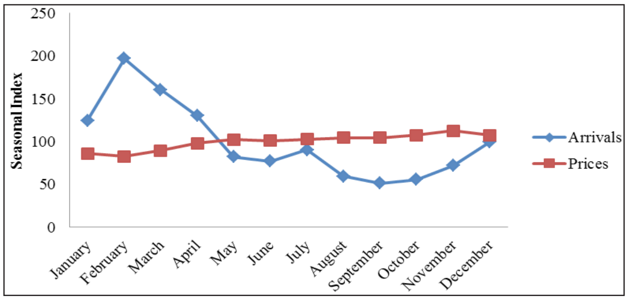

Fig. 4: Seasonal Indices of arrivals and prices of potato in Indore market from 2005 through 2014

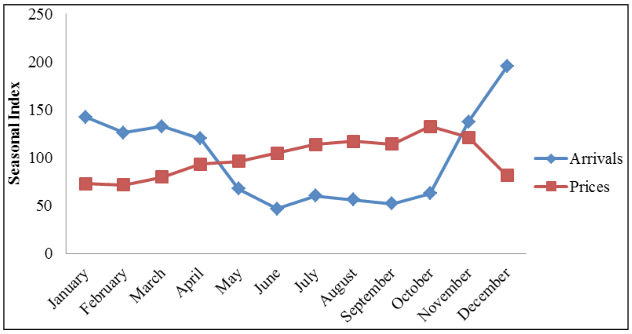

Fig. 5: Seasonal Indices of arrivals and prices of potato in Jalandhar market from 2005 through 2014

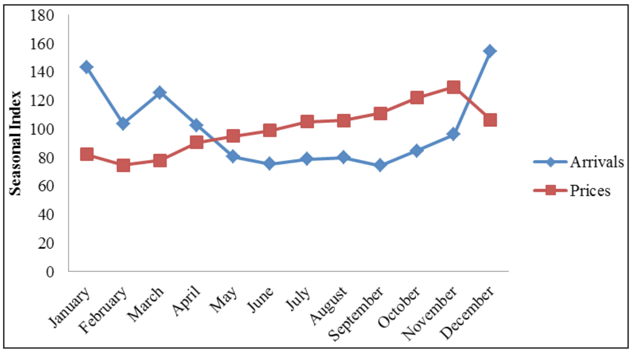

Fig. 6: Seasonal Indices of arrivals and prices of potato in Ahmadabad market from 2005 through 2014

The results of the analysis of factors affecting the potato prices for all the six markets taken together are presented in table 4. It can be observed that the results area in par with the results obtained separately for each market. Potato prices showed a negative relation with the total arrivals and positive relation with the future prices and price lag. The regression coefficient of total arrivals was found to be -0.008 significant at 1 per cent level. The elasticity of prices with respect to the total arrivals was found to be -0.01 indicating that 1 per cent change in total arrivals would decrease the price by 0.01 per cent at all India level. The regression coefficient of production was found to be -0.0002. The elasticity of prices with respect to production was found to be -0.15, i.e., 1 per cent change in total production would decrease the price by 0.15 per cent The regression coefficient for future prices was found to be 0.30 significant at 1 per cent level indicating a positive relationship of market prices and future prices. The elasticity of market prices with respect to future prices was found to be 0.15 indicating that 1 per cent increase in future price would increase the market prices by 0.15 per cent. Similarly, a positive relation was established between the market price

Table 4: Factors affecting prices of potato in major markets in India

Dependent variable: Current Prices		Independent variables								
		Coefficients				Elasticity				
Market	Intercept	Arrivals	Production	Future Prices	Lagged Price	Arrivals	Production	Future Prices	Price lag	R^2
Agra	710.67	-0.01*** (0.01)	-0.0002	0.41*** (0.05)	0.08*** (0.05)	-0.08	-0.41	0.47	0.72	0.89
Patna	-97.71	-0.35*** (0.17)	-0.007	0.36*** (0.07)	0.73*** (0.03)	-0.06	-5.75	0.36	0.71	0.85
Burdwan	-335.19	-0.02*** (0.01)	-0.0004	4.42*** (0.74)	6.14*** (0.63)	-0.02	-0.54	0.41	0.59	0.85
Indore	1102.78	-0.05*** (0.03)	-0.001	4.16*** (0.59)	0.43*** (0.07)	-0.04	-0.19	4.62	0.42	0.72
Jalandar	503.91	-0.17*** (0.04)	-0.004	0.22*** (0.04)	0.66*** (0.06)	-0.11	-1.40	0.35	0.65	0.78
Ahmadabad	1395.68	-0.08*** (0.03)	-0.002	0.30*** (0.07)	0.74*** (0.06)	-0.14	-0.33	0.25	0.74	0.79
Total	-421.33	-0.008 (0.003)	-0.0002	0.30 (0.02)	0.76 (0.02)	-0.01	-0.15	0.33	0.70	0.83

****-significant at 1% level**-significant at 5%,*-significant at 10%.*

and lagged prices with a regression coefficient of 0.76. The elasticity of prices with respect to the lagged prices was found to be 0.70 indicating that one per cent increase in lagged prices would increase the market prices by 0.70 per cent. The coefficient of multiple regression was found to be 0.83, indicating that 83 per cent of total variation in price of potato was explained by the arrivals, future prices and lagged prices.

There are also other factors like pest and disease attacks, weather irregularities, marketing aspects like transportation, storage, inadequate and costly cold chain facilities which affect the prices of potato. We know that about 90% of potato in India is produced in *rabi* season hence storage plays an important role in distributing supply over the remaining months of the year. Shortage of cold storage space in many states of India and erratic electricity supply create problems for potato marketing.

CONCLUSION

The price of agricultural commodities form the basis of income to the producers to allocate the resources in the marketing activities and allocation of goods and services among the prospective buyers and thus is the deciding factor of growth of a particular crop in the country. The present study examined the behavior of prices and arrivals of potato in major markets of the country. There is huge inter-year and intra-year instability in prices of potato. Production of potato and the seasonality in production are the two important factors affecting the same. Price discovery of potato is a complex process and is affected by a number of factors like production, total arrivals, lagged price, future prices, which have been quantified here and other factors like transportation, storage, weather uncertainties and pests and disease attack. Unexpected natural calamities and pests and diseases and frost have at times caused sudden drop in production of the crop in some state leading to higher prices. These higher prices induce the potato growers to increase the area under potato next year resulting in the increased production and arrivals leading to glut in the market and sharp decline in prices. Thus cobweb type demand supply cycle is prevalent in the potato production and marketing system in the country which bring violent fluctuations in potato prices and at the same time have serious political implications. Policy makers should emphasize on price stabilization strategies to safeguard the interest of all stake holders associated with the potato industry.

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Study of Non Timber Forest Products (NTFPS) in Meghalaya State of India: Methods for Empirical Analysis

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ABSTRACT

Non-timber forest products (NTFPs) income plays an important role in the household economy in the rural forest dwelling communities. The study utilised both the primary data and secondary data. Primary data were collected from 30 sample households from two villages in Ri-Bhoi district of Meghalaya to analysis the significant of NTFPs income in the rural household economy with the objectives, (i) To study the determinants of income generation through NTFP (ii) To estimate the extent of employment generation through NTFP (iii) Price behaviour of selected NTFP in Mawiong regulated market. Econometric model and Box-Jenkins Autoregressive moving average (ARIMA) methodology were applied for the study. The study found that income from business was the major income sources (45.74 % share to the total household income). Income from NTFPs collection has the second largest share with 22.05 per cent followed by crop production with 14.61 per cent, labour with 9.16 per cent and livestock with 8.44 per cent. The lin-log model was selected as best model based on the value of R^2 value (0.89). Years of experience, total hours spent in NTFPs collection and average land holding have positive and significant relationship with the NTFPs income while age and distance travelled has a negative and significant association with it. Broom grass and Tezpatta contribute 2 and 1 manday/qtl/year to the total NTFPs employment. ARIMA (0, 1, 1) was the best fitted model as it has the lowest Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). The price of Broom grass was forecasted for five weeks from 4th week of November to 4th week of December 2018 using ARIMA (0, 1, 1). The forecast Broom grass price for 4th week of November to be ₹ 2891.66 /qtl which will decrease to ₹ 2687.46 in 4th week of December.

Hightlights

- Income from business was the major income sources followed by NTFPs collection and livestock
- The lin-log model was selected as best model based on the value of R^2 value
- Broom grass and Tezpatta contribute 2 and 1 manday/qtl/year to the total NTFPs employment
- ARIMA (0, 1, 1) was the best fitted model

Keywords: NTFP, Forest, Method, AIC and BIC

Non-timber Forest Products (NTFPs) are defined as biological material other than round wood or timber that may be extracted from natural ecosystems, natural forest plantations or in agro forestry systems used in household, marketed or has social-cultural or spiritual significance (FAO, 2001). NTFPs including all tangible products, natural, crafted or processed, derived from forests or any other land under similar use, other than timber. Non-timber forest products include products such as bark, roots, tubers, leaves, fruits, flowers, seeds, resins, honey, mushrooms, and fuel wood (Sunderland *et al.* 2003). Globally, more than two billion people are dwelling in forests, depending on forest resources for subsistence, income and livelihood security (Vantomme, 2003).

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NTFPs are considered to be vital for sustaining rural livelihoods, reducing rural poverty, biodiversity conservation and facilitating rural economic growth (Maske *et al*. 2011). The NTFPs provide the products such as food, shelter, medicines, fibres, energy and cultural artefact for many of the world's poorest people and a considerable proportion of the less poor (Saha and Sundriyal, 2012). It also provides many households with a means of income generation, either as supplementary income to other livelihood activities, or as the primary means of cash generation (Mahapatra *et al.* 2005). According to World Resource Institute, over 500 million people in India are dependent on NTFPs for their subsistence and cash income (Sarmah and Arunachalam, 2011).

Several studies have highlighted the importance of NTFPs in livelihood activities. Pervaz (2002) observed that the NTFP generated maximum employment (60.72 %), followed by agriculture (22.30%), allied activities (15.83 %) and other sources (1.16 %). NTFPs like fuel-wood, medicinal plants, wild edible vegetables, house building materials etc are an integral part of day-to-day livelihood activities, especially for tribal people (Sarmah *et al.* 2006). The income from sale of the NTFPs for households living in and around forest constitutes 40 to 60 per cent of their total income (Nayak *et al.* 2014). NTFP's play an important role in improving the livelihoods as well as meeting the needs especially for food, medicine, poverty reduction etc of the rural tribal communities particularly in the Paschim Medinipur district of West Bengal (Shit and Pati, 2012). Realising the importance of NTFPs, information regarding the prices of it must be known as it helps the farmers to plan the future farming activities, farm planning and budgeting. Modelling and forecasting of prices of agricultural commodities is essential for policymakers as well as for various stakeholders in the marketing chain of these commodities, right from farmers to consumers.

Assessing the quantity and value of NTFPs and transform their use from subsistence development by incorporating them into mainstream forest products such as timber. Yet, knowing the economic value of non-marketed NTFPs helps to give more accurate accounts of the total income of gatherers, as well as better estimates of the economic value of the forest. Forest development integrated with agricultural and industrial progress has great potential to enhance livelihood security, poverty reduction and food security for vulnerable section of society including illiterate, unskilled, resource-poor, jobless, and landless people in the area. Keeping the above facts in view, the present study has been undertaken to investigate the livelihood contributions of forest resources to the people in Meghalaya with the objectives, (i) To determine the determinants of NTFP income (ii) To estimate the extent of employment generation through NTFP (iii) To study the price behaviour of selected NTFP in Mawiong regulated Market.

Data and Methodology

Both primary and secondary data were used for the study. Primary data were collected from the field through structured schedule. The data collection pertains to quantity of NTFPs (Broom grass and Tezpatta) collected annually, total income obtained per year from NTFPs collection. Factor influencing collections in the study area were analysed using econometric model. Secondary data on prices of Broom grass were collected from AGMARKNET (www.agmarknet.gov.in). The weekly wholesale prices for Mawiong Regulated market was used to examined the pattern and behaviour of price movement for Broom grass. The data on wholesale weekly prices of Broom grass for the period of 11 months (January to November) were used to forecast the future price for 5 weeks. Box-Jenkins Autoregressive moving average (ARIMA) methodology (Box *et al.* 2007) using the SAS software package.

Analytical tools

Multiple regression model which is specified as:

$$Y = \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \beta_6 X_5 + \beta_7 X_6 + \beta_8 X_7 + u$$

Where, Y = the NTFPs income; X_1 = Age (yrs); X_2 = Year of Experience; X_3 = Family Size; X_4 = Distance Travelled (Km); X_5 =Total Hours Spent in NTFPs Collection; X_6 = Average land holding; X_7 = Total income excluding NTFPs; u = stochastic disturbance term.

Box- Jenkins Autoregressive Integrated moving average (ARIMA) Model

ARIMA modelling is carried out in three stages, identification of the model, parameter estimation, diagnostic checking and forecasting. The identification step determines: (i) whether the process is stationary and the possible transformations to obtain stationarity; and (ii) whether the form of the process is autoregressive (AR), moving average (MA) or both (ARMA), and its order(s). Three parameters used in summarizing an ARIMA model are the AR parameter p, integration parameter d, and MA parameter q. Parameters p and q denote the order of AR and MA, while d denotes the degree of differencing the series to make it stationary. The autocorrelation (ACF) and partial autocorrelation functions (PACF) of a series together are the most powerful tool usually applied to reveal the correct values of the parameters. The ACF gives the autocorrelations calculated at lags 1, 2 and so on, while PACF gives the corresponding partial autocorrelations, controlling for autocorrelations at intervening lags. The final results included the parameter estimates, standard errors, estimate of residual variance, standard error of the estimate, natural log likelihood, Akaike's information criterion (AIC), and Bayesian Information criterion (BIC). Model selection was based on the minimization of AIC and SBC. These criteria are descriptors of the model's parsimony as they simultaneously account for the model's fit onto the observed series alongside number of parameters used in the fit.

The Autoregressive moving average (ARMA) model, denoted as ARMA (p,q), is given by,

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \varphi_3 y_{t-3} + \ldots + \varphi_p y_{t-p} + \varepsilon_t - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \ldots \theta_q \varepsilon_{t-q}$$

Or equivalently by,

$$\varphi(B)\, y_t = \omega(B)\, \varepsilon_t$$

Where, B is the backshift operator defined by $By_t = y_{t-1}$

A generalization of ARMA models which incorporates a wide class of nonstationary time-series is obtained by introducing "differencing" into the model. The simplest example of a nonstationary process which reduces to a stationary one after differencing is "Random Walk". A process $\{y_t\}$ is said to follow Autoregressive integrated moving average (ARIMA), denoted by ARIMA (p,d,q), if $\nabla^d y_t = (1-B)^d \varepsilon_t$ is ARMA (p,q).

The model is written as, $\varphi(B)(1-B)^d\, y_t = \theta(B)\, \varepsilon_t$

Where ε_t are identically and independently distributed as N $(0,\sigma^2)$. The integration parameter d is a non negative integer. When $d = 0$, the ARIMA (p,d,q) model reduces to ARMA (p,q) model.

Estimation of parameters for ARIMA model is generally done through nonlinear squares method. Among the competitive models the best models are selected based on minimum value of Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) and for measuring the accuracy in fitted models, Mean Absolute Percentage Error (MAPE) were computed.

$$\text{AIC} = 2k - 2ln(L)$$

$$\text{BIC} = -2ln(L) + kln(n)$$

$$\text{MAPE} = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{x_i - \hat{x}_i}{x_i}\right| * 100$$

Where, X_i, $\hat{x}_i$ are the value of the i^{th} observation and estimated value of the i^{th} observation of the variable X and k is the number of parameters in the statistical model, and L is the maximized value of the likelihood function for the estimated model.

RESULTS AND DISCUSSION

Determinants of NTFPs income

The local people in the study area depend on a number of income sources. Crop production, animal husbandry, forest product, off-farm activities are the main household's income sources. They combine the income from forest product with income from other farm and off-farm activities to improve their welfare. In the study area, NTFPs (Broom grass and tezpatta) are one of the most crucial sources of household annual income and this study supports the notion of high dependency of rural populations on the forest for their livelihood.

Table 1: OLS regression of NTFPs income against household socioeconomic variables

Functional Forms	Dependent variable	Constant Term	X_1	X_2	X_3	X_4	X_5	X_6	X_7	R^2
Linear	Y	17675.100	390.310	4551.13	-200.90	-3094.28	13843.68	4028.27	-0.03	0.881
			(0.026**)	(0.023**)	(0.814)	(0.012)	(0.002***)	(0.158)	(0.306)	
Log-Lin	ln Y	9.165	-0.013	0.237	-0.001	-0.136	0.216	0.053	0.0001	0.802
			(0.07*)	(0.007***)	(0.973)	(0.009***)	(0.193)	(0.65)	(0.159)	
Lin-Log	Y	51223.570	-16160.523	19815.609	-79.874	-7744.845	48237.814	5381.785	-4126.312	**0.891**
			(0.014**)	(0.013**)	(0.984)	(0.003***)	(0.001***)	(0.045**)	(0.129)	
Double log	ln Y	11.67325	-0.499	1.019	0.042	-0.295	0.782	0.103	-0.191	0.816
			(0.061*)	(0.003***)	(0.812)	(0.008***)	(0.158)	(0.339)	(0.099*)	

Variance Inflating Factor (VIF): X_1=1.28, X_2=1.99, X_3=1.38, X_4= 1.32, X_5=2.19, X_6= 1.19 and X_7=1.67
Note: Figures in the parenthesis indicate the p value
****significant at 1%; **significant at 5%; *significant at 10%.*

Lin-log Model

$$Y = 5123.75 + ln\ (-16160.52X_1) + ln\ (19815.61X_2) + ln\ (-79.87X_3) + ln\ (-7744.85X_4) + ln\ (48237.81X_5) + ln\ (5381.79X_6) + ln\ (-412.31X_7)$$

The lin-log model was selected as best model based on the value of R² value (0.891). As indicated in Table 1, years of experience (X_2), total hours spent in NTFPs collection (X_5) and average land holding (X_7) have positive and significant relationship with the NTFPs income while age (X_1) and distance travelled (X_4) has a negative and significant association with it (Table 1). Similar finding was put forth by Opeluwa *et al.* (2011) stating that the distance separating the households to the source of NTFPs negatively affected their decision to collect NTFPs.

Extent of employment generation through NTFP

Broom grass was the major employment source contributing 55% (2 mandays/qnt/year) to the total NTFPs employment. Tezpatta was the next important employment generating activity which provides 44% (1 mandays/qtl/year) to the total NTFPs employment (Table 2).

Table 2: Contribution of NTFPs in employment generation

NTFPs	Season	Employment generation (days/qtl/year)
Broomgrass	January - May	2.26 (55.67)
Tezpatta	January- April	1.8 (44.33)
Total		4.06 (100.00)

Note: *figures in the parentheses indicates the percentage.*

Price behaviour of the selected NTFP

ARIMA model is estimated only after transforming the variable under forecasting into a stationary series. The stationary series is the one whose values vary over time only around a constant mean and constant variance. There are several ways to ascertain this. The most common method is to check stationarity through examining the graph or time plot of the data.

Visual Inspection for stationarity

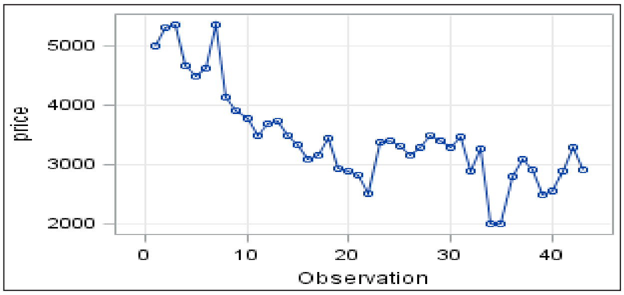

Fig. 1: Weekly average prices from January to November 2018

Fig. 1 revealed that the data was nonstationary. Nonstationarity in mean is corrected through appropriate differencing of the data.

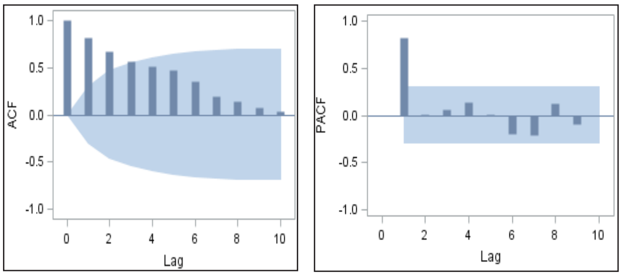

Fig. 2: ACF and PACF of the series

Autocorrelation check for White Noise

H_0: Series is stationary

In this case the white noise hypothesis is rejected based on autocorrelation test, this is expected as the series is non stationary. The p value for the test is printed as < 0.0001 which significantly rules out the assumption of stationary series (Table 3).

Table 3: Autocorrelation check for White Noise

To lag	Chi-square	df	p-value
6	97.56	6	<0.001

Trend analysis after differencing

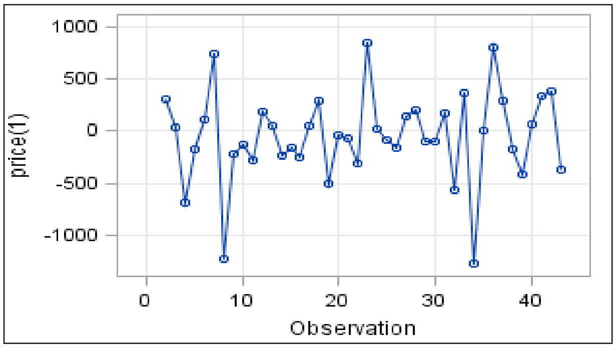

Fig. 3: Weekly average prices from January to November 2018 after differencing

The newly constructed variable Yt was stationary in mean, the next step is to identify the values of p and q. For this Autocorrelation (ACF) and Partial Atocorrelation (PACF) of various orders of Y_t were presented in Fig. 4.

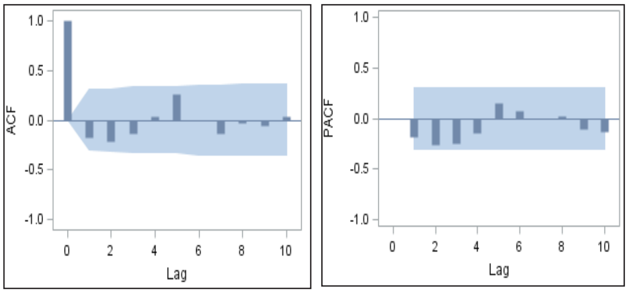

Fig. 4: ACF and PACF of differenced series

Autocorrelation check for White Noise

H_0: Series is stationary

In this case the white noise hypothesis is accepted based on autocorrelation test. The *p* value for the test is not significant.

Table 4: Autocorrelation check for White Noise of differenced series

To lag	Chi-square	df	p-value
6	7.83	6	0.251

Model selection criterion

The various ARIMA models were fitted. The model which had minimum AIC and BIC value was chosen. The various ARIMA models and their AIC and BIC values are presented in Table 5 indicating that ARIMA (0, 1, 1) has the lowest AIC and BIC value.

Table 5: AIC and BIC value of ARIMA

Model	Estimates	Standard error	p- value	AIC	BIC
ARIMA (1,1,1)	AR 0.432	0.295	0.151	628.085	633.298
	MA 0.776	0.214	0.0008***		
ARIMA (0,1,1)	MA 0.434	0.143	0.0042***	628.241	631.716
ARIMA (1,1,0)	AR -0.184	0.156	0.247	630.312	633.787
ARIMA (1,0,1)	AR 1.000	0.028	<.0001***	645.8098	651.093
	MA 0.281	0.158	0.0829*		
ARIMA (1,0,0)	AR 0.985	0.039	<.0001***	646.112	649.634
ARIMA (0,0,1)	MA -0.648	0.120	<.0001***	674.241	677.763
ARIMA (2,1,1)	AR -0.227	0.201	0.265	628.87	635.29
	MA 0.534	0.352	0.138		

The value of the AIC and BIC was lowest and worked out to be 628.241 and 631.716 for the ARIMA (0,1,1) and the MAPE value recorded to 6.13, indicated that ARIMA (0,1,1) was the most suitable model for forecasting Broom grass prices.

Validation of ARIMA (0, 1, 1)

To judge the forecasting ability of the fitted ARIMA model, important measures of the sample period forecasts accuracy were computed. The Mean Absolute Percentage Error (MAPE) for Broom grass prices worked out to be 6.13. Table 6 indicates that the forecasting inaccuracy is low.

Table 6: Mean Absolute Percentage Error (MAPE)

Weeks	Actual price (₹/ qtl)	Forecasted price (₹/qtl)
3rd week, Oct 2018	2500.00	2781.89
4th week , Oct 2018	2566.67	2721.09
1st week, Nov 2018	2900.00	2660.30
2nd week, Nov 2018	3283.33	2599.50
3rd week, Nov 2018	2920.00	2538.71
Average	2834.00	2660.30
MAPE	6.13	

ARIMA forecasting

From the table 7 it was observed that the forecasted weekly prices of Broom grass from 4th week November, 2018 was ₹ 2891.66 /qtl which will decrease to ₹ 2687.46 in 4th week of December.

Table 7: Price Forecast of Broom grass (₹/qtl) for fitted ARIMA (0, 1, 1) model

Weeks	Forecast	Std Error	95% Confidence limit	
4th week Nov, 2018	2891.66	418.59	2071.23	3712.08
1st week Dec, 2018	2840.61	480.92	1898.03	3783.19
2nd week Dec, 2018	2789.57	536.04	1738.94	3840.18
3rd week Dec, 2018	2738.51	586.00	1589.97	3887.06
4th week Dec, 2018	2687.46	632.02	1448.71	3926.22

CONCLUSION

The paper is based on a comprehensive data set collected from 30 households from the Ri- Bhoi district of Meghalaya. The study concluded that major sources of income include income from business, NTFPs followed by crop production. The lin-log model was selected as best model based on the value of R^2 value (0.89). Years of experience, total hours spent in NTFPs collection and average land holding have positive and significant relationship with the NTFPs income while age and distance travelled has a negative and significant association with it. Broomgrass and Tezpatta contribute 2 and 1 manday/qtl/year to the total NTFPs employment. The study has revealed that the ARIMA model being stochastic in nature could be used successfully for modelling as well as forecasting of weekly prices. ARIMA (0, 1, 1) was selected as the best fitted model and the forecast Broom grass price for 4th week of November to be ₹ 2891.66 /qtl which will decrease to ₹ 2687.46 in 4th week of December.

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A Comparative Analysis of Rural-Urban Migrants and Non-Migrants in the Selected Region of Tamil Nadu, India

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ABSTRACT

The study has assessed the impact of rural-urban migration by comparing migrant and non-migrant households in the Tiruppur district of Tamil Nadu. In this connection, a purposive sampling technique was used to select 80 migrant and 80 non-migrant respondents from the study region. Moreover, the study was employed decomposition analysis to understand the income difference between two groups with respect to migration. The estimated result shows that 65.35 percent of the income difference between migrant and non-migrant households due to migration. Also, noticed that comparatively migrants experience a better standard of living along with savings due to higher income and they did not have an idea of returning to agriculture. However, migration is an indication of unequal development of rural and urban which could be minimized by improvising rural living standards by creating employment opportunities, motivating entrepreneurship activities, supporting farming community with special reference to small and marginal farmers.

Highlights

- The study evaluated the impact of migration in terms of their economic condition. It stresses the need to develop the rural household standards to prevent the social rural-urban imbalance.

Keywords: Rural-urban migration, impact of migration, decomposition analysis, return migration

Migration is the movement by people from one place to another with the intentions of settling temporarily or permanently in the new location (Lee, 1966; Ekong, 2003). Migration occurs at a variety of scales: intercontinental (between continents), intracontinental (between countries on a given continent), and interregional (within countries). In larger countries like India and China, internal migration is more common than international migration (ILO, 2015). The increasing degree of industrialization, consequent increase in demand for labour, existence of informal sector activities, the scope for self-employment and above all the preparedness to accept any kind of job for an earning drive people towards urban areas (Hossain, 2001; Wheeler and Waite, 2003; Kees and Richard, 2004; Deshingkar, 2009; Sundaravaradarajan *et al.* 2011; Kishore, 2013). As the chances of crop failure e on these lands is very high due to prevalence of more than 50 percent of net cultivable area under rain-fed situation, where the rainfall pattern is also erratic in its nature, the farmers generally do not invest in external inputs like improved seeds, fertilizers and plant protection measures and end up with poor crop yields, even during normal years. This leads to low agricultural income, agricultural unemployment, and underemployment which are considered as basic factors pushing the migrants towards urban areas with greater job opportunities

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(Ranis, 2004; Farooq *et al.* 2005; Thorat *et al.* 2011; Vinayakam and Sekar 2013).

In India, migration is mostly influenced by social structures and patterns of development. The development policies of the state governments have not been able to check the process of migration. Uneven development is the main cause behind migration (Skeldon, 2000; Dev, 2014; Nair, 2014). In India, nearly 29 percent of the persons were migrants and the migration rate (proportion of migrants in the population) in the urban areas (35 percent) was far higher than the migration rate in the rural areas (26 percent). Among the migrants in the urban areas, nearly 59 percent migrated from the rural areas and 40 percent from urban areas. The reason for migration for male migrants was dominated by employment-related reasons, in both rural and urban areas. Nearly 29 percent of rural male migrants and 56 percent of urban male migrants had migrated due to employment-related reasons. A higher percentage of the persons were found to be engaged in economic activities after migration, for males the percentage of workers increased from 51 percent before migration to 63 percent after migration in rural areas and from 46 percent to 70 percent in urban areas. Migration in India is predominantly to short distances, with around 60 percent of the migrants changing their residence within their district of birth and 20 percent within their state, while the rest move across the state boundaries (NSSO,2010).

Tamil Nadu is the second-largest economy in India and is one of the top industrialized and urbanized states of India with 48.45 percent of the population living in urban areas (Census of India, 2011). According to a census of India 2001, in Tamil Nadu, 94.30 percent of them have migrated within the state, of that 68.40 percent was intradistrict migration and 25.90 percent was inter-district migration. Coimbatore is one of the top 5 districts with higher in-migrants and Tiruppur is a part of Coimbatore in this period (Census of India, 2010). A higher percentage of the persons were found to be engaged in economic activities after migration (Anamica, 2010; Khatri 2007; Singh *et al.* 2011; Kaur, 2011; Basu and Faetanini, 2015), for males the percentage of workers increased from 51 percent before migration to 63 percent after migration in rural areas and from 46 percent to 70 percent in urban areas. (NSSO, 2010). With this background this paper analyses the impact of this rural-urban migration to reveal the benefits of migration on status of income, expenses, savings, debt, etc., and the impact on agriculture, by the direct investment made by migrants through their remittances and indirectly by overcoming debt position of the household which would support farming. Also, the intention of migrants on their interest in returning back to agriculture had been studied to ensure the farming community population.

Methodology

The influence of growing urban centers and industries on rural economies has been strongly felt most typically in Tiruppur which often called the "Banian city". Manufacturing of knitted products ranked 8th in terms of labour intensity (Das *et al.* 2009) and this labor-intensive manufacturing sector attracted numerous labours, including migrants from nearby villages, different districts of Tamil Nadu and more recently from north Indian states as well. The textile industry provides employment to over six lakh people and a large portion of them i.e., about 75-80 percent of them are migrants (Trade Union, CITU). Thus Tiruppur district is selected purposively for the study. Migrants comprises of labours who work in textile industries of Tiruppur city and migrated from the agricultural sector and thus purposive sampling method was used in the selection of migrants.

There were 60 wards in Tiruppur city, from that two wards in each direction is chosen randomly and there come to a totally 8 wards. From each ward, 10 migrants who came from the agricultural sector have been chosen purposively. Thus there comes 80 migrants in total. Eighty Non-migrants were chosen purposively from respective villages of migrants and distribution of respondents were presented in Table 1 and 2. Therefore 160 is the total sample size. Primary data on the details required for the study were collected through personal and phone interview employing a pretested and well-structured questionnaire.

Decomposition analysis for income difference between Migrant and Non-migrant

The economic impact of migration is revealed through Blinder decomposition. The factors like age

Table 1: Distribution of migrant sample respondents in the Tiruppur District

Sl. No.	Direction	Residential area (Random)	No. of compounds	Compounds selected (Random)	Samples per compound (Purposive)	Total sample
1	North	Chellamalnagar	18	5	2	10
		Nesavalar colony	26	5	2	10
2	East	NGR nagar	17	5	2	10
		Bharathinagar	34	5	2	10
3	South	Poonganagar	23	5	2	10
		Vinobanagar	27	5	2	10
4	West	Kattabommannagar	32	5	2	10
		Appachinagar	21	5	2	10
	Total					80

Table 2: Distribution of non-migrant sample respondents from the migrant's native place

Sl. No.	District	Sample Non-migrants
1	Dindigul	10
2	Karur	3
3	Madurai	9
4	Pudukkottai	5
5	Sivaganga	8
6	Theni	6
7	Thanjavore	3
8	Thirunelveli	2
9	Thiruvannamalai	3
10	Tiruvarur	7
11	Trichy	6
12	Villupuram	4
13	Virudhunagar	6
14	Others	8
	Total	80

of the worker, education level, number of workers in the household, land size and marital status have been identified as important factors in determining the income level of migrant households. On the basis of these variables, wage equations were estimated and decomposed by using the technique of Blinder (1973) in the following manner:

$$1n\bar{W}m = \alpha_{m0} + \alpha_m \sum_{t=1}^{t} \bar{X}_m + \varepsilon_m \quad \ldots(1)$$

$$1n\bar{W}n = \alpha_{n0} + \alpha_n \sum_{t=1}^{t} \bar{X}_n + \varepsilon_n \quad \ldots(2)$$

In Equations (1) and (2) above, the symbol' stands for migrants and 'n' for non-migrants. The symbol 'W' stands for household income measured in rupees. The estimated coefficients from such a model approximately measure the proportionate effect on incomes by the change in the right side variable 'X', which is a vector of the measured characteristics of the households such as age, education level, number of workers in the household, landholdings size and marital status of the respondents. The vector of regression coefficient 'α' (alpha) reflects the return that the market yields to a unit change in endowments and the error term 'ε' reflects the measurement error as well as the effect of the unmeasured or unobserved factors.

The Blinder Decomposition simply shows that equation 1 & 2 can be expanded as,

$$\left(1n\bar{W}m - 1n\bar{W}n\right) \quad \ldots(3)$$

$$=$$

$$(\propto_{m0} - \propto_{n0}) + \{\propto_{m1}(\bar{X}_{m1} - \bar{X}_{n1}) + \propto_{m2}(\bar{X}_{m2} - \bar{X}_{n2}) + \propto_{m3}(\bar{X}_{m3} - \bar{X}_{n3}) + \propto_{m4}(\bar{X}_{m4} - \bar{X}_{n4}) + \propto_{m5}(\bar{X}_{m5} - \bar{X}_{n5})\} + \{\bar{X}_{n1}(\propto_{m1} - \propto_{n1}) + \bar{X}_{n2}(\propto_{m2} - \propto_{n2}) + \bar{X}_{n3}(\propto_{m3} - \propto_{n3}) + \bar{X}_{n4}(\propto_{m4} - \propto_{n4}) + \bar{X}_{n5}(\propto_{m5} - \propto_{n5})\} + (\varepsilon_m - \varepsilon_n)$$

Where,

$\ln \overline{Wm}$ =log of migrant's annual income (₹/year)

$\ln \overline{Wn}$ = log of non-migrant's annual income (₹/year)

α_{m0} = Intercept of migrant equation

α_{n0} = Intercept of the non-migrants equation

X_{m1} = Age of migrant (years)

X_{m2} = Educational level of migrants (years)

X_{m3} = Number of workers in migrant households (numbers)

X_{m4} = Size of land holdings of migrant (ha)

X_{m5} = Marital status of migrant (dummy variable = 1: married, 0: unmarried)

X_{n1} = Age of non-migrant (years)

X_{n2} = Educational level of non-migrants (years)

X_{n3} =Number of workers in non-migrant households (numbers)

X_{n4} = Size of land holdings of non-migrant (ha)

X_{n5} = Marital status of migrant (dummy variable=1: married, 0: unmarried)

ε_m = Error term of migrant equation

ε_n = Error term of non-migrant equation

This is the overall income gap in the group of migrants (m) and non-migrants (n). The income gap is divided into two components: one is the portion attributable to differences in the endowments of income-generating characteristics ($X_m - X_n$) evaluating at the group 'M' returns (α_m). The second portion is attributable to the difference in the returns (α_m- α_n) that groups 'm' and 'n' get for the same endowment of income-generating characteristics (X_n). This component is often taken as a reflection of discrimination or income differentials.

RESULTS AND DISCUSSION

Average monthly income of sample respondents: Income was the prime factor seeking for which migration takes place generally. The monthly household income of sample respondents is provided in Table 3. A higher on-farm and off-farm income of non-migrant households indicate the dependence of agriculture by non-migrants. The non-farm income of sample households was ₹ 16700 and ₹ 2350 for sample migrant and non-migrant farm households, respectively. It implies the influence of migration on income of migrant among migrant households and lesser non-farm income among non-migrants indicates the poor employment opportunities in the rural areas. Average income between migrant and non-migrant households differs significantly and it concluded that the average income of migrant households (₹ 17868) was much higher than non-migrant households (₹ 7202).

Debt position: It is very much essential to assess the debt position of sample migrants before and after migration with regard to know about the influence of migration on changes in debt position. Hence it was estimated and presented in Table 3. It was noticed that there were increases in percent of sample migrant respondents free from debt position i.e. In the beginning, only 35 percent of the sample respondents did not have debt before migration and it was increased to 48.75 percent due to migration. This shows the power of migration in increasing the earning capacity of individuals and reducing the debt position of households.

Monthly Household Expenditure: Expenditure measures the economic standard of living and it was estimated from Table 3 that the monthly average expenditure of migrants was ₹ 11825.69 and non-migrants were ₹ 5661. Migrant expenditure was much higher than non-migrant, which implies that migrants had a better standard of living than non-migrants.

Savings Position: Savings amount can be used for the creation of assets and make use of money for better health, education and to meet out unforeseen circumstances, etc. The savings position of sample respondent households was estimated and presented in Table 3. The average monthly savings of migrants were higher than the non-migrants and this finding supports Lewis dual sector model according to which savings of workers moving to the industrial sector from agricultural would increase because of increased income level.

Return Migration: Return Migration is the voluntary movements of immigrants back to their place of origin. Even though migrants have moved to urban they are also having an idea to come back to villages

Table 3: Descriptive Statistics of the Sample Respondents

Source wise average monthly income of sample respondents (in Rupees)					
S. No.	**Source of income**			**Migrant**	**Non-migrant**
1	Crop			3069.82	5472.04
2	Livestock			1135.41	1850.00
3	Off-farm			1901.43	3079.72
4	Non-farm			16700.38	2350.97
5	Average Household income per month			17868.28	7202.03
Debt position of sample migrants before and after the migration (in Rupees)					
Sl. No.	**Debt**	**Before Migration**	**%**	**After Migration**	**%**
1	No debt	28	35.00	39	48.75
2	<50000	9	11.25	15	18.75
3	50001-100000	21	26.25	15	18.75
4	100001-300000	18	22.50	11	13.75
5	>300000	4	5.00	0	0.00
	Total	80	100.00	80	100.00
	Average debt	87625		42775	
Monthly Household expenditure of sample respondents (in Rupees)					
Sl. No.	**Expenditure level**	**Migrant**		**Non migrant**	
		Number	**Average**	**Number**	**Average**
1	1500-3000	0 (0.00)	0	17 (21.25)	2255.88
2	3001-5000	0 (0.00)	0	13 (16.25)	4169.23
3	5001-10000	33 (41.25)	7819.84	49 (61.25)	7047.55
4	10001-15000	30 (37.50)	12347.50	1 (1.25)	15000.00
5	>15000	17 (21.25)	18680.88	0 (0.00)	0.00
	Total	80 (100.00)	—	80 (100.00)	—
	Average expenses	11825.69		5661	
Monthly Savings position of sample respondents (in Rupees)					
Sl. No.	**Savings**	**Number**	**Average**	**Number**	**Average**
1	No savings	7 (8.75)	0.00	47 (58.75)	0.00
2	<1000	31 (38.75)	754.83	14 (17.50)	635.71
3	1001-2500	23 (28.75)	1854.34	14 (17.50)	1735.71
4	2501-5000	10 (12.50)	3321.42	5 (6.25)	3200.00
5	>5000	9 (11.25)	7833.33	0 (0.00)	0.00
	Total	80 (100.00)		80 (100.00)	
	Average Savings	2163.12		615.00	

Figures in the parentheses indicate percentage to total.

after completing their commitments. Migrants' idea on return migration is provided in Table 4.

Table 4: Return Migration According to Land Holding of Migrants

Sl. No.	Landholding (in Hectares)	Yes	No	Total
1	Landless labour	0 (0.00)	30 (100.00)	30 (100.00)
2	Marginal (<1)	6 (19.35)	25 (80.64)	31 (100.00)
3	Small (1-2)	9 (81.81)	2 (18.18)	11 (100.00)
4	Medium (2-4)	7 (87.50)	1 (12.50)	8 (100.00)
	Total	22 (27.50)	58 (72.50)	80 (100.00)

Figures in the parentheses indicate percentage to total.

The idea it was revealed from the table that, the agricultural labours do not want to return to agriculture and it is evident from the table that landholdings and return migration are directly related to each other. As the size of land holdings increases more there is an idea of returning to agriculture.

Income Determination between Migrants and Non-migrants: To delineate the impact of migrant's income on rural households income, the decomposition analysis was used by estimating the income equations for migrants and non-migrants separately and results are presented in Table 5. The regression coefficients have been used for calculating wage differentials due to personal endowments and structural differences. Both the equations show high values of R^2 and variables in both the equation seems well specified. The high values of F indicate the overall significance of the model.

It could be seen from the table that in the case of non-migrant the coefficient of determinations (R^2) was 0.68 which indicated that 68 percent of variation in the dependent variable was influenced by the explanatory variables which are included in the model. The significant F value of 34.97 indicates the goodness of fit. The dependent variable log of annual income is about 11.168. Explanatory variables like the educational level of the respondent, the number of workers in the household and the size of landholdings had a positive and significant influence at one percent level. One percent increase in the educational level of sample respondents, working population of household and land size would increase the income of non-migrants by 0.03, 0.55 and 0.10 percent, respectively.

In the case of migrant, the coefficient of determinations (R^2) was 0.77 which indicated that 77 percent of variation in the dependent variable was influenced by the explanatory variables of the model. The significant F value of 54 indicates the goodness of fit. The dependent variable log of annual income is about 12.220. Explanatory variables like the educational level of the respondent and the number of workers in the household had a positive and significant influence at one percent level. One percent increase in the educational level of sample respondents and the working population of household would increase the income of migrants by 0.09 and 0.15 percent, respectively.

The absolute contribution of individual variables towards overall earnings differential between migrants and non-migrants is given in table 6. The endowment related factors of the workers like education, the number of workers in the household, size of land holdings contribute favourably in the case of migrants, whereas age and marital status favoured non-migrants.

Table 5: Decomposition Analysis
Income determination model for Migrant and Non-migrant Respondents

Variables	Non-migrant	Migrant
Explained variables		
Log of annual income (₹)	11.1681	12.2207
Explanatory variables		
Age	0.000888	0.002265
Education	0.030237***	0.091209***
Workers	0.551049***	0.158831***
Land size	0.108816***	-0.00636
Marital status	0.016558	0.020453
Intercept	9.795078***	10.97726***
R square	0.68	0.77
F value	34.97	54.00

Note: **** indicates significant at 1 % level.*

Further, the contribution of different factors towards the income difference between the two groups arises due to the differences in coefficients of the explanatory variables of the two-income equations. It is seen from the table that age, education and marital status contributed in favour of migrants.

From table 7, the estimated result shows that 65.35 percent of the income difference between the migrant and non-migrant sample respondent households was due to the structural difference called migration. Whereas, the endowment differences contributed to 34.64 percent of income difference due to factors included in the model like age (-2.24 percent), education (34.76 percent), workers population (2.82 percent), land size (0.01 percent) and marital status (-0.72 percent). The average annual income

Table 6: Decomposition of Income Differentials between Migrant and Non-migrants

Variables	α_M	α_N	X_M	X_N	$\alpha_M (X_M - X_N)$	$X_N (\alpha_M - \alpha_N)$
Constant	10.9770	9.7950				
Age	0.0020	0.0008	31.9750	42.4125	-0.0236	0.0584
Education	0.0910	0.0300	9.3875	5.3750	0.3659	0.3277
Workers	0.1580	0.5510	1.9750	1.7875	0.0297	-0.7010
Land size	-0.0060	0.1080	1.5562	1.5875	0.0002	-0.1828
Marital status	0.0200	0.0160	0.5375	0.9125	-0.0076	0.0035
Differences due to endowments					0.3646	
Differences due to coefficients						0.6879

of migrant was ₹ 214419.3 and non-migrant were ₹ 86424.3. Out of the total difference of ₹ 127995, the difference due to superior endowment of migrants about ₹ 44337.46 and difference due to migration was ₹ 83644.73 per annum.

Table 7: Decomposition of Total Differences in Income of Migrant and Non-migrant respondents

Summary	Coefficients	Percent
Over all income difference	1.0525	100.00
Income difference due to coefficients / migration	0.6879	65.35
Income difference due to explanatory variables/ endowments		
Age	-0.0236	-2.24
Education	0.3659	34.76
Workers	0.0297	2.82
Land size	0.0001	0.01
Marital status	-0.0076	-0.72
Total	**0.3646**	**34.64**

CONCLUSION

The study analysed the impact of rural-urban migration by comparing income, expenditure and savings position of migrants and non-migrants and it was found that migrants had higher income, higher expenses and better savings implicating the betterment of life of migrants because of migration. The debt position of migrants had drastically reduced (to 51.18 percent) after migration because of higher income. As migrants started earning higher wages from migration, it helps them in savings and creation of assets. Migrant households made an investment in jewels, purchasing of vehicles, and housing and to a lesser extent in agriculture. It was also noted that almost three fourth of the migrants did not want to return to the agriculture sector which has to considered alarming. The study stresses the need for the creation of employment opportunities in rural areas that will decrease the rate of migration and also will increase the economic standard of non-migrant households.

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Bio-inoculants as Prospective Inputs for Achieving Sustainability: Indian Story

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ABSTRACT

Increasing consumption of synthetic chemical fertilizers played a great role in alleviating hunger but has also resulted in some adverse effects on natural resources like disaster in soil quality and conceivable outcomes of water pollution. Due to these unfavorable effects, emphasis is being laid on alternate forms of agriculture that are more sustainable. The development of bioinoculant with multi-crop growth promoting activities is most important for sustenance of agriculture. Instead of being financially viable and eco-accommodating in nature, a few imperatives incorporate temperamental supplies and non-appearance of appropriate quality control limit the application or execution of the innovation. In the present review status, use and major manufacturer /industries involved for production of bioinoculants in India has been presented. The total number of units including public, private and cooperatives estimated to be 297. Maharashtra is having the highest number of private companies (68) followed by Gujarat (56) while Tamil Nadu have the highest number public sector units (7) and Delhi is having highest number of co-operatives units (3). Production data (carrier base in MT) revealed that Gujarat (6575 MT) topped the list first followed by Madhya Pradesh and Karnatka (2589.9 MT) during 2016-17. Zone wise bio-fertilizer production in India during the same period is highest in Karnatka both in carrier based formulation (31553.06 MT) and liquid based formulation (993.443 KL).

Highlights

- Complementary use of bio-fertilizers and organic matter in suitable combinations with chemical fertilizers is the only way out in the present set of frgile agro ecosystem.
- The global market for biofertilizers is expected to exceed a market worth of USD 10.2 billion by 2018.
- Western parts of India is having more concentration of private companies while southern states is having the highest number public sector units and central part of India is having highest number of co-operatives units.
- Key issue in formulation development and production of bioinoculant is the quality control of the products.

Keywords: Fertilizers, bioinoculant, Karnatka, soil, agriculture

The green revolution bought amazing consequences in food grain production (283.7 MT during 2018-19) but with insufficient concern for agriculture and environmental sustainability. Sustainable agriculture is proving as one of the toughest jobs in these days. There is no uniformity in agriculture practices all over the world, but one thing which

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is more or less common is the use of chemical pesticides and fertilizers causing agriculture fatigue. Therefore, it is a matter of concern to overcome nutritional effects through the help of intensification of agriculture with the use of chemical fertilizers, broad spectrum pesticides. Due to the necessity to reduce chemical products (chemical fertilizers, pesticides, and supplements), it's the moral responsibility aiming sustainable agriculture and protecting the environment. Integrated plant nutrient management is an important component through rational use of existing technology for sustainable agriculture. The best available options lie in the complementary use of bio-fertilizers and organic matter in suitable combinations with chemical fertilizers (Rakshit *et al.* 2014). The efficient bio-fertilizers are gaining importance in sustaining agriculture as bio-inoculants may be the most viable option to overcome from agriculture fatigue due to various complementing combinations of microbial inoculants for management of major nutrients are necessary for agriculture sustainability which are more robust than synthetic chemicals as the formulation product of a single microbe may involve direct interactions with pathogens, and numerous mechanisms take part in disease suppression and plant growth promotion (Rodrigo *et al.* 2011; Bhardwaj *et al.* 2014; Rakshit *et al.* 2014).

Bio fertilizers are related commonly to plant growth promotion and responses to abioticstresses, induced by a pool of bioactive compounds from a great diversity of environment friendly sources (Barman *et al.* 2017; Meena *et al.* 2017). The beneficial bacteria can produce phytohormones and other compounds (Borriss 2011), biomasses and their extracts, e.g., algae (Jannin *et al.* 2013) and yeast (Lonhienne *et al.* 2014), or by mycorrhizal fungi (Bettoni *et al.* 2014), even products obtained by fermentation as amino acid sources (Civiero *et al.* 2013), among a huge diversity of sources that nature and the biotechnology can offer. Leguminouscrop fixes the atmospheric nitrogen by *Rhizobium* which requires optimum levelof phosphorus in plant tissue. Mineral solubilizers play an important role in seedlingsetting because more of the tropical soils are phosphate fixing and make itunavailable to the plants. Phosphate-solubilizing microorganisms (PSMs) thatsolubilize bound form of phosphorus and AM fungi act as uptaker of phosphorusand make it available to the host plants. Microorganisms facilitate plant mineral nutrition by changing the amounts, concentrations and properties of minerals available to plants.

Status of bioinoculant production

Global scenario

The growth in the organic food market is a major driving force for the increasing trends in the global biofertilizers and biopesticides market. The reason for this advancement is due to the fact that future organic industry is strongly dependent upon the crop promotion and protection products free of chemicals.

The global market for biofertilizers in terms of revenue was estimated to amount to about 5 billion USD in 2011. The Asia-Pacific region was responsible for approximately 34% of the total demand in 2011. According to a detailed analysis of the current market and of the scenarios for its development in different continents, it is forecasted to double by 2017, actively in Latin America, India and China. The global market for biofertilizers is expected to exceed a market worth of USD 10.2 billion by 2018. The global biofertilizers market size valued at USD 1.34 billion in 2018 and is projected to reach USD 3.18 billion by the end of 2026, exhibiting a compound annual growth rate (CAGR) of 11.3% Dec. 2019, (https://www.fortunebusinessinsights.com/industry-reports/biofertilizers-market-100413,). Latin America is currently among the top consumers of biofertilizers: in Mexico, a programme to support the introduction of nitrogen-fixing biofertilizers based on *Azospirillum* was carried on 1.5 million hectares. According to estimates of the Indian National Biofertilizer Development Center (NBDC) and the Bio-Tech Consortium of India Ltd (BCIL), about 350.000–500.000 tonnes of biofertilizers are potentially required for Indian agriculture. European and Latin American countries are the leading consumers of biofertilizers, owing to the stringent regulations imposed to chemical fertilizers, which tend to be replaced by biofertilizers (source: https://www.bio-fit.eu/q3/lo10-bio-fertilizers-technology-%E2%80%93-awareness,-marketing-and-future?showall=1).

Indian scenario

As we know that the Indian government has drawn its considerations lately in comparison of developed country but had put big initiatives in collaboration with national institutes to look forth and contributes enhancement of biofertilizer productions. Indian biofertilizer market had grown rapidly in the period of financial year 2009 till today, the production of biofertilizers in India had more than tripled during 2009-18. The growth is expected to continue in future owing to the strong push by the Government of India (GoI) to promote bio-agriculture. Maharashtra is having highest no. of companies (68) followed by Gujarat (56) as shown in Fig. 1.

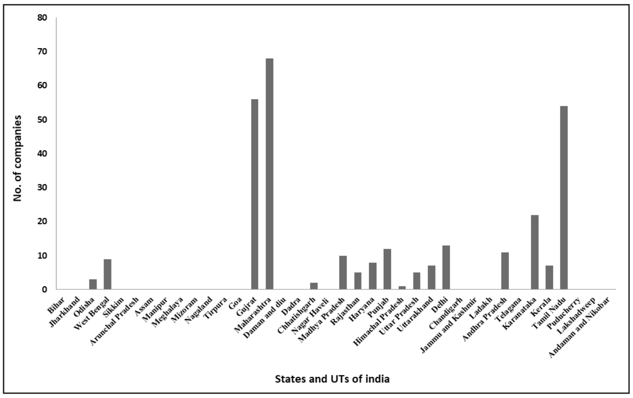

Fig. 1: Number of private companies engaged for producing bio fertilizers in different states of India

Number of private companies engaged for producing bio fertilizers in different states of India revealed that Tamil Nadu have the highest no. public sector companies (7) and Delhi is having largest number of co-operative units (3) as indicated in Fig. 2.

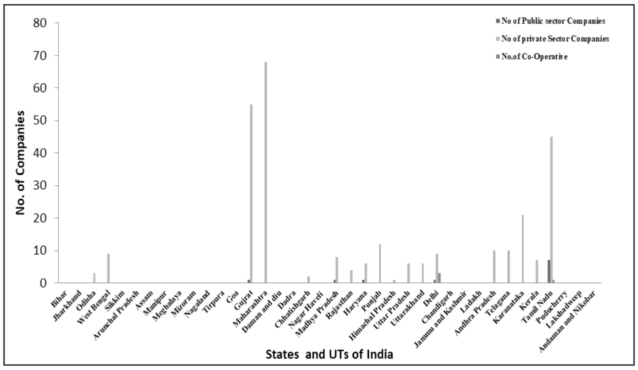

Fig. 2: Break up of different organization(public, private and co-operatives) in different states of India

Inoculant wise biofertilizer production (carrier base) (MT) in different State/UT of India during 2016-17 is highest in Gujarat i.e., 6575 MT followed by Madhya Pradesh and Karnatka 2589.9 as shown in Fig 3. Zone wise bio-fertilizer production in India during 2016-2017 highest in Karnatka both in carrier based formulation i.e., 31553.06 MT and liquid based formulation i.e., 993.443 KL as indicated in Table 1.

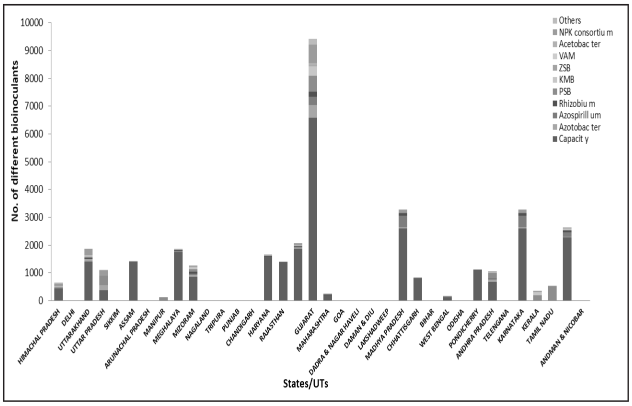

Fig. 3: Inoculant wise biofertilizer production (carrier base) (MT) in different State/UTof India during 2016-17

Quality Control is a concern

The interest in biofertilizers is also increasing due to their potential for use in sustainable agriculture. However, many of the products that are currently available worldwide are of poor quality. The formulation of an inoculant is a multistep process that results in one/several strains of microorganisms included in a suitable carrier, providing a safe environment to protect them from the harsh conditions during storage and ensuring survival and establishment after introduction into soils. A key issue informulation development and production is the quality control of the products, at each stage of the production process.

The successful application and use of biofertilizers for the agricultural system is restricted by several limitations as Non-reliable efficacy: the efficacy of most biofertilizers is doubtful, since their mechanism of action in promoting growth is not well understood, despite the extensive research in this direction; Effect of abiotic factors on biofertilizers efficacy: it is still not clear how variations in soil type, management practices and weather affect the biofertilizer efficacy; Field trials performance: It is still difficult to test inoculants in the field as routine experiments.

The quality specifications of biofertilizers differ from country to country and may contains parameters such as the microbial strain(s) used; the quality of biofertilizers is usually defined in terms of two important characteristics: presence

Table 1: Zone wise bio-fertilizer production in India during 2008 to 2017

Sl. No.	State	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15		2015-16		2016-17	
		Carrier based (MT)	Carrier based (MT)	Carrier based (MT)	Carrier based (MT)	Carrier based (MT)	Carrier based (MT)	Carrier based (MT)	Liquid based (KL)	Carrier based (MT)	Liquid based (KL)	Carrier based (MT)	Liquid based (KL)
						South Zone							
1	A & N Islands	—	—	—	—	—	—	—	—	—	—	—	—
2	Andhra	168.136	1345.28	999.60	1126.35	1335.74	2714.22	2668.8000	274.8560	3062.6	317.811	3375.91	365.24
3	Daman & Diu	—	—	—	—	—	—	—	—	—	—	—	—
4	Karnataka	11921.057	3695.50	6930.00	5760.32	7683.72	9907.337	16462.6200	23.0561	23042.91	488.142	31553.06	993.443
5	Kerala	1187.001	1936.45	3257.00	904.17	1045.64	3520.66	4916.9700	10.5096	4926.045	56.5751	4993.8692	59.6143
6	Lakshadweep	—	—	—	—	—	—	—	—	—	—	—	—
7	Pondicherry	561.7924	452.79	783.00	509.45	621	516.98	560.9500	1.4976	283.641	4.088	203.966	11.197
8	Tamil Nadu	4687.818	3732.59	8691.00	3373.81	11575.7	14104.83	15373.2900	11.3017	23721.2104	861.9535	27427.962	875.292
	Total	**18525.804**	**11162.61**	**20660.60**	**11674.1**	**22261.8**	**30764.027**	**39982.6300**	**321.2210**	**55036.41**	**1728.57**	**67554.7672**	**2304.7863**
						West Zone							
1	Chhattisgarh	—	—	—	276.34	501.63	712.07	1024.680	9.620	954.371	9.38	955.074	10.23
2	Gujarat	1149.695	1309.19	6318.00	2037.35	978.48	6411.434	3667.929	2800.500	3963.42	2873.317	3909.82	2857.77
3	Goa	—	—	—	—	370	66.26	802.520	—	820.52	—	822	—
4	Madhya	848.448	1587.68	2455.57	2309.06	1408.08	4824.194	2637.990	119.216	2741.3077	131.033	5609.006	238.103
5	Maharashtra	1249.87	1861.33	2924.00	8743.69	5897.91	6218.607	14847.397	324.767	7825.142	389.665	8323.616	398.33
6	Rajasthan	353.67	805.57	819.75	199.78	982	1315	599.898	0.000	680	—	711	—
7	D & N Haveli	—	—	—	—	—	—	—	—	—	—	—	—
	Total	**3601.683**	**5563.77**	**12960.72**	**13566.22**	**10138.10**	**19547.565**	**23580.414**	**3254.103**	**16984.76**	**3403.395**	**20330.516**	**3504.433**
						North Zone							
1	Delhi	1165.1	1021.85	1205.00	1617	—	396	104.500	—	106.2	—	116.2	—
2	Chandigarh	—	—	—	—	—	—	—	—	—	—	—	—
3	Haryana	14.25	6.20	6.53	914.41	5832.61	1146.483	872.955	46.489	1097.457	58.032	2360.644	70.148
4	H.P.	—	8.50	9.00	1.29	—	26.147	0.768	33.070	2.712	190.05	3.276	194.7

5	J & Kashmir	—	—	—	—	—	45.26	—	—	—	—	—	—
6	Punjab	1.14	301.23	2.50	692.22	2311.33	2124.852	6305.453	74.278	2197.197	149.581	5533.774	210.177
7	Uttar Pradesh	885.5174	962.64	1217.45	8695.08	1310.02	2682.221	4099.068	98.036	3053.115	223.34	2835.79	461.19
8	Uttarakhand	48.23	32.00	45.00	263.01	2758.21	5493.851	2129.952	208.034	3549.39	428.22	3720.68	696.9
	Total	**2114.2374**	**2332.42**	**2485.48**	**12183.01**	**12212.17**	**11914.814**	**13512.696**	**459.907**	**10006.07**	**1049.223**	**14570.364**	**1633.115**
					East Zone								
1	Bihar	—	—	136.26	75	52.4	52.4	64.90	0.00	97	—	107	—
2	Jharkhand	15.00	15.00	0.00	8.38	35.3	14.2	9.08	0.00	9.172	—	18.552	—
3	Odisha	405.03	289.87	357.66	590.12	407.1	1097.61	1074.46	4.70	467.634	13.701	516.281	31.79
4	West Bengal	241.24	256.50	393.39	603.2	1110	1682.7076	2061.83	14.63	2826.27	23.537	3195.18	26.21
	Total	**661.27**	**561.37**	**887.31**	**1276.7**	**1604.8**	**2846.9176**	**3210.27**	**19.33**	**3400.076**	**37.238**	**3837.013**	**58**
					North East Zone								
1	Arunachal	—	—	—	—	—	59	59	—	3062.6	317.811	119.7	—
2	Assam	129.3552	121.04	130.00	68.33	89	149	88.000	—	1315	22.5	1359.05	26
3	Manipur	—	—	—	—	—	—	—	—	—	—	25	—
4	Meghalaya	—	—	—	—	—	—	—	—	—	—	—	—
5	Mizoram	1.996	2.50	2.00	—	—	4	3.600	—	4.2	—	2.5	—
6	Nagaland	16.0092	18.25	21.50	13	7.45	7.45	7.450	—	8.81	—	51.45	—
7	Sikkim	—	—	—	—	9.5	10.1	12.400	—	12.91	—	16.25	—
8	Tripura	14.68	278.40	850.00	1542.85	514	225	240.000	—	1143.07	—	1153.5	—
	Total	**162.0404**	**420.19**	**1003.50**	**1624.18**	**619.95**	**454.55**	**410.450**	**—**	**5546.59**	**340.311**	**2727.45**	**26**
Grand Total			**25065.035**	**20040.36**	**37997.61**	**46836.82**	**65527.87**	**80696.45**	**4054.56**	**88029.30**	**6240.92**	**109020.11**	**7526.33**

Source: *Compiled from the data provided by NCOF (Data Provided by Production Units/State Government/ RCOFs).*

of a recommended strain in the required quantity and in active form;Microbial density at the time of manufacture and at the time of expiry: the number of selected microorganisms in the active form per gram or milliliter of biofertilizer. The guidelines used are limited to the density of the available microorganisms and their viability and preservation;the permissible contamination: it is important to set control schemes that account for putative contaminating microorganisms;the expiry period;the pH, the moisture and the carrier;the control management is very essential and must be performed continually. The procedure of biofertilizer quality control includes guaranteed identification of the strains;guaranteed cell density of the strains; assessment of the main activities as effect indicators of biofertilizers; regular inspection for quality control by the competent authorities; evaluation of the effect on target crops; registration under the regulation.

Government Initiatives

The government of India is very proactive in cause of taking actions against the miserable conditions of agriculture sector. It has been always in the attention of the government officials to look after the fertility of soil and its health. Government of India has been implementing the scheme for the promotion of bio-fertilizers since 7th Five Year Plan. Under this scheme, one national centre - NCOF and six regional centres-RCOFs have been established. In 1988, under full grant-in-aid of Govt. of India OAIC (Odisha Agro Industries Corporation Limited) a Govt. of Odisha undertaking set up a bio-fertilizer production unit at Laxmisagar, Bhubaneswar. Since then the unit has been processing quality bio-fertilizers namely *Rhizobium* Culture, P.S.B., *Azotobactor*, *Azospirrilum*, Potash Mobilizing Bacteria (KMB) *Trichoderma* for compost production The unit has also been making constant effort in promoting the use of bio-fertilizer in different crops mainly in paddy, oil seed crops, pulses, vegetables, orchard crops, sugarcane and beetle leafs. In Gujarat setting up a Bio-Fertilizers and Bio-Pesticides Unit Biotechnology Government of Gujarat: Savli Biotech park, Gujarat Industrial Development Corporation (GIDC) in Vadodara district an ideal location to establish a biofertilizer and biopesticide manufacturing plant. It had developed in three phases. The site is owned and managed by GIDC and has gained traction from large fertilizer and pesticide companies including GSFC and Bayer.

Entrepreneurship Development Programme" In Biotechnology Sponsored by Development Commissioner Small Scale Industries(DCSSI) Government of India & Department of Biotechnology (DBT), Government of India Conducted by Biotech Consortium India Limited (BCIL), New Delhi & Small Industries Service Institute, Mumbai. The present information contains on technical and general aspects of management of biotechnology projects such as biofertilizers, biopesticides, enzymes, micropropagation, organic farming, medicinal plants extraction, immuno-diagnostics, prawn culture, prawn hatchery, pearl aquaculture, nutraceuticals and solid waste management for biotech products. This document has been put together by BCIL in association with EKTA Incubation Center (WBUT) under the guidance of DBT and DCSSI, Government of India to create awareness about the management of biotechnology projects among the prospective entrepreneurs.

National Project on Organic Farming (NPOF) is a continuing central sector scheme since 10th Five Year Plan. Planning Commission approved the scheme as PILOT project for the remaining two and half years of 10th plan period with effect from 01.10.2004 with an outlay of ₹ 57.04 crore. The scheme is continuing in the 12th Plan. NPOF is being implemented by National Centre of Organic Farming at Ghaziabad and its six Regional Centres. Besides working for realisation of targets under NPOF, NCOF and RCOFs are also performing specific roles in promotion of organic farming and having some objectives to be aimed by these institutions such as promotion of organic farming in the country through technical capacity building of all the stakeholders including human resource development, transfer of technology, promotion and production of quality organic and biological inputs; awareness creation and publicity through print and electronic media; to act as nodal quality control laboratory for analysis of biofertilizers and organic fertilizers as per the requirement of Fertilizer Control Order (FCO, 1985); revision of standards and testing protocols keeping in view the advances in research and technology and bringing remaining organic inputs under quality control regime;

Table 2: List of agritechstart ups initiated for production of low cost biofertiliser and biopesticide

Sl. No.	Name	Year of functioning	States/UT	Technology/Protocols	Mentoring institute	Products	Address and Website
1	OAIC	**1988**	Odisha	Isolation of bacteria, selection of suitable effective strain, preparation of mother or seed culture, isolation of bacteria, inoculants production, carrier preparation and their mixing, followed by curing, packaging, storage and dispatch.	**NCOF-RCOF**	*Rhizobium* Culture, P.S.B., Azotobactor, *Azospirrilum*, Potash Mobilizing Bacteria (KMB) *Trichoderma* for compost production	Odisha Agro Industries Corporation Limited Laxmisagar, Bhubaneswar, Odisha Web:www.apicol.co.in
2	FIB-SOL Life Technologies	2013	Tamil Nadu	Nanofibre technology ultra-lightweight membrane embedded withlow-weight biodegradable and low-cost biofertiliser	IIT- Madras	Gel based formulations N-GEL, P-GEL and K-GEL for providing bioavailable nitrogen, phosphorus and potassium to plants.	Kamarajar Street, Chennai. Web: www.fibsol.com
3	Agril and biotech	2017	Gujarat	Novel biofertiliser, phosphate solubiliser	-	Glomusfasiculatum	Savli Biotech park, GIDC in Vadodara, Gujarat Web: www.ipindiaservices.gov.in
4	Entrepreneurship Development Programme" In Biotechnology	2007	Maharashtra	Technology developed at SPIC Science Foundation (SSF), It does not involve liquid fermentation.	Department of Biotechnology	*Rhizobium*, *Azospirillum*, Gluceanoacetobacter and PSB	Pune, Maharashtra Web: www.biotech.co.in
5	Agri Life Bio-Solutions for Soils, Crops	2009	Telangana	Oxygen liberating product for root respiration, Immunomodulator for prevention of Bacterial diseases Biocide for treatment of on farm debris)	National Centre for Industrial Microbes (NCIM), Jawaharlal Nehru Technological University, Hyderabad and Indian Council of Agricultural Research	Nitrogen fixing bacteria Phosphorus solubilizing bacteria, Potassium mobilizing bacteria, Ferrous mobilizing bacteria, Zinc mobilizing bacteria, Sulphur mobilizing bacteria, Manganese solubilizing microbe, Mycorrhizae	Hyderabad Web: www.agrilife.in
6	Biofertilizer Production Centre (BPC)	2009	Madhya Pradesh	BPC works under Business Planning and Development Unit is set up under National Agricultural Innovation Project (NAIP) in collaboration with Indian Council of Agricultural Research (ICAR), New Delhi.	JNKVV, Jabalpur; ICAR, New Delhi.	*Rhizobium*, *Azotobacter*, *Azospirillum*, Phosphate Solubilizing Bacteria, *Trichoderma*, Enriched Bio-organics for all crops	Jawaharlal Nehru Agricultural University (JNAU), Jabalpur www.bpd.jnkvv.org
7	Agpulse Pvt. Ltd.	2016	Delhi	Ayurvedic plant medicine to control pest and diseases in crops without inducing toxicity in ecosystem.	IARI, New Delhi	Biopesticides and crop Nutrition	Delhi Web: www.agpulse.com

8	Agri Life Biotech,	2015	Telangana	*Trichoderma* based formulation for management of Phytopthora foot rot and slow wilt diseases of black pepper, and rhizome rot of cardamom and ginger	IISR, Calicut	Biopesticides and Crop Nutrition	Hydrabad Web: www.agrilifebiotech.com
9	Codagu Agritech	2016	Karanatka	Biocapsule technology for control of rootknot nematodes in black pepper, *Trichoderma harzianum* formulation to manage Phytophthora foot rot disease in black pepper and plant growth promoting rhizobacteria (PGPR) for enhanced growth and vigour in black pepper	IISR, Calicut	Biopesticides and Crop Nutrition	Kudlur City (Kushalnagar) Web: www.codaguagritech.com
10	Jai Biotech Research Centre	2015	Rajasthan	Phosphate solubilizing bacteria based biofertilizer technology	IARI, New Delhi	Biopesticides and Biofertilisers	Jaipur Web: www.jaibiotech researchcentre.com
11	JayvionsAgritech Industries	2015	Maharashtra	Low cost multiplication technology of salt tolerant bio-growth enhancers for normal sodic soils (CSR-BIO) 2015 Less than 1 Tonne	IVRI, Izatnagar	Microbacterial Formulations for Biofertilizers	Mumbai Web: www. jayvion sagritechindustries.com
12	Jeevanksh Eco Products Pvt. Ltd.	2012	Assam	Marketing and supply chain efficiency by integrating on the backward supply chain	IARI, New Delhi	Biopesticides and Crop Nutrition	Guwahati Web: www.Jeevanksh.com
13	KrishiBiosys	2011	Karnataka	Mass Production of Biopesticides *Trichoderma harzianum, Trichoderma viride, Pseudomonas fluorescens, Verticillium chlamydosporia, Paecilomyces lilacinus*	IIHR, Bengaluru	Biopesticides Using *Trichoderma* Formulations	Bengaluru Web: www.krishibiosys.com
14	Natura Crop Care	2016	Karnataka	Microbial consortium in powder, liquid forms, and neem and pongamia soaps	IIHR, Bengaluru	Production of Microbial Consortium, Neem Soap & Pongamia Soap	Bengaluru Web: www.naturacropcare.com
15	Navaratna Cropscience Pvt. Ltd.	2011	Telangana	New products Development in Biofertilizers, Biostimulants, Microbial consortiums, Probiotics, Prebiotics and Organic Inputs.	NAARM, Hyderabad	Biofertilizers and Biostimulants	Secunderabad Web: navratnacropscience.com
16	Sana Agri Industries	2017	Madhya Pradesh	Unique microbial process for degossypolization and nutritive enrichment of cotton seed meal.	CIRCOT, Mumbai	Crop Nutrition withMicrobial Process for Nutrition Enhancement of Cotton seed meal	Sehore Web: www. sanaagroindustries.com
17	Suma Agro India Pvt. Ltd.	2012	Tamil Nadu	Enriching the product humicas with microbial inoculants.	IIHR, Bengaluru	Crop Nutrition Enriched Humic Acid	Chennai Web: www.sumaagro.com

18	Benzer Crop Science	2015	Karnatka	Development of microbial formulations and consortia of *Pseudomonas fluroscenes* and *Paecilomyces lilacinus*, Trichodermaviride and VAM	IIHR, Bengaluru	Biofertilisers	hubli road, Sirsi, Karnataka Web:www. benzercropscience.com
19	Bloom Biotech	2015	Karnataka	Arka microbial consortium liquid formulation and formulation of fungal cultures	IIHR, Bengaluru	Liquid Biofertilisers	Chikmagalur Karnataka Web:www.bloombiotech .co.org
20	Organica Biotech	2004	Maha-rashtra	Microbiome enhancement technology and development of microbial consortia.	Self R&D lab and products have been certified by DSIR, GMP and ECOCERT	Magicgro-super, Drip Sol, KMB, PSB, ZMB	Microbiome enhancement technology and development of microbial consortia. Web: www. organicabiotech.com

organic input resource management, technology development through support to research and market development; to maintain National and Regional culture collection bank of biofertilizer, biocontrol, waste decomposer organisms for supply to production units, development & procurement and efficacy evaluation of biofertilizer strains and mother cultures; promotion of organic farming through low cost certification system known as "Participatory Guarantee System". NPOF scheme provides financial assistance through Capital Investment Subsidy Scheme (CISS) for agro-waste compost production units, bio-fertilizers/ bio-pesticides production units, development and implementation of quality control regime, human resource development, etc.

CONCLUSION

Uncontrolled over-application of chemical fertilizers by farmers during intensive agricultural practices has led to excess nutrients (particularly P) accumulation in soils, which, as a result, makes the soils dead. That is why, nowadays, the production of efficient and sustainable biofertilizers for crop plants, wherein inorganic fertilizer application can be reduced significantly to avoid further pollution problems, represents major research interest. It comprises undertaking short-term, medium and long-term research programmes combining the efforts and scientific potential of soil microbiologists, agronomists, plant breeders, plant pathologists, nutritionists and economists to work together. Successful promotion of biofertilizers technology in sustainable agriculture depends on implementation of programmes for raising awareness among the biofertilizers producers and consumers. Biofertilizers are apparently an environmentally sound and farmer-friendly renewable source of low cost agro-input. However, bioinoculants, especially those regarded as broad spectrum biofertilizers (*Azotobacter, Azospirillum*, phosphate-solubilizing bacteria and *Arbuscular mycorrhizal* fungi) have not received the deserved attention.

Considering at the worldwide market it is evident that during 2018, the demand for biofertilizers were anticipated to exceed a market worth of US$ 10.2 billion. The top consumers of biofertilizers were Europe and Latin America, mainly because in the countries from these regions, there were stringent regulations imposed on chemical fertilizers. These were followed by Asia-Pacific, which controlled more than 35% of the market. Looking at the present perspective and growing awareness for organic farming for restoring natural resource base authenticated inventorisation is key. The total number of units involved in technology making and its legitimations, their product's, productions and productivity, their demand in present and need in future, development of initiatives, startups and entrepreneurships their availability of resources as well-warrant digitization. Although efforts have been started from seventh five year plan but taking advantage of proactive government set up it is high time to streamline the informations for a greater cause and revival of fresh initiative.

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Price Behaviour and Forecasting of Onion Prices in Kurnool Market, Andhra Pradesh State

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ABSTRACT

The objective of present study was to analyse the behaviour of onion prices in Kurnool market and forecasting the prices for the future. Based on secondary data from January 2003 to December 2017, the future prices were predicted for the months of January to June, 2018 by employing the Auto Regressive Integrated Moving Average (ARIMA) technique. The annual increase in prices of onion in Kurnool market was observed to be ₹ 6.22 per quintal per annum. The highest seasonal index was observed in the month of August and lowest seasonal index was recorded in May. Price cycles were not identified in onion prices. Maximum R-Square (62.34), minimum Mean Absolute Percentage Error (MAPE) (34.96), Root Mean Square Error (RMSE) (454.71) and Mean Absolute Error (MAE) (263.19) was used as a criteria to select the best model for price forecasting. Based on the above criteria the model (1,1,1) (1,1,1) was found to fit the time series to predict future prices. The forecasted price of onion would be ranging from ₹ 2956 to ₹ 1651 per quintal for the months from January to June 2018 respectively.

Highlights

- The seasonal price index was high for the month of August and low for the month of May in Kurnool onion market.
- The ARIMA was best technique to forecast prices of onion in the Kurnool market with narrow variations in between the actual and forecasted values.

Keywords: ARIMA technique, Forecasting, MAPE, MAE, RMSE and Seasonality

Onion has become an almost indispensable part of the Indian diet and also its prices are highly volatile. Onion price fluctuations are occurring all over Indian markets and they are causing damage to both onion producers and consumers. The ARIMA model is commonly used in price time series prediction, especially for series that has a cyclic or seasonal pattern. At the same time, Box-Jenkins ARIMA model give the good representation of short time forecasting. The principle of the model contains filtering out the high-frequency noise in the data, detecting local trends based on liner dependence and forecasting the trends. Despite its high predictive performance, the model has some limitations which decrease its scope of application. The model assumes a linear relationship between the dependent and independent variables while the actual data often present non-linear relationships. Besides, the model assumes that the mean and variance of response series are independent of time, which means stationary. Thus, more than one model should be tested to choose a better one. Forecasting of prices of perishable agricultural commodities is very difficult because they are not only governed by demand and supply but also by

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so many other factors which are beyond control like weather vagaries, storage capacity, transportation *etc*. Takle (2002) studied the behaviour of market arrivals and prices of *rabi* Jowar for the period from 1981 to 1995 for seven regulated markets of Marathwara region. Chahal *et al.* (2004) examined the price behaviour of green peas in Hoshiarpur and Ludhiana (Punjab) markets from 1994 to 2002. Sangeeta (2004) analyzed the behaviour of arrivals and prices of onion in Lasalgaon and Pune markets (Maharashtra) from 1999-2002. Devi *et al.* (2016) studied the price behaviour of chillies in Guntur market of Andhra Pradesh, India for the years 1997-2014. ARIMA model was employed by Darekar *et al.* (2015) to forecast the prices of onion at Lasalgaon market of Western Maharashtra, Darekar and Reddy (2017) forecasted the prices of cotton in major producing states of India, Chandran and Pandey (2007) forecasted the prices of potato for Delhi market, Devi *et al.* (2011) forecasted sunflower and groundnut prices in Kurnool market.

The main objective of present research was to analyse the price behaviour and forecasting of onion prices in Kurnool market of Andhra Pradesh state.

MATERIALS AND METHODS

The time series data on monthly prices of onion required for the study was collected from the registers maintained by the respective market committees, National horticulture board database (Anonymous 2018) and NHRDF (National Horticulture Research and Development Foundation). The data related to monthly modal prices (₹/qtl) for the period from January 2003 to December 2017 (15 years) was used for time series analysis and for price forecasting from January to June 2018.

To analyse all the four components of a time series *viz.*, trend, seasonal, cyclical and irregular fluctuations, a multiplicative model of the following type was used as elucidated in Areef *et al.* (2019),

Monthly data $Y_t = T_t \times S_t \times C_t \times I_t$

where,

Y_t = Time series data on prices at time period '*t*'
T_t = Trend component at time period '*t*'
S_t = Seasonal variations at time period '*t*'
C_t = Cyclical movements at time period '*t*'
I_t = Irregular fluctuations at time period '*t*'

Trend Component

Over a long period, time series is likely to show tendency to either increase or decrease over time. Price trend explains the general direction of the movement of prices over long period of time. Ordinary least square method was employed to ascertain the trend in prices by estimating the intercept (a) and slope coefficient (b) in the following linear functional form:

$$Y_t = a + bX_t + e_t$$

where,

Y_t = Trend value at time *t*

X_t = period (Serial number assigned to the t^{th} month)

e_t = Random disturbance term (assumption of zero mean and constant variance)

a = Intercept parameter

b = Slope parameter

The goodness of fit of trend line to the data was tested by computing the multiple coefficient of determination (R^2).

Seasonal Variations

In order to estimate the seasonal variation, the twelve month centered moving average method was used which gives us the periodic changes without seasonality. To estimate the seasonal index, a 12 month centered moving average was calculated as follows:

$$M_1 = Y_1 + Y_2 + Y_3 + \ldots + Y_{12} / 12$$
$$M_2 = Y_2 + Y_3 + Y_4 + \ldots + Y_{13} / 12$$
$$M_3 = Y_3 + Y_4 + Y_5 + \ldots + Y_{14} / 12 \ldots\ldots\ldots \textit{etc.}$$

This is sequential manner for each points of time *t*. In this fashion, a 12 month centered moving average removes a large part of fluctuation due to the seasonal effects so that what remains is mainly attributable to other sources *viz.*, long term effects T_t, cyclical effect C_t and the irregular variation I_t which is due to random causes is also minimized by the process of smoothing out effect. Thus, this affords a means of not only estimating TC effect but also estimating seasonal components. In the next step of computing the seasonal index, the original series is divided by the centered moving average. This gives the first estimate of seasonal component S_t.

$$S_t = Y/(TC)_t = T_t * C_t * S_t * I_t / T_t * C_t$$

It is always expressed in terms of percentages. In this process, we do not have moving average for the first six and last six months. These seasonal components are next arranged month-wise for each year (Table 1). The last row in the Table 1 give estimates of seasonal index for the 12 months adjusted for their total to 1200 or averaged to 100. The last row in the Table. 1 gives the first estimates of seasonal variations. In order to obtain a better estimate *i.e.*, stabilized seasonal indices we need to employ an interactive process as under. The original observation (Y_t) is divided by corresponding (S_t) value and then obtain the residual $(TCI)_t$ corresponding to time point t.

$$(TCI)_t = Y_t / S_t = (TCSI)_t / S_t$$

The residual series $(TCI)_t$ thus obtained is subjected to the same process of determining 12 month centered averages as done earlier to obtain better estimates for trend cycle effect *viz.*, $(TC)_t$. These revised estimates are next employed as above to generate a revised set of seasonal indices by dividing each observation (Y_t) by the corresponding $(TC)_t$ value. This will lead to revise estimates of seasonal indices (S_t) as second interactive ones.

$$(TCI)_t = [S_{(i+j)} - S_i] / S_i \times 100 \leq 5$$

$$i = j = 1, 2, \ldots\ldots\ldots, 12.$$

This interactive process is separately employed until stabilized seasonal indices are obtained i.e., two successive seasonal indices do not differ by more than five per cent.

Where adjusted

Seasonal indices = Seasonal indices × correction factor

and

Correction factor = 1200 / Sum of seasonal indices

Cyclical movements

Cyclical variations are long term oscillatory movements with duration of greater than one year. The most commonly used method for estimating cyclical movement of time series is the residual method by eliminating the seasonal variation and trend. This is accomplished by dividing (Y_t) by corresponding (S) for time 't'

Symbolically,

$$T.C.S.I/S \text{ and } T.C.I/T = C.I$$

Irregular variations: It was estimated as residual component by using the estimates of model prices and cyclical components.

$I_t = P_t / T_t * C_t \times 100$

$= T_t * C_t * I_t / T_t * C_t \times 100$

$= I_t * 100$

The details of ARIMA forecasting model are as follows:

Auto Regressive Integrated Moving Average (ARIMA) Model

Introduced by Box and Jenkins (1976), the ARIMA

Table 1: Average of percentage centered 12 months moving average and computation of seasonal index for observation

Year	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
2003	*	*	*	*	*	*	S	S	S	S	S	S
2004	S	S	S	S	S	S	S	S	S	S	S	S
**	*	*	*	*	*	*	*	*	*	*	*	*
**	*	*	*	*	*	*	*	*	*	*	*	*
2017	S	S	S	S	S	S	S	S	S	S	S	S
Mean	*	*	*	*	*	*	*	*	*	*	*	1200
Adjusted Seasonal Index	*	*	*	*	*	*	*	*	*	*	*	100

model has been one of the most popular approaches for forecasting. The ARIMA model is basically a data oriented approach that is adopted from the structure of the data itself. In an ARIMA model, the estimated value of a variable is supposed to be a linear combination of the past values and the past errors. Generally a time series can be modelled as a combination of past values and errors, which can be denoted as ARIMA (p,d,q) which is expressed in the following form

$$Y_t = \theta_0 + \Phi_1 Y_{t-1} + \Phi_2\ Y_{t-2} + \dots + \Phi_p\ Y_{t-p} + e_t - \theta_1 e_{t-1} - \theta_2\ e_{t-2} - \dots - \theta\ e_{t-q}$$

where Y_t and e_t are the actual values and random error at time t, respectively, Φ_i (i = 1,2,……, p) and θ_j (j = 1,2,……, q) are model parameters, p and q are integers and often referred to as orders of autoregressive and moving average polynomials respectively. Random errors are assumed to be independently and identically distributed with mean zero and constant variance. Similarly, a seasonal model is represented by ARIMA (p, d, q) × (P, D, Q), where P is the number of seasonal autoregressive (SAR) terms, D is the number of seasonal differences and Q is the number of seasonal moving average (SMA) terms. Basically this method has four steps identification of the model, estimating the parameters, diagnostic checking and forecasting

RESULTS AND DISCUSSION

The results revealed that there was an increasing trend in onion prices in Kurnool market for the study period. The trend equation estimated for the present study was 264.39 + 6.22*t and graphically shown in Fig. 1. The annual increase in prices of onion in Kurnool market was observed to be ₹ 6.22 per quintal. Areef *et al.* (2019) revealed that the annual increase in prices of onion in Bangalore market was ₹ 6.92 per quintal for the period from Jan-2003 to Dec-2017 and it was found to be statistically significant. In order to analyse the seasonal variation in onion prices in the Kurnool market, seasonal indices were computed by adopting 12 months centered moving average method. The results (Table 2 and Fig. 2) revealed that the highest seasonal index was observed in August, followed by November and July as the indices stood at 140.80, 121.31 and 117.07 respectively. Lowest seasonal index was recorded in May with 62.72. The cyclical and irregular fluctuations in onion prices were graphically shown in Fig. 3 and Fig. 4 respectively. A definite periodic fluctuations were not identified in Kurnool market which was revealed by the absence of price cycles.

Table 2: Seasonal indices (%) in prices of onion in Kurnool market

Months	Seasonal indices
January	108.42
February	99.78
March	72.21
April	70.28
May	**62.72**
June	81.14
July	117.07
August	**140.80**
September	105.55
October	110.74
November	121.31
December	109.98

For forecasting onion prices in Kurnool market, ARIMA model was used after transforming the variable under forecasting into a stationary series. The stationary series is the one whose values vary over time only around a constant mean and constant variance. Identification of the model was concerned with deciding the appropriate values of (p,d,q) (P,D,Q). It was done by observing Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) values (Fig. 5). The Auto Correlation Function helps in choosing the appropriate values for ordering of moving average terms (MA) and Partial Auto-Correlation Function for those autoregressive terms (AR).

Table 3: Residual analysis of monthly prices of onion

Sl. No.	Model	R-square	MAPE	RMSE	MAE
1	(1,1,0) (1,111)	58.50	35.98	476.01	274.86
2	**(1,1,1) (1,1,1)**	**62.34**	**34.96**	**454.71**	**263.19**
3	(0,1,1) (1,1,1)	58.54	36.00	475.99	274.93
4	(1,1,1) (0,1,1)	61.37	36.14	459.58	271.25

ARIMA model was estimated after transforming the variables under study into stationary series through computation of either seasonal or non-seasonal or both, order of differencing. Based on the maximum

Fig. 1: Trends in prices of onion in Kurnool market

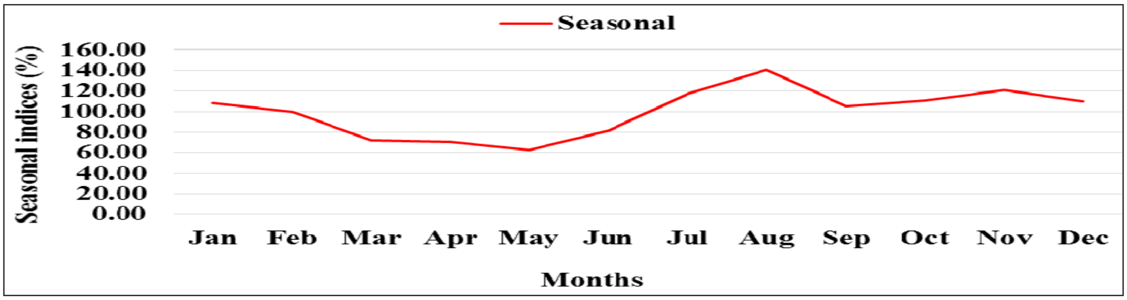

Fig. 2: Seasonal indices of onion prices in Kurnool market

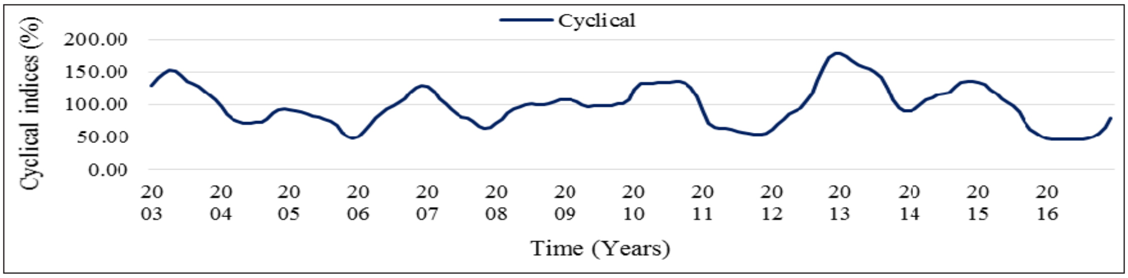

Fig. 3: Cyclical indices of onion prices in Kurnool market

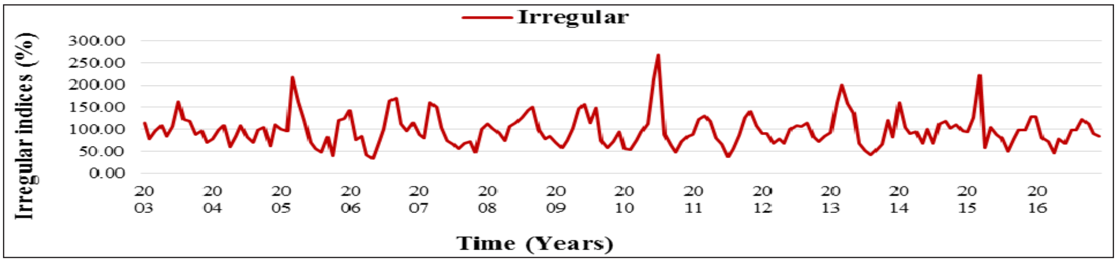

Fig. 4: Irregular indices of onion prices in Kurnool market

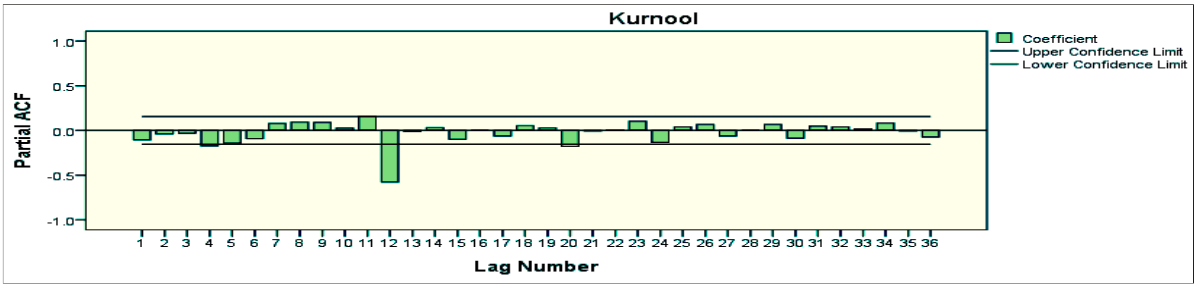

Fig. 5: Autocorrelation and Partial Autocorrelation coefficients of onion prices in Kurnool market

R-Square, minimum MAPE (Mean Absolute Percentage Error), RMSE (Root Mean Square Error) and MAE (Mean Absolute Error) the model (1,1,1) (1,1,1) was found to be fit the data and suitable to forecast future prices in Kurnool market (Table 3).

Table 4: Conditional least square estimates of onion prices

	Estimate	SE	t	P value
AR (1)	0.770	0.075	10.331	0.000
MA(1)	0.998	0.502	1.987	0.049
Seasonal AR (1)	-0.197	0.103	-1.923	0.056
Seasonal MA (1)	0.806	0.090	8.967	0.000

The parameters of the tentatively identified model were estimated and are presented in Table 4. The autocorrelation and partial autocorrelations of various orders of the residuals of ARIMA (1,1,1) (1.1,1) up to 36 lags were computed and are shown in Fig. 6. The figures showed that, the autocorrelation at lag 15 and 36 and partial autocorrelation functions at lag 15 and 20 were significantly different from zero and fell slightly outside the 95 per cent confidence interval, which indicated the presence of white noise error in the residuals.

Table 5: Ex-ante and Ex-post forecast of monthly prices of onion

Year	Month	Actual	Predicted	Year	Month	Actual	Predicted
2003	Jan	200	*		Oct	530	488
	Feb	125	*		Nov	880	492
	Mar	125	*		Dec	890	802
	Apr	190	*	2009	Jan	1000	883
	May	270	*		Feb	1030	935
	Jun	505	*		Mar	785	885
	Jul	530	*		Apr	515	661
	Aug	480	*		May	380	494
	Sep	480	*		Jun	550	559
	Oct	600	*		Jul	670	685
	Nov	519	*		Aug	660	703
	Dec	570	*		Sep	630	807
2004	Jan	830	*		Oct	865	575
	Feb	565	755		Nov	1350	762
	Mar	390	585		Dec	1315	1151
	Apr	270	493	2010	Jan	955	1218
	May	250	405		Feb	1145	896
	Jun	225	545		Mar	425	988
	Jul	340	335		Apr	330	394
	Aug	455	348		May	375	341
	Sep	350	477		Jun	675	577
	Oct	195	495		Jul	655	826
	Nov	295	160		Aug	840	733
	Dec	350	343		Sep	875	904
2005	Jan	270	582		Oct	1165	799
	Feb	220	162		Nov	1540	1113
	Mar	240	174		Dec	2700	1350
	Apr	280	238	2011	Jan	3370	2361
	May	160	319		Feb	1025	2874
	Jun	375	311		Mar	545	909
	Jul	495	443		Apr	385	502
	Aug	570	506		May	505	409
	Sep	955	509		Jun	685	720
	Oct	730	875		Jul	825	864
	Nov	580	675		Aug	1105	895
	Dec	305	606		Sep	820	1131
2006	Jan	235	447		Oct	775	854
	Feb	175	136		Nov	565	943
	Mar	200	137		Dec	420	654
	Apr	80	195	2012	Jan	225	532
	May	195	108		Feb	300	420
	Jun	250	320		Mar	325	224
	Jul	445	352		Apr	450	315
	Aug	330	490		May	450	465
	Sep	330	384		Jun	480	690
	Oct	200	286		Jul	640	664
	Nov	200	218		Aug	875	767
	Dec	400	213		Sep	560	938
2007	Jan	600	425		Oct	730	701
	Feb	970	441		Nov	730	961
	Mar	780	804		Dec	1060	1033
	Apr	555	670	2013	Jan	1235	1239
	May	450	493		Feb	1275	848
	Jun	725	549		Mar	1170	947
	Jul	800	773		Apr	945	968
	Aug	830	788		May	795	882
	Sep	1150	881		Jun	1270	962
	Oct	1050	957		Jul	2015	1299
	Nov	745	927		Aug	4145	1904
	Dec	440	674		Sep	3775	3474
2008	Jan	365	498		Oct	3000	3241
	Feb	280	325		Nov	2810	2708
	Mar	235	279		Dec	1260	2630
	Apr	220	220	2014	Jan	900	1357
	May	125	256		Feb	650	693
	Jun	355	296		Mar	510	542
	Jul	630	500		Apr	550	532
	Aug	775	630		May	800	615
	Sep	575	834		Jun	675	975
	Jul	1915	874		Jul	910	1234
	Aug	1570	1884		Aug	670	1422
	Sep	1095	1425		Sep	450	746

	Oct	1280	1173		Oct	300	686
	Nov	1050	1346		Nov	570	571
	Dec	1450	1281		Dec	460	747
2015	Jan	1000	1533	2017	Jan	640	604
	Feb	1560	856		Feb	610	717
	Mar	1295	1305		Mar	600	568
	Apr	1140	1151		Apr	580	627
	May	1105	1078		May	490	693
	Jun	1260	1300		Jun	730	767
	Jul	1775	1493		Jul	610	1288
	Aug	2800	2232		Aug	1730	1325
	Sep	3500	2482		Sep	1060	1787
	Oct	900	3034		Oct	1250	734
	Nov	1700	1106		Nov	3130	1442
	Dec	1230	1547		Dec	3500	2671
2016	Jan	1050	1299	2018	Jan	*	2956
	Feb	560	901		Feb	*	2447
	Mar	520	536		Mar	*	2021
	Apr	540	575		Apr	*	1757
	May	440	671		May	*	1596
	Jun	680	728		Jun	*	1651

Hence, except for lag 15, 20 and 36 autocorrelation was absent in the residuals. This showed that the selected ARIMA model was appropriate for forecasting the price of onion during the period under study. Both ex-ante and ex-post forecasting were done and it was compared with actual observations. The prices were forecasted up to June, 2018. The results of ex-ante and ex-post forecasted prices are presented in Table 5 and illustrated in Fig. 7. The forecast are also depicted that there is narrow variations in between the actual and forecasted values of prices of onion in the Kurnool market. According to the forecasts the price of onion would be ranging from ₹ 2956 to ₹ 1651 per quintal for the months from January to June 2018.

CONCLUSION

Reliable price forecast model enable the government to make appropriate decisions in advance like procurement, regulating export & imports and possibility of check on trader hoardings. The price seasonal indices and forecasted price information was more important for the farmer to selection of crop varieties, allocation of scarce inputs under different crops and adjusting the sowing & harvesting dates to get remunerative prices in a more rational way.

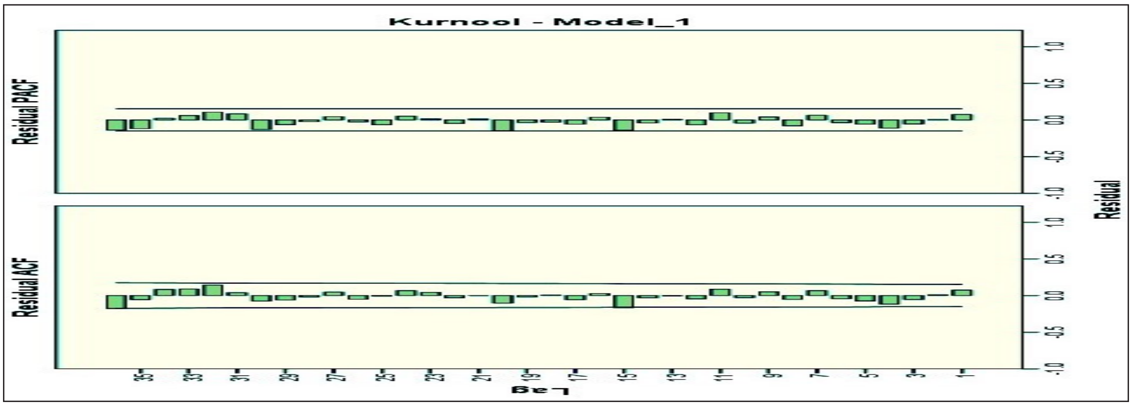

Fig. 6: Autocorrelation and Partial Autocorrelation coefficients of residual of ARIMA (1,1,1) (1,1,1) model for the onion prices

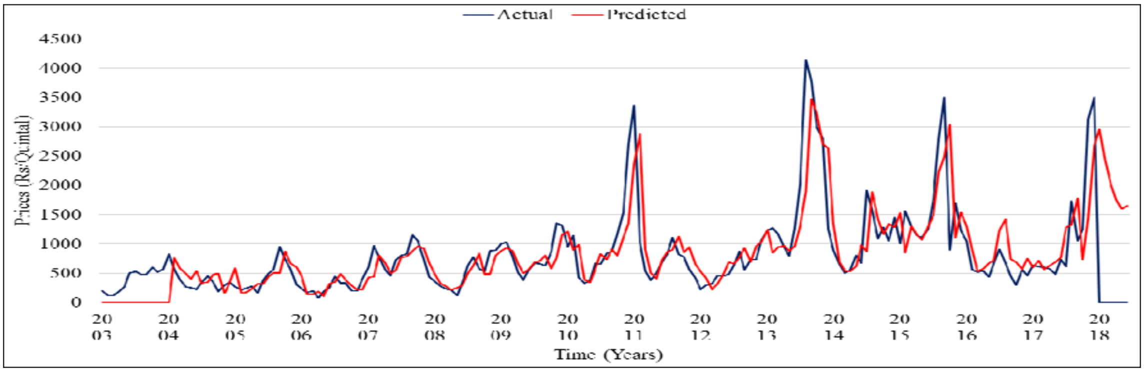

Fig. 7: Ex-ante and Ex-post forecast of monthly prices of onion in Kurnool market

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Analysis of Yield and Technological Gaps of Potato Production in Bihar

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ABSTRACT

The existence of large yield and technological gaps in different crops is a major problem faced by Indian agriculture. Potato being the most important vegetable of the country, also faces similar problem where actual yields are far below the potential yield. This study was attempted to analyze the yield and technological gap in potato production in Bihar. Data was collected from 90 farmers of Vaishali and Saran districts of Bihar using a structured interview schedule. The results revealed that the overall yield gap of 43.4 per cent existed in potato production in sampled area, which was largely due to the wide scale adoption of a local red skinned potato variety, *Bhura aloo*. The yield gap was maximum for marginal farmers (48.57%) followed by small farmers. Intensity of adoption was highest for this local variety *i.e. Bhura aloo* (33.01%) followed by Kufri Sindhuri (27.7%), Kufri Pukhraj (12.64%), Kufri Jyoti (6.83%) and Lal Gulab (5.53%). Large technological gap was observed with respect to the use of recommended dose of NPK fertilizers and pesticides by the farmers. Overall gap in input use per unit area was highest in case of potassium fertilizer (35.4%) followed by nitrogenous fertilizers (27.6%). This yield and technological gaps can be bridged by motivating and supporting farmers to adopt high yielding improved varieties and provision of effective extension services to enable farmers to use recommended level of fertilizers and pesticides.

Highlights

- Large gap in yield of potato was observed ranging from 30-50 per cent in Vaishali and Saran districts of Bihar mostly due to prevalence of local variety among farmers.

Keywords: Yield gap, technological gap, intensity of adoption, potato production, Bihar

The agriculture sector plays a very important role in Indian economy. It is the largest private sector occupation providing employment to more than half of Indian population mostly residing in rural areas. According to the 2011 census of India, 68.84% of Indian population (around 83.31 crore) live in 6,40,867 different villages distributed all over India (MHA, 2011). Therefore, India's development is intimately linked with development of agriculture sector and improving income of farmers. The Government is also keen towards increasing income of farmers and improving their socio-economic status. This is obvious from the fact that the Govt. has set a target of doubling farmers' income by the year 2022-23 to promote farmers' welfare, reduce agrarian distress and bring parity between income of farmers and those working in non-farm sector (Chand, 2017). Increasing crop productivity is one of the important measures for improving farm income as large yield gap is observed in many parts of the country. As yields of cereals such as rice

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and wheat are likely to level off or even decline in many regions of the world over the next decades because maximum achieved yields are closer to the crop potential yields (Lobell *et al.* 2009; Licker *et al*. 2010). Horticulture crops will play a definitive role in achieving the food and nutritional security across the world. Yield gap in horticulture crops is a major issue in India where actual yields are far below the potential yield. Potential yield is the yield of a cultivar when grown in an environment to which it is adapted, with optimal amounts of water and nutrients, and all biotic stresses effectively controlled. It is relevant to crops and environments where irrigation, the amount and distribution of rainfall, or a combination of irrigation and rainfall ensure that water deficits do not constrain yield (Licker *et al*. 2010; Haverkort and Struik, 2015).

Potato (*Solanum tuberosum* L.), the third most important food crop after rice and wheat, is consumed by over a billion people (Devaux *et al*. 2014). India is the second largest potato producing country in the world. As per estimates, India produced a record 48.6 million tonnes of potato during 2016-17. Potato is the most important vegetable in our country and contribute 27.3 per cent of total vegetable production (Singh *et al.* 2018). Most of the potato in India is consumed as vegetable. Uttar Pradesh (UP) is the highest potato producing state of the country followed by West Bengal and Bihar (DAC&FW, 2018). With ever increasing population, Nearly 125 million t of potato will be required from an enhanced area of 3.62 million ha with an average productivity of 34.5 t/ha during the year 2050 (CPRI, 2015). It will be a real challenge to increase potato productivity of India from current 22 t/ha to 34.5 t/ha. Being a cash crop, potato cultivation is a profitable enterprise for farmers and marketed surplus can be as high as 97.3% in this crop leading to more income (Sinha and Singh, 2019). The yield of potato varies widely in plains, plateau and hilly regions due to difference in agro climatic conditions, soil types as well as farmers' practices. In Bihar, yield of potato is hovering around 19-20 t/ha since last 4-5 years which is below the national productivity (Nearly 22 t/ha). Within Bihar also, yield is different in different agro- climatic zones. Keeping in mind these facts, current study was undertaken to analyse current status of potato productivity, varietal adoption pattern, extent of yield gap and technological gap of some important production input technologies in Bihar state of Eastern India.

MATERIAL AND METHODS

Sampling procedure and sources of data

This study was conducted in Vaishali and Saran districts of Bihar (Fig. 1). Both these districts are selected purposively since these were two top potato producing districts of North West regions (Agro climatic Zone I) of Bihar. Three blocks in each district (total six blocks) and 15 potato growers from each block were selected for data collection. Thus, the total sample size for this study was 90 farmers. Primary data was collected through survey method using a structured interview schedule and analyzed using suitable statistical tools. Secondary data was also collected from already published articles for data on area, production and productivity as well as yield data for demonstration yield and potential yield of a variety.

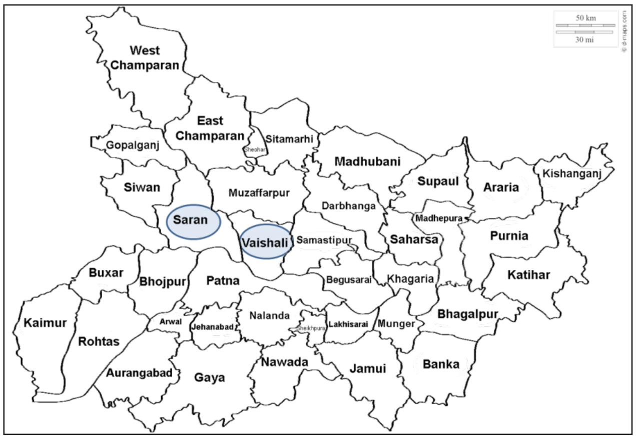

Fig. 1. Map showing the study areas

Quantification of data

The yield gap of potato in this study was estimated using methodology developed by the International Rice Research Institute (IRRI). The yield gap (Y_g) is the quantitative differences between a base-line yield (normally taken as average farmers' yield) and either attainable (taken as experiment-based yield) or potential yield (Y_p) over some specified spatial and temporal scale (Sadras *et al.* 2015). Potential yield was defined as the per hectare crop yield realized on the research station, demonstration plot yield (Y_d) is defined as the per hectare yield realized on the Frontline Demonstration (FLD) plots and the Actual yield (Y_a) was defined as the per hectare yield realized by the farmers on their field. The total yield gap (TYG) was computed as the difference between the potential yield (Y_p) and the actual yield (Y_a).

$$TYG = Y_p - Y_a \quad \ldots(1)$$

Where,

Y_p = Potential yield

Y_a = Actual yield

This total yield gap comprised of yield gap I and yield gap II. Yield Gap I (YG-I) is the difference between the potential yield (Y_p) and yield of Frontline Demonstration plot yield (Y_d). Yield data of Kufri Sindhuri in FLD plot in Bihar was taken as Y_d for this study (CPRI Annual Report, 2017).

$$YG\text{-}I = Y_p - Y_d \quad \ldots(2)$$

Where, Y_d = Demonstration plot yield

Yield Gap II (YG-II) is the difference between the demonstration plot yield (Y_d) and the actual yield (Y_a)

$$YG\text{-}II = Y_d - Y_a \quad \ldots(3)$$

Use of local varieties instead of modern high yielding improved varieties can cause yield gap at farmer's field. So, both incidence (percentage of farmers adopting improved varieties) and intensity (percentage area under improved varieties) of adoption was worked out for different varieties.

The adoption of improved production technologies is vital for bridging the yield gap of the crops. Thus, we also analyzed the technological gap of five important production input technologies, namely, seed rate, recommended dose of Nitrogen, Phosphorus and Potassium and recommended dose of plant protection chemicals used to control late blight disease. Technological gap has been defined as the proportion of gap in the adoption of practices recommended and it is expressed in percentage (Ray *et al.* 1995). The technological gap of each technology was calculated by the following formula.

$$\text{Technological Gap} = \frac{\text{Recommended practice} - \text{Actual input use}}{\text{Recommended practice}}$$

RESULTS AND DISCUSSION

Estimation of yield gap I & II

Based on analysis of data collected from farmers of Vaishali and Saran districts, yield gap I and II was estimated along with percentage yield gap (Table 1). It was observed that there was a significant difference in productivity of potato at demonstration plot and farmers' fields. The potential farm yield (yield of Frontline Demonstration plot) realized was 29.1 t/ha which was nearly 6 t/ha lesser than the potential yield. The actual average yield at sampled farms was even lesser at 19.8 t/ha. It is inferred that there was 16.85 per cent of yield gap between potential yield and demonstration yield. The yield gap II which is the difference between the demonstration plot yield (Y_p) and actual yield (Y_a) was found to be 31.95 per cent. The total yield gap (TYG) observed is 43.43 per cent at overall level. Higher yield of potato at demonstration plot could be attributed to the fact that cultivation practices are on scientific lines and carried out under the supervision of scientists.

Table 1: Yield gap in potato at sampled farms in Vaishali and Saran districts (yield in t/ha)

Particulars	Size Groups			Overall (N=90)
	Marginal (< 1 ha) (n=44)	Small (1-2 ha) (n=28)	Large (> 2 ha) (n=18)	
Potential yield* (Y_p)	35	35	35	35
Potential farm yield (FLD** yield) (Y_d)	29.1	29.1	29.1	29.1
Actual yield (Y_a)	18.0	20.1	23.9	19.8
Yield gap I (Y_p-Y_d)	5.9	5.9	5.9	5.9
Per cent gap	16.8	16.8	16.8	16.85
Yield gap II (Y_d-Y_a)	11.1	9.0	5.2	9.3
Per cent gap	38.1	30.9	17.9	31.9
Total yield gap (Y_p-Y_a)	17	14.9	11.1	15.2
Per cent gap	48.6	42.6	31.7	43.4

** Taken as potential yield of most popular variety Kufri Sindhuri; ** Yield of Frontline Demonstration of Kufri Sindhuri in the study area.*

Category wise analysis indicated highest yield gap in marginal farms (48.57%) followed by small and large farms having 42.57 and 31.71 per cent yield gap respectively. Thus, yield gap is decreasing with increasing farm size. This may be due to better management of farms and optimum use of inputs by large farmers due to more availability of economic resources. Similar trend was observed in case of study of sugarcane crop in Bihar (Singh, 2015).

Adoption pattern of improved potato varieties

It is a known fact that the yield of a crop depends on its varietal attribute and it varies from variety to variety. Therefore, adoption pattern of improved potato varieties was studied in selected area to find out the possible reasons of yield gap (Table 2 & Fig. 2).

Table 2: Incidence and intensity of adoption of different potato varieties in selected districts of Bihar (N = 90)

Name of varieties	Incidence of adoption (% adopters)	Intensity of adoption (% area)
*Bhura aloo**	40.85	33.01
Kufri Sindhuri	26.22	27.7
Kufri Pukhraj	6.20	12.64
Kufri Jyoti	6.50	6.83
Lal Gulab	6.50	5.53
Kufri Lalit	7.78	3.10
Others	5.95	11.19

* *This included a mix of various red colour local potato cultivars.*

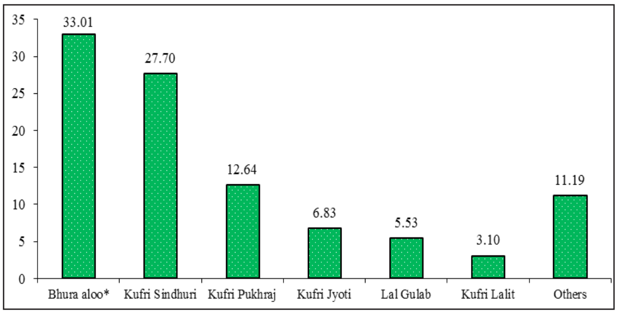

Fig. 2: Percentage area under different potato varieties the study areas

It could be seen from the results that a majority of farmers (40.8%) use *Bhura aloo* which is actually a mix of many red skinned local potato cultivars. Nearly one fourth of total respondents adopted improved red skinned variety Kufri Sindhuri. Kufri Pukhraj, Kufri Jyoti and Kufri Lalit were adopted by small number of farmers. When intensity of adoption was analyzed, it was found that area under *Bhura aloo* was highest (33%) followed by Kufri Sindhuri (27.7%), Kufri Pukhraj (12.64%) and others. Thus, it could be seen that red skin varieties were very popular among farmers and covered more than three fourth of total area. Only white skin variety Kufri Pukhraj had significant area under cultivation.

This finding complemented the fact that large gap in yield is prevalent due to cultivation of local varieties of potato by farmers. Improved varieties developed by ICAR institute *viz*. Kufri Sindhuri, Kufri Pukhraj, Kufri Jyoti and Kufri Lalit could give more yields as compared to local cultivars. Therefore, in order to bridge the existing yield gap in study area, adoption rate of improved varieties need to be enhanced. Local cultivars should be replaced by high yielding varieties by making farmers aware about the benefits of new varieties over older ones. This can be done through organization of training, laying out of Front Line Demonstrations and other awareness programmes as well as supply of quality seed of improved potato varieties.

Technological gap of important production inputs

Potato crop uses a lot of nutrients like nitrogen, phosphorus and potash for per unit area to provide high yield. The yield level also depends on other inputs like quantity of seed and pesticides used for control of disease and pests. Therefore, actual level of inputs used by farmers and the technological gap of farmers were analyzed (Table 3). Results revealed that overall technological gap per unit area was highest in case of use of potassium fertilizer (35.4%) followed by nitrogenous fertilizers (27.6%). Negative gap was observed in case of phosphorus use as farmers reported use of higher doses of phosphatic fertilizers (110 kg/ha) and plant protection chemicals (3.7 kg/ha) than recommended level. These results were in confirmation with the results found during study of potato crop in Bihar by Singh and Rai (2011). As far as quantity of seed per unit area (seed rate) is concerned, overall farmers used almost same quantity of seed as the recommended level of 2.5 t/ha. Therefore, gap in seed use was minimum at 2.2 per cent only. Input use was also studied among different category of farmers. It was observed that large farmers used recommended seed rate with minimum gap (0.16%) while marginal farmers used lower seed rate. All categories of farmers used lower than recommended dose of nitrogen with a gap ranging from 27.4 to 31.6 per cent. Pesticide use

Table 3: Level of material input use and technological gap of sampled farmers (N=90)

Particulars	Recommended dose*	Marginal Farmers (< 1 ha)		Small Farmers (1-2 ha)		Large farmers (> 2 ha)		Overall	
		Actual input use	Gap	Actual input use	Gap	Actual input use	Gap	Actual input use	Gap
Seed (Kg/ha)	2500	2348	152 (6.08)	2558	-58 (2.32)	2504	-4.0 (0.16)	2445	55 (2.20)
Nitrogen (Kg/ha)	150	108.93	41.07 (27.38)	111.83	38.17 (25.44)	102.57	47.43 (31.62)	108.56	41.44 (27.62)
Phosphorus (Kg/ha)	90	107.87	- 17.87 (- 19.85)	117.47	- 27.47 (- 30.52)	103.53	- 13.53 (- 15.03)	110.0	- 20.00 (- 22.23)
Potassium (Kg/ha)	100	65.35	34.65 (34.65)	68.72	31.28 (31.28)	56.46	43.54 (43.54)	64.62	35.38 (35.38)
Plant protection chemical (Kg/ha)	2.0	3.63	- 1.63 (- 81.5)	3.48	- 1.48 (- 74.0)	4.14	- 2.14 (- 107.0)	3.68	- 1.68 (- 84.0)

**Source:* Department of Agriculture, Govt. of Bihar (www.krishi.bih.nic.in);*
Note: *1. Figures in parentheses indicate the gap in percentage; 2. Negative sign (-) indicates the excessive use of inputs by farmers; 3. Dose of chemical used to control late blight disease in potato is taken as recommended plant protection measure.*

was found to be very high among farmers and large farmers used more than double of the recommended dose of pesticides. Phosphorus use was also 15-30 per cent higher than required dose.

Use of higher doses of pesticides and phosphorus by potato growers may be on account of lack of awareness and knowledge about ill effects of these chemicals on plant, soil and environment. Therefore, awareness programmes should be organized in study area in order to control rampant use of chemical pesticides.

CONCLUSION

Generally, potato yield realized on the farmer's field is considerably lower than that recorded on the demonstration plot. Bihar faces the problem of low productivity and thus, high yield gap in potato production despite having highly fertile land and ample water availability for irrigation. This study revealed that total yield gap of 43.4 per cent exists in potato in Vaishali and Saran district of Bihar. Since red skinned local potato cultivar commonly called *'Bhura aloo'* was predominantly grown in this region, the yield level was low. If farmers would adopt high yielding improved varieties viz. Kufri Sindhuri, Kufri Lalit, Kufri Pukhraj, Kufri Ashoka etc, the existing yield gap could be bridged to a large extent. Lack of awareness about correct doses of fertilizer application, imbalanced use of NPK and lack of potash application were other major reasons of low productivity in the study area. Rampant use of pesticides was observed in the study areas which is a cause of concern for policy makers. In order to protect soil and environment from harmful chemical pollution, farmers must be made aware about ill effect of these chemicals. The yield gap may also be attributed to the fact that farmers used farm saved seed for a long period of time and late planting of potato due to water logging condition in some areas. Farmers would also require effective extension services to enable them to use recommended level of fertilizers and pesticides.

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Types and Scales of Enterprises Being Run by the Women Entrepreneurs of Self-help Groups in Andhra Pradesh

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ABSTRACT

The present investigation was carried out in three districts of Andhra Pradesh viz., Chittoor (from Rayalaseema region), East Godavari (from Coastal region) and Srikakulam (from North Coastal region) during 2016-18. About 63 types of enterprises being run by 240 entrepreneurs depending upon availability of natural resources and demand in the local area coming to a total of 286 enterprises. Provision shop (16.08%) was the main choice of the respondents, followed by Tailoring (13.29%), Dairy (6.99%), equal (4.55%) percentage with Small hotel/Tiffin centre and Sarees and dress materials/ Cloth business and Fancy shop (4.20%). One-third (33.22%) of the SHG members running the enterprise with an income range of ₹ 50,001-1,00,000. Only 0.70 per cent of the SHG members running the enterprise with an income range of ₹ 5,00,001 and above. More than half (56.99%) of the enterprises being run by the SHG women entrepreneurs were the primary sources of income for their family. There was a significant association between the types of enterprises and scale of enterprise.

Highlights

- The findings of the study revealed that majority of women were found to be involved in traditional activities as they were less risky. Hence, training on viable and challenging enterprises should be given to these groups thus decreasing competition in the market.

Keywords: Annual income, scale of enterprise, women entrepreneurs, self-employment, training programmes

'Woman' is the key for success of any human being because of their excellent qualities such as hard-working nature, patience, cordial affiliation, convincing capacity, communication etc., in handling multifaceted activities. On the other hand women in rural areas are comparatively less educated, economically poor, confined to limited geographical boundaries and live under rigid structural constraints. Entrepreneurship is one of the prospective options to uplift rural women by generating self-employment opportunities. The concept of Self Help Group (SHG) acts as a driving force for the rural women with the ultimate objective of converting household women as enterprising women and encouraging them to enter into entrepreneurial activities. SHGs are the main medium for rural employment generation. Encouragement and support will solve the problems of rural women, which can be achieved by realizing the need for empowerment through SHGs. Since the overall empowerment of women is crucially dependent on economic empowerment, these SHGs could generate income and employment to build their empowerment (Sowjanya, 2007). Exploration of different types and scales of enterprises being run by

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the women entrepreneurs was useful for identifying the area specific enterprises being run by the respondents, need to conduct training programmes to change the attitude of women entrepreneurs to take up skill oriented and innovative enterprises which were based on availability of natural resources and demand in the local area and also need for conversion of all entrepreneurs as large-scale entrepreneurs.

METHODOLOGY

Andhra Pradesh state was purposively selected. One district each from three regions of the state viz., Chittoor (from Rayalaseema region), East Godavari (from Coastal region) and Srikakulam (from North Coastal region) were purposively selected based on the highest number of SHGs. Four mandals from each district, two villages from each mandal and one hamlet from each village were purposively selected based on the highest number of SHGs thus making a total of 12 mandals, 24 villages and 24 hamlets respectively. From each village ten women entrepreneurs were selected from all the existing SHGs in that hamlet, by using simple random sampling procedure thus making a total of 240 women entrepreneurs as the sample of the study. In the present study an attempt was made to find out the different enterprises being run by the women entrepreneurs and annual income generated from these enterprise and contribution of enterprise income to the family income were analysed. Cross tabs were used where ever it is necessary.

Chi-square test for Independence of Attributes (χ^2)

Chi square is a statistical test used to test the association between two categorical variables. The Chi-square statistic ($\chi 2$) used for the study was under,

$$\chi^2 = \sum_{i=1}^{n} \frac{\left(O_i - E_i\right)^2}{E_i}$$

where,

O_i = Observed frequencies

E_i = Expected frequencies

n = Number of cells (or classes)

RESULTS AND DISCUSSION

It is very important to examine the types of the enterprises being run by the respondents, the scales of enterprises and their contribution to the annual income of the family.

Number of Enterprises being run by the Women Entrepreneurs

From the table 1 it could be concluded that majority (83.33%) of the respondents have established single enterprise followed by two enterprises (15.00%), three enterprises (1.25%) and only 0.42 per cent of the respondents have established five enterprises and coming to a total of 286 enterprises.

Table 1: Number of enterprises being run by the women entrepreneurs (n = 240)

Number of enterprises established	Number of entrepreneurs		Total number of enterprises	
	Frequency	Percentage	Frequency	Percentage
One	200	83.33	200	69.93
Two	36	15.00	72	25.17
Three	3	1.25	9	3.15
Five	1	0.42	5	1.75
Total	**240**	**100.00**	**286**	**100.00**

Types of Enterprises being run by the Women Entrepreneurs

In the present study, an attempt was made to find out the enterprises owned by members of SHGs. The respondents were asked open-ended questions to enlist the income generative activities carried out by members of SHGs.

Table 2: Types of enterprises being run by the women entrepreneurs (n = 240)

Sl. No.	Enterprise	Rayala-seema	Coastal	North-Coastal	Total
1	Provision shop	12	19	15	46 (16.08)
2	Tailoring	14	17	7	38 (13.29)
3	Dairy	13	3	4	20 (6.99)
4	Fancy shop	4	6	2	12 (4.20)
5	Small hotel/ Tiffin centre	7	3	3	13 (4.55)
6	Sarees and dress materials/ Cloth business	6	2	5	13 (4.55)
7	Petty shop	1	1	8	10 (3.50)

8	Floor mill	4	1	3	8 (2.80)
9	Fruit business	2	1	5	8 (2.80)
10	Pottery making	1	6	—	7 (2.45)
11	Fish selling	—	6	—	6 (2.10)
12	Vegetable selling	—	2	4	6 (2.10)
13	Bangle shop	—	—	6	6 (2.10)
14	Water plant	2	1	2	5 (1.75)
15	Laundry shop	1	4	—	5 (1.75)
16	Sweet shop/ Bakery shop	1	—	3	4 (1.40)
17	Weaving	—	—	4	4 (1.40)
18	Beauty parlour	3	—	—	3 (1.05)
19	Flower vending	2	—	1	3 (1.05)
20	Dairy products shop	1	2	—	3 (1.05)
21	Pooja items	1	—	2	3 (1.05)
22	Basketry shop	—	3	—	3 (1.05)
23	Thread bangles and earring making	—	1	2	3 (1.05)
24	Noodles shop	—	—	3	3 (1.05)
25	Tea house	—	—	3	3 (1.05)
26	Goatery/ Shepary	—	—	3	3 (1.05)
27	Threads business	2	—	—	2 (0.70)
28	Spinning top business	2	—	—	2 (0.70)
29	Juice shop	1	1	—	2 (0.70)
30	Soft drink shop	1	—	1	2 (0.70)
31	Panipuri business	1	—	1	2 (0.70)
32	Print and Xerox shop/ Stationary	1	—	1	2 (0.70)
33	Cashew processing unit	—	2	—	2 (0.70)
34	Paper plate making	—	2	—	2 (0.70)
35	Rice vending	—	1	1	2 (0.70)
36	Handicrafts	—	1	1	2 (0.70)
37	Pan shop	—	—	2	2 (0.70)
38	Chicken shop	1	—	—	1 (0.35)
39	Mulbery/ Sericulture	1	—	—	1 (0.35)
40	Groundnut business	1	—	—	1 (0.35)
41	Cattle feed unit	1	—	—	1 (0.35)
42	Electrical business	1	—	—	1 (0.35)
43	Lime business	1	—	—	1 (0.35)
44	Chips making	1	—	—	1 (0.35)
45	Auto	1	—	—	1 (0.35)
46	Photo studio	1	—	—	1 (0.35)
47	Carpenter	1	—	—	1 (0.35)
48	Wood crafts shop	1	—	—	1 (0.35)
49	Doll making	1	—	—	1 (0.35)
50	Pickle making	—	1	—	1 (0.35)
51	Wooden logs business	—	1	—	1 (0.35)
52	Neel liquid blue making	—	1	—	1 (0.35)
53	Phenyl making	—	1	—	1 (0.35)
54	Steel items selling	—	1	—	1 (0.35)
56	Soan papdi making	—	1	—	1 (0.35)
57	Seat cover making	—	1	—	1 (0.35)
58	Soda shop	—	1	—	1 (0.35)
59	Tobacco shop	—	1	—	1 (0.35)
60	Season business	—	—	1	1 (0.35)
61	Cotton wicks	—	—	1	1 (0.35)
62	Coconut shop	—	—	1	1 (0.35)
63	Chappal shop	—	—	1	1 (0.35)
	Total number of enterprises	**95 (33.22)**	**95 (33.22)**	**96 (33.57)**	**286 (100.00)**
	$\chi^2 = 216.229$**		p = 0.000		

*Figures in parentheses are percentages; ** : Significant at 0.01 level of probability.*

From the above table 2. It could be concluded that 63 types of enterprises being run by 240 entrepreneurs depending upon availability of natural resources and demand in the local area coming to a total of 286 enterprises. Provision shop (16.08%) was the main choice of the respondents, followed by Tailoring (13.29%), Dairy (6.99%),equal (4.55%) percentage with Small hotel/Tiffin centre and Sarees and dress materials/ Cloth business and Fancy shop (4.20%).

About 3.5 percent of the SHG members were setup the enterprise like Petty shop followed by Fruit business and Floor mill (2.80%), Pottery making (2.45%), Fish selling, Vegetable selling and Bangle shop (2.10%), equal (1.75%) percentage with Laundry shop and Water plant, Sweet shop/Bakery shop and Weaving (1.40%).

Equal (1.05%) percentage of the respondents were engaged in businesses like Dairy products shop, Basketry shop, Thread bangles and earrings making, Beauty parlour, Pooja items, Flower vending, Noodles shop, Tea house and Goatery/Shepary.

Equal (0.70%) percentage of the members running the enterprises like Paper plate making, Rice vending, Cashew processing unit, Juice shop, Handicrafts, Spinning top business, Print and Xerox shop/Stationary, Panipuri business, Soft drink shop, Threads business and Pan shop.

Equal (0.35%) percentage of the SHG members setup the enterprises like Neel liquid blue making, Phenyl making, Steel items selling, Cot knitting, Soan papdi making, Seat cover making, Soda shop, Tobacco shop, Chicken shop, Pickle making, Wooden logs business, Mulbery/Sericulture, Groundnut business,Cattle food unit, Electrical business, Lime business, Chips making,Wood crafts shop, Auto, Photo studio, Carpenter, Doll making, Season business, Cotton wicks, Coconut shop and Chappal shop. The above results have shown diversity of businesses been run by the women entrepreneurs. Further it also portray the zeal and enthusiasm on part of the women entrepreneurs in exploring the possible opportunities to start the businesses.

The 'chi-square' value (216.229) and 'p' value (0.000) from the table 2 predicted that, there exists a significant association between the region and 'types of enterprises being run by the women entrepreneurs'. The finding was in agreement with finding of Hemalatha (2012), Borah (2014), Vijayabharathi and Masthani (2014)and Soni (2015).

Scales of Enterprises being run by the Women Entrepreneurs

The data in table 3 shows that the one-third (33.22%) of the SHG members running the enterprise with an income range of ₹ 50,001 –1,00,000 followed by 30.42 per cent with ₹ 1,00,001 – ₹ 2,00,000, 26.92 per cent with ₹ 50,000 and below, 8.74 per cent with ₹ 2,00,001 – ₹ 5,00,000 and a tiny (0.70%) percent with ₹ 5,00,001 and above. The 'chi-square' value (18.410) and 'p' value (0.04) from the table predicted that, there exists a significant association between region and income of women entrepreneurs. The result signifies the existence of majority of cottage industries started with limited capital and earning limited profits. These results were in accordance with the findings of Bhagyasree (2014).

Table 3: Scales of enterprises being run by the women entrepreneurs (n = 240)

Scale of enterprise (in ₹)	Rayalaseema	Coastal	North Coastal	Total
50,000 and below	19 (6.64)	32 (11.19)	26 (9.09)	77 (26.92)
50,001 – 1,00,000	35 (12.24)	33 (11.54)	27 (9.44)	95 (33.22)
1,00,001 – 2,00,000	28 (9.79)	19 (6.64)	40 (13.99)	87 (30.42)
2,00,001 – 5,00,000	12 (4.20)	10 (3.50)	3 (1.05)	25 (8.74)
5,00,001 and above	1 (0.35)	1 (0.35)	—	2 (0.70)
Total	**95 (33.22)**	**95 (33.22)**	**96 (33.57)**	**286 (100)**
χ^2 = 18.410*		p = 0.04		

*Figures in parentheses are percentages; ** : Significant at 0.05 level of probability.*

Contribution of Enterprise Income to the Annual Income of the Family (in terms of sources of income)

A look into table 4 pointed out that more than half (56.99%) of the enterprises were the primary sources of income followed by secondary source of income (34.97%) and tertiary source of income (6.29%).

Table 4: Contribution of enterprise income to the annual income of the family (n = 240)

Contribution as source of income	Number of entrepreneurs			
	Chittoor	East godavari	Srikaku-lam	Total
Primary source	51 (17.83)	48 (16.78)	64 (22.38)	163 (56.99)
Secondary source	38 (13.29)	34 (11.89)	28 (9.79)	100 (34.97)
Tertiary source	6 (2.10)	8 (2.80)	4 (1.40)	18 (6.29)
Quaternary source	—	3 (1.05)	—	3 (1.05)

Quinary source	—	1 (0.35)	—	1 (0.35)
Senary source	—	1 (0.35)	—	1 (0.35)
Total	**95 (33.22)**	**95 (33.22)**	**96 (33.57)**	**286 (100)**
$\chi^2 = 18.321^{NS}$	p= 0.193			

Figures in parentheses are percentages; NS: Non significant.

The remaining meagre percent of the enterprises were under Quaternary(1.05%) quinary (0.35%) and senary (0.35%)source of income. The 'chi-square' value (18.321) and 'p' value (0.193) from the table 4 predicted that, the 'contribution as source of income' distribution of women entrepreneurs was not related to the region.

Association between Types of Enterprises and Scales of Enterprises

The data pertaining to the table 5 stated that,there was a significant association between type of enterprise and scale of enterprise at the 1 per cent level, since the p value was less than 0.01 (0.000<0.01) for the corresponding chi square value 3536.108. Hence, it could be concluded that there was a significant association between type of enterprise and scale of enterprise.

The possible reason for the above trend might be that each enterprise will have its own quality of goods and services with differential demands and price variations. The cost incurred towards manufacturing of the goods as well as delivery of the services also might have contributed for the above trend.

Table 5: Association between types of enterprises and scales of enterprises (n = 240)

S. No.	Enterprise	50000 and below	50001-100000	100001-200000	200001-500000	500001 and above	Total
1	Paper plate making	1	1	—	—	—	2
2	Petty shop	4	3	3	—	—	10
3	Provision shop	8	10	16	12	—	46
4	Neel liquid blue	—	1	—	—	—	1
5	Phenile making	—	1	—	—	—	1
6	Steel items selling	1	—	—	—	—	1
7	Fancy shop	5	4	3	—	—	12
8	Sarees and dresses / Cloth business	4	4	5	—	—	13
9	Laundry shop	—	4	—	1	—	5
10	Tailoring	9	17	12	—	—	38
11	Dairy	2	11	4	3	—	20
12	Pottery making	4	3	—	—	—	7
13	Dairy products shop	2	—	1	—	—	3
14	Basketry shop	—	3	—	—	—	3
15	Cot knitting	1	—	—	—	—	1
16	Soan papdi making	—	—	1	—	—	1
17	Seat making	—	1	—	—	—	1
18	Water plant	—	—	4	—	1	5
19	Rice vending	—	2	—	—	—	2
20	Soda shop	—	—	1	—	—	1
21	Tobacco shop	1	—	—	—	—	1
22	Small hotel/Tiffen	1	2	6	4	—	10
23	Cashew processing	—	—	—	2	—	2
24	Juice shop	—	1	—	—	—	2
25	Chicken shop	—	—	1	—	—	1
26	Pickle making	1	—	—	—	—	1
27	Handicrafts	1	1	—	—	—	2
28	Thread bangles and earring making	1	1	1	—	—	3
29	Fish selling	3	1	2	—	—	6
30	Fruit business	3	—	5	—	—	8
31	Wooden logsbusiness	—	1	—	—	—	1
32	Vegetable selling	—	4	2	—	—	6
33	Floor mill	4	2	2	—	—	8
34	Mulbery/ Sericulture	—	—	—	—	1	1
35	Spinning top business	—	2	—	—	—	2
36	Sweet shop/ Bakery	—	1	2	1	—	4
37	Groundnut business	1	—	—	—	—	1
38	Animal grass business	—	—	—	1	—	1
39	Electrical business	—	—	—	1	—	1
40	Print and Xerox shop/Stationary	1	—	1	—	—	2
41	Beauty parlour	1	2	—	—	—	3
42	Lime business	—	1	—	—	—	1
43	Chips making	—	1	—	—	—	1
44	Panipuri business	—	—	2	—	—	2
45	Pooja items	1	—	2	—	—	3
46	Wood crafts shop	—	—	1	—	—	1

47	Soft drink shop	1	—	1	—	—	2
48	Threads business	2	—	—	—	—	2
49	Auto	—	—	1	—	—	1
50	Flower business	2	—	1	—	—	3
51	Photo studio	1	—	—	—	—	1
52	Carpenter	—	1	—	—	—	1
53	Doll making	—	1	—	—	—	1
54	Noodles shop	—	1	2	—	—	3
55	Season business	1	—	—	—	—	1
56	Tea house	1	1	1	—	—	3
57	Cotton wicks	1	—	—	—	—	1
58	Pan shop	1	1	—	—	—	2
59	Coconut shop	1	—	—	—	—	1
60	Chappal shop	1	—	—	—	—	1
61	Goatery/Shepary	3	—	—	—	—	3
62	Weaving	—	2	2	—	—	4
63	Bangle shop	2	2	2	—	—	6
	Total	**77**	**95**	**87**	**25**	**2**	**286**
χ^2 = 3536.108**				p = 0.000			

*** : Significant at 0.01 level of probability.*

CONCLUSION

SHG is a novel and innovative organizational setup in India for women upliftment and welfare. The role played by SHGs in the field of empowering women, particularly in the rural areas is being recognized. In India, there is a silent revolution made by the SHGs to uplift the economic condition and empowerment of women. The SHGs are characterized in empowerment of women through focusing attention on women below the poverty line to provide self-employment and establishing different cottage enterprises by imparting training in different activities and improving the available local skills, improving the status of women in the family as well as in the society. It offers not only economic opportunities but also a change to learn new skills, make wider social contacts and experience. It creates an environment through positive economic and social policies for full development of women to enable them to realize their full potential. Thus the SHGs certainly play an important role in women empowerment. The findings of the study revealed that majority of women were found to be involved in traditional activities as they were less risky. Hence, training on viable and challenging enterprises should be given to these groups thus decreasing competition in the market.

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Economic Analysis of Impact Assessment of Production Technology of Paddy Cultivation in Nasik Region of Maharashtra in India

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ABSTRACT

The study had assessed the impact assessment of production technology of paddy cultivation in Nasik region of Maharashtra for the year 2016-17, based on the data of costs and returns. Analytical techniques like benefit-cost ratio (BCR), technology adoption index, yield gap, were exercised to have the extent of economic impact of improved paddy technology. High adopter group earned the net profit of ₹ 2298.09/ha (BCR=1.32) compared to ₹ 3629.3/ha (BCR= 1.06) for low adopter group. Average technology adoption index was 71.57 per cent indicating that the farmers adopting recommended production technology of paddy could get yield of 41.63q/ha. Factor share analysis showed that contribution of *Char-sutri method* to the total yield was the highest yield (i.e. 32.84 per cent) which was followed by urea (19.76 per cent), doses of manures (12.02 per cent), intercultural operation, planting distance, transplanting time contributes about 8.09 per cent etc. respectively. Estimates of yield gap analysis proved existence of yield gap in all level which ranged from 41 percent (low adopter) to 23 percent (high adopter). So, reduction or bridging up the yield gap may be utmost priority to increase the overall production and income of the farmers.

Highlights

- The study showed that application of recommended technologies in paddy afforded good return to the sample farmers

Keywords: Production technology, Benefit-cost ratio, yield gap, adoption index

India is one of the leading rice producing country in the world with cultivated area of 42.94 Mha and production of 111 million tonnes in 2017-18. The leading rice producing states in India are West Bengal, Uttar Pradesh, Orissa, Andhra Pradesh and Panjab. Maharashtra is also one of the major rice growing State in India. In Maharashtra, paddy is grown in14.46 million ha with an annual production of 26.60 million tonnes and productivity at 2025 kg/ha during the year 2017-18. Maharashtra ranks 12th in production and 13th in productivity among major rice growing States of the country (*www.indiastat.com,* 2018).

In India, rice is an important ingredient of household food-basket, yet its yield level is low, stagnant and uncertain (Barah, 2009). Among the various agronomic practices, judicious use of manures and fertilizers is one of the important strategies for increasing production of rice per unit area. The breeding of high yielding varieties have laid the basis for rice production in India. The improved varieties can give the anticipated yield per unit area, when grown under favorable environmental conditions without which they are not able to manifest their maximum yield potential. In India, taking into consideration the soils having low levels

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of organic carbon, it is a great challenge to feed hybrid rice with balanced nutrition. Therefore, more attention needs to be given on organic sources like FYM, poultry manures and green manures with optimum use of chemical fertilizers. More specially, green revolution denotes the large increase in crop yields which in recent years, resulted mainly from the development and adoption of new hybrids and the improved technology associated with their culture.

It is evident that in spite of adoption of adequate technologies by the farmers, yield level has been lagged much compared to potential yield. Yield gap remains to be a global issue in agriculture since long back. Following Table shows some comparative evidences of yield gaps of rice between the world, India.

Table 1: Yield Gap of Rice in World, India
(Unit : q/ha)

Sl. No.	Category	Average Yield	FLD* Yield	Yield Gap
1	World	32.57	37.00	4.43
2	India	23.27	33.63	10.36

FLD : Field level demonstration
Source: *www. agritech.tnau.ac.in (1/11/2018)*

Production levels of individual farmer as well as total production have been reduced and net income of the farmers are also declined. The extent of yield gap and adoption level have remained virtually unexamined. Considering the above facts the study on economic analysis of impact assessment of paddy production technology (*charsutri method)* in Nashik region of Maharashtra was initiated which mainly focused on technical and economic aspects. With this background, present study was undertaken with the objective to find out the extent of adoption of *Kharif* paddy production, contribution of recommended technology to yield and Yield Gap between farms.

Empirical Methodology

The study was conducted in the Nashik district of Maharashtra. The data was collected for the year 2016-17. The study covered 90 sample farmers and on the basis of pilot survey and availability of farmers', 40 farmers from small (Upto 0.20 ha), 30 farmers from medium (0.21 to 0.40 ha) and 20 farmers from large (above 0.41 ha) categories were selected following the techniques of simple random sampling. They were spread in six villages of the Igatpuri and Trimbakeshwar tahsils of Nasik District.

Extent of adoption of technology

Actual level of adoption of each item of technology on farmers field was identified using recommended technology developed by Igatpuri reaserch station under MPKV, Rahuri and efficiency of each technology was calculated with the help of following formula:

$$\text{Adoption of particular practices} = \frac{\text{Practices actually adopted}}{\text{Practices recommended}}$$

Technology Adoption Index (TAI)

One of the objectives of the study was to study the adoption pattern of improved paddy production technology and impact, and estimate the yield gaps. Therefore, the technology adoption indices were worked out.

Technology Adoption Index (TAI) are worked out. The major factors which affect the paddy production are *viz.*, date of sowing, method of sowing, seed, manures, fertilizers and plant protection measures. Following pattern is employed (Table 1) to assign the scores for ascertaining the use levels of inputs due to technologies.

Technologies followed in this exercise are (i) Harrowing (ii) F.Y.M (iii) Puddling (iv) Fertilizer (v) Seedling (vi) Time of Transplanting (vii) Planting Distance (viii) Intercultural Operation (ix) Char-sutri Method. Three levels of use of technology like (a) as per recommendation, (b) after recommendation and (c) before recommendation were taken with assigning 3 points, 2 points and 1 points on them respectively.

Technology Adoption Index (TAI) was worked out with the help of following formula (Kiresur *et al.* 1996) :

$$TAI = \frac{A_i}{M_i} \times 100 \qquad \ldots(1)$$

Where,

A_i = Average adoption score registered by the farmer for a particular Technology.

M_i = Maximum adoption score registered for a particular Technology.

Following the guidelines of Rogers (1962), the selected farmers were classified into three groups which is presented in Table 1 also :

1. Low adopters (TAIi) = 0-62.45 %
2. Moderate adopters (TAIi) = 62.46 to 79.17%
3. High adopters (TAIi) > 79.17 %

Table 2: Classification of sample farmers on the basis of Technology Adoption Index (TAI)

Sl. No.	TAI Range (%)	No. of farmers	Adoption level
1	Up to 62.45	24	Low
2	62.46 to 79.17	45	Moderate
3	Above 79.17	21	High

For easy understanding of cost of cultivation, Cost A, Cost B, Cost C have been derived from the existing farm management technique for estimating cost of cultivation as given by the Ministry of Agriculture, Government of India which has been explained below:

- **Cost-A:** It includes all the variable costs on account of hired human labour, bullock labour, machinery charges, value of manures, value of fertilizers, value of seed, irrigation charges, plant protection charges, land revenue, depreciation and repairs, interest on working capital etc.
- **Cost-B:** This cost consists of imputed costs in terms of rental value of land and interest on fixed capital and are added to the Cost-A.
- **Cost-C:** It is the total cost of cultivation which includes all the cost items, actual as well as imputed costs which also considers the family labour.

Benefit-cost ratio (BCR)

Benefit-cost ratio (BCR) is derived from the formula i.e. Gross Income/ Total cost

Factor share analysis

For estimating the contribution of each factor in yield, the multiple linear regression analysis is carried out by using the following equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + U \qquad \ldots(2)$$

Where,

Y = Yield per hectare (dependent variable), a = Constant, b_i = Regression coefficient, X_1 = Number of harrowings (No.), X_2 = Number of puddlling (No.), X_3 = Transplanting time (day), X_4 = Planting distance (cm.), X_5 = Manures tonnes/ha, X_6 = urea kg/ha, X_7 = Potash kg/ha, X_8 = Intercultural operation (No.), X_9 = Char-sutri method (No.) and U = Error term.

After fitting the data in this model, percentage contribution was estimated by the following formula :

Per cent contribution = $bi \times R^2$

Where, bi = Standard partial regression coefficient of i[th] independent variables

R^2 = Multiple correlation coefficient

Yield Gap

Yield gap was estimated by using the methodology develop by International Rice Research Institute (IRRI), Manila, Philippine.

Yield Gap-I = Yp – Yd

Yield Gap-II = Yd – Ya

Average Yield Gap = Yp – Ya

Where,

Yp = potential yield (yield realized at research station)

Yd = potential farm yield (yield realized on demonstration plot)

Ya = actual yield (yield realized on sample farm)

RESULTS AND DISCUSSION

Extent of adoption of recommended technology for the different size groups of farmers is presented in Table 3.

Table 3: Technology adoption Index

Sl. No	TAI Range (%)	No. of Farmers	Adoption Level	Average TAI	Yield/ ha
1	Up to 62.45	24	Low	59.93	37.79
2	62.46 to 79.17	45	Moderate	69.91	42.34
3	Above 79.17	21	High	88.44	44.53
Total		**90**	**Overall**	**71.57**	**41.63**

At the overall level, the technology adoption index (TAI) was worked out to 71.57 per cent indicating that the sample farmers adopted recommended paddy production technology obtaining 41.63 q/ha yield. The average technology adoption indices were to the extent of 59.93, 69.91 and 88.44 per cent for low, moderate and high adopters respectively. It showed that the high adopters had used maximum technologies followed by moderate and low adopters. Thus, the technology adoption index and average technology adoption index were found to increase with the level of adopters groups.

Costs and Returns

Costs, returns and profitability were carried out to know the economic impact of technology. Table 4 revealed that total yield obtained from paddy at the overall level was 41.63 quintals/ha. For low, moderate and high adopters, the values recorded as 37.79, 42.34, and 44.53 quintals/ha respectively. It implied that the yield/ha of paddy increased with the increase in the level of adopters. The total cost/ha were 62232.2, ₹ 66709.61, and ₹ 67591.91 for low, moderate and high adopters respectively.

Table 4: Costs and Returns of selected paddy farmers

Sl. No	Particulars	Adopters' level			
		Low	Moderate	High	Overall
1	Total cost (₹/ha)				
	i) Cost-A	38598.04	43755.43	47555.00	43302.82
	ii) Cost-B	50608.2	57545.62	64441.88	57531.9
	iii) Cost-C	62232.2	66709.61	67591.91	65511.24
2	Net return (₹/ha)				
	i) Cost-A	27263.46	32587.47	42335	34061.98
	ii) Cost-B	15253.3	18797.28	25448.12	19832.9
	iii) Cost-C	3629.3	8298.12	22298.09	11408.50
3	Production (q/ha)	37.79	42.34	44.53	41.63
4	Gross income	65861.5	76342.9	89890.00	77364.8
5	B:C ratio at				
	i) Cost-A	1.71	1.74	1.89	1.78
	ii) Cost-B	1.30	1.33	1.39	1.34
	iii) Cost-C	1.06	1.14	1.32	1.18

While at the overall level, it was ₹ 65511.24. The Net return (₹/ha)at Cost 'C' was the highest in case of high adopters (₹ 22298.09) followed by moderate adopters (₹ 8298.12) and low adopters (₹ 3629.3).

The benefit cost ratio at Cost 'C' was highest in case of high adopters group (1.32), followed by moderate adopters group (1.14) and low adopter group (1.06). At the overall level, benefit cost ratio was 1.18. The benefit cost ratio at all the levels of cost and groups were observed more than unity, therefore the cultivation of paddy is viable economic proposition in all adopter groups.

Contribution of different recommended technologies towards total yield

Factor share analysis revealed that char-sutri method showed highest contribution (i.e. 32.84 per cent) on yield, followed by Urea (19.76 per cent). Number of manures and potash shows nearly contribution of about 12.02 and 14.84 per cent respectively. Intercultural operation, Planting distance, Transplanting time contributes about 8.09 per cent, 8.05 per cent, 4.40 percent respectively (Table 5).

Table 5: Contribution of technologies to total yield

Sl. No	Technology	Variables	Contribution (%)
1	Transplanting time (Days)	X_1	4.4
2	Planting distance(cm)	X_2	8.05
3	Manures tones/ha	X_3	12.02
4	Urea kg/ha	X_4	19.76
5	Potash kg/ha	X_5	14.84
6	Intercultural operation (No.)	X_6	8.09
7	Char-sutri method (No.)	X_7	32.84

Yield gap-I in Paddy

To understand the difference between actual yields of farmer and potential yield, yield gap estimation was carried out. Yield gap was estimated by using the methodology developed by International Rice Research Institute (IRRI), Manila, Philippines. Table 6 shows details of the results.

Table 6: Yield gap-I in Paddy

Sl. No.	Particulars	Quintals/ha
1	Potential yield	65.00
2	FLD* yield	50.00
3	Yield gap	15.00
4	Yield gap (%)	23.08

**Field level demonstration.*

The potential yields was 65 q/ha., while field level demonstration delivered 50.00 q/ha. Thus, the estimated yield gap was 15 q/ha which was 23.08 per cent to potential yield.

Yield gap-II and Yield gap-III of Paddy

Yields obtained by low, moderate, high adoption level were 37.79, 42.34 and 44.53 q/ha respectively. Yield gap-II per ha were recorded to 12.21 q (24.22%) for low, 7.66q (15.32%) for moderate and 5.47 q (10.94%) for high adoption level. Accordingly, the Yield Gap-III was also estimated for different adoption level which has been presented in Table 7.

Table 7: Yield gap-II and Yield gap-III of Paddy

Sl. No.	Particulars	Adoption levels			Aggregate level
		Low	Moderate	High	
Yield gap-II					
1	Yield (q/ha)	37.79	42.34	44.53	41.63
2	FLD yield (q/ha)	50.00	50.00	50.00	50.00
3	Yield gap (q/ha)	12.21	7.66	5.47	8.37
4	Yield gap (%)	24.22	15.32	10.94	16.74
Yield gap-III					
5	Yield (q/ha)	37.79	42.34	44.53	41.63
6	Potential yield (q/ha)	65.00	65.00	65.00	65.00
7	Yield gap (qtl/ha)	27.21	22.66	20.47	23.37
8	Yield gap (%)	41.86	34.86	31.49	35.95

In case of yield gap-III, it was quite higher compared to yield gap- I and yield gap-II as for low adopters, it was 27.21 q/ha (41.86%), for moderate 22.66 q/ha (34.86%) and 20.47 q/ha (31.49%) for high adopters and at aggregate level, it stood at 23.37 q/ha (35.95%).

Thus, all the estimates of yield gap showed that there were substantial low level of yield at farmers' level compared to FLD and research station which calls for more attention.

Conclusion and Policy Implication

The study showed that application of recommended technologies in paddy afforded good return to the sample farmers. The extent of return was more for high adopter category of farmers. Factor share analysis through econometric technique revealed that char-sutri method being the highest contributor on yield which was followed by urea, organic manures, potash, inter-culture operations, etc. Estimates of yield gap analysis proved existence of yield gap in all level which ranged from 41percent (low adopter) to 23 percent (high adopter). So, reduction or bridging up the yield gap may be utmost priority to increase the overall production and income of the farmers. Thus, the study called for strengthening extension activities regarding adoption of recommended technology in *kharif* paddy. Besides, more attention towards improving input supply mechanism, timely credit and marketing facilities may be provided so that all the farmers can access these.

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Marketing Analysis of Marigold in Jammu Subtropics of Jammu and Kashmir

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ABSTRACT

An economic analysis of marketing was done in Jammu region to analyze the efficiency of exchange of flowers from production to consumption side. Primary data were collected from farmers selected through multistage sampling technique and wholesalers and retailers selected randomly from subtropical area of Jammu and Kathua districts in 2017-18. Five marketing channels were found in the study area which were farmer-retailer-consumer, farmer-wholesaler-retailer-consumer, farmer- retailer (pre harvest contract)-consumer, farmer-retailer (farm marketing)-consumer, farmer-consumer in which first 3 were followed by farmers of Jammu district and all 5 were followed in Kathua district. In Jammu district, the most efficient marketing channel was channel III followed by I and II while in Kathua district, channel V was found most efficient followed by channel IV, III, I and II. Major marketing constraints faced by farmers were distant markets followed by lack of regulated markets, lack of market information and high transportation cost.

Highlights

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Keywords: Marketing, marigold, efficiency, pre harvest contract, farm marketing

Floriculture is one among the most promising sector of the horticulture. India ranks second in flower cultivation next to China. India's present share in the global floricultural export market is negligible (0.61%) as compared to the Netherlands (58%), Columbia (14%), Equador (7%), Kenya (5%), Israel (2%), Italy (2%), Spain (2%) and others (10%) (Anonymous, 2015a). In 2013-14, India has a total area of 255020 ha under total flower cultivation with an annual production of 1754500 MT loose flowers and 47942 lakh cut flowers. Tamilnadu, Karnataka, West Bengal, Maharashtra, Andhra Pradesh and Gujarat are the major flower producing states having 1,21,150 ha area that accounts for nearly half of the India's total area under floriculture (Anonymous, 2015b). India has exported 22,518.58 MT of floriculture products to the world for the worth of ₹ 479.42 crores in 2015-16 (APEDA, 2017). Marigold is grown over an area of 53530 ha with a total production of 497720 MT loose flowers and 765000 numbers of cut flowers (Anonymous, 2015b). Marigold is regularly exported to Mexico, Peru, USA, Japan, Spain, Romania, Netherlands, Turkey, Poland, Italy, Australia, Canada, Africa etc. (Chaurasia, 2013). In Jammu and Kashmir, flowers are grown over an area of 750 ha in 2013-14 (Anonymous, 2015b). Out of which marigold crop ranked first among all flowers with maximum area of 530 ha under cultivation followed by gladiolus, rose, tulip, chrysanthemum etc. (Anonymous, 2015b). In Jammu province, a total of 468.53 ha area

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is under flower cultivation with a total production of 13680 MT loose flowers and 10.01 lakh number of cut flowers in 2014-15. Out of which, marigold flowers were grown over an area of 467.33 ha with a total production of 13680 MT (Anonymous, 2016b). Jammu subtropics have suitable agro climatic conditions for production of marigold. Jammu district has the highest area (289.36 ha) under marigold production followed by Kathua (65.00 ha), Reasi (54.05 ha) and Samba (30.65 ha). The production of marigold follows the same order like the trend of area as 6960 MT in Jammu, 1560 MT in Kathua, 1300 MT in Reasi and 730 MT in Samba (Anonymous, 2016).

Methodology

The present study was conducted in Jammu and Kathua districts of Jammu & Kashmir purposively during 2017-18 as the selected districts were having highest area, 289.36 ha and 65 ha respectively under marigold flower crops during the year 2014-15. Five villages were selected from each district on the basis of highest number of marigold farmers, so as to constitute a total of 10 villages and ten farmers each were selected randomly from the selected villages to make a sample size of 100 farmers in all for carrying out the study. Flower markets of the sampled area were selected purposively to collect information related to marketing, arrivals and prices of marigold flower crop. 5 wholesalers from flower market of Jammu and 5 retailers from each of the district were selected for collecting information regarding marketing.

Analysis of Marketing

Net Farmers Price: The net price received by the farmer has been estimated as the difference in gross price received and sum of marketing costs and value loss during harvesting, grading, transport and marketing.

$$NP_F = GP_F - \{C_F + (L_F \times GP_F)\} \text{ or} \qquad \ldots(1)$$

$$NP_F = \{GP_F\} - \{C_F\} - \{L_F \times GP_F\}$$

Where NP_F is net price received by the farmers (₹/kg),

GP_F is gross price received by the farmers or wholesale price to farmers (₹/kg),

C_F is the cost incurred by the farmers during marketing (₹/kg),

L_F is physical loss in produce from harvest till it reaches assembly market (per Kg or %).

Marketing Margins: The margins of market intermediaries included profit and returns, which accrued to them for storage, the interest on capital and establishment after adjusting for the marketing loss due to handling.

Intermediaries Margin =

Gross price (sale price) – Price paid (cost price) – Cost of marketing – Loss in value during wholesaling

Net marketing margin of the wholesaler is given mathematically by,

$$MM_w = GP_w - GP_F - C_w - (L_w \times GP_w) \text{ or}$$

$$MM_w = \{GP_w - GP_F\} - \{C_w\} - \{L_w \times GP_w\} \qquad \ldots(2)$$

Where, MM_w is net margin of the wholesaler ₹/kg),

GP_w is wholesaler's gross price to retailers or purchase price of retailer (₹/kg)

C_w is cost incurred by the wholesalers during marketing (₹/kg),

L_w is physical loss in the produce at the wholesale level (per kg)

In the marketing chain, when more than one wholesaler is involved, i.e., primary wholesaler, secondary wholesaler, etc, then the total margin of the wholesaler is the sum of the margins of all whoelsaers. Mathematically,

$$MM_w = MM_{w1} + \ldots\ldots + MM_{wi} + \ldots\ldots + MM_{wn}$$

Where MM_{wi} is the marketing margin of the i-th wholesaler.

Net marketing margin of retailer is given by:

$$MM_R = GP_R - GP_W - C_R - (L_R \times GP_R) \text{ or}$$

$$MM_R = \{GP_R - GP_W\} - \{C_R\} - \{L_R \times GP_R\} \qquad \ldots(3)$$

Where, MM_R is net margin of the retailer (₹/kg),

GP_R is price at the retail market or purchase price of the consumers (₹/kg)

L_R is physical loss in the produce at the retail level (per kg),

C_R is the cost incurred by the retailers during marketing (₹/kg).

The first bracketed term in equations (1), (2) and (3) indicates the gross return, while the second and third bracketed terms indicate respectively the cost and loss at different stages of marketing.

Thus, the total marketing margin of the market intermediaries (MM) is calculated as,

$$MM = MM_W + MM_R$$

Similarly, the total marketing cost (MC) incurred by the producer/ seller and by various intermediaries is calculated as

$$MC = C_F + C_W + C_R$$

Total loss in the value of produce due to injury/ damage caused during handling of produce from the point of harvest till it reaches the consumers is estimated as

$$ML = \{L_F \times GP_F\} + \{L_W \times GP_W\} + \{L_R \times GP_R\}$$

Marketing Efficiency: Acharya's modified marketing efficiency formula (Acharya and Agarwal, 2001) is used for calculating marketing efficiency.

$$ME = \frac{NP_F}{MM + MC + ML}$$

Where NP_F is net price received by the farmers (₹/ kg),

MM is the marketing margin,

MC is marketing cost,

ML is marketing loss.

Problems and constraints: The producers were facing numerous constraints in production and marketing of marigold. Thus, to analyze whether they are similar or dissimilar between different categories of farmers, chi square test was performed according to the following formula:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where,

O_i = Observed frequency of problems

E_i = Expected frequency of problems.

RESULTS AND DISCUSSION

Marketing channels are the path followed for movement of the produce from point of production to point of consumption. The different marketing channels were operating in the study area and these are given as under:

Marketing channels followed by farmers of Jammu district:

(i) Producer- Retailer-Consumer

(ii) Producer-Wholesaler-Retailer-Consumer

(iii) Producer-Retailer*-Consumer

Marketing channels followed by farmers of Kathua district:

(i) Producer- Retailer-Consumer

(ii) Producer-Wholesaler-Retailer-Consumer

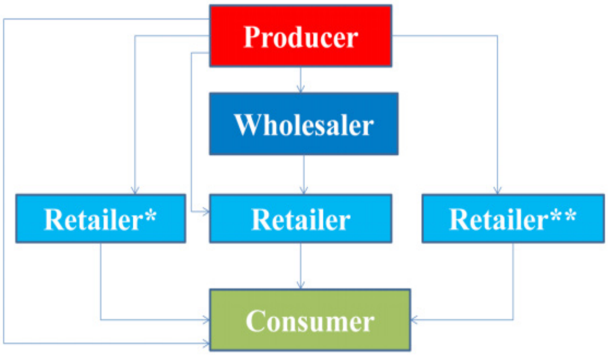
(iii) Producer-Retailer*-Consumer

(iv) Producer-Retailer**-Consumer

(v) Producer-Consumer

*Retailing through pre harvest contract

** Retailing through farm marketing



*Retailing through pre harvest contract
** Retailing through farm marketing

Fig. 1: Flow chart of various marketing channels of the study area

The quantity of marigold sold through the different marketing channels is given in table 1. The table revealed that the quantity sold through channel I, II and III in Jammu district was worked out to be 1253q, 445q and 180q, respectively and in Kathua district, the quantity sold through channel I, II, III, IV and V was worked out to be 678q, 436q, 127q, 90q and 120q, respectively

Table 1: Disposal of flowers through different channels in quintals (q)

Marketing Channels	Jammu	Kathua
Farmer-Retailer-Consumer	1253 (66.72)	678 (46.73)
Farmer-Wholesaler-Retailer-Consumer	445 (23.70)	436 (30.05)
Farmer-Retailer*-Consumer	180 (9.58)	127 (8.75)
Farmer-Retailer**-Consumer	0 (0.00)	90 (6.20)
Farmer-Consumer	0 (0.00)	120 (8.27)
Total	1878 (100)	1451 (100)

Figures in parenthesis indicates percentage of total.

The channel wise decomposition of marketing costs components for marigold in Jammu district is given in Table 2. These costs varied to the extent of ₹ 6.50, ₹ 5.50 and ₹ 5.50 per kg for channel I, II and III, respectively. It was further observed from the table that labour charges accounted for the maximum share in marketing cost i.e., 46.15 per cent, 54.55 and 54.55 per cent of total marketing cost in channel I, II and III, respectively. Apart from that, transportation charges also made a considerable share in the marketing cost i.e., 46.15 per cent, 36.36 per cent and 36.36 per cent in channel I, II and III, respectively. Marketing cost borne by wholesaler in channel II was ₹ 2.50/kg in which the labour charges accounted for 80 per cent of total marketing cost. The shop and rehri charges accounted for the maximum share in the marketing cost of the retailer i.e., 80 per cent, 45.45 per cent and 83.33 per cent in channel I, II and III, respectively.

The channel wise decomposition of marketing costs components for marigold in Kathua district is given in Table 3 and they varied to the extent of ₹ 6.50, ₹ 5.50 and ₹ 8.50 and ₹ 12.00 per kg for channel I, II and III, and V, respectively. It was further observed from the table that labour charges accounted for the maximum share in marketing cost in channel I and channel III i.e., 52.63 per cent and 55.56 per cent, respectively while in channel II, transportation cost accounted for the maximum share, i.e. 64.52 per cent. In channel IV, as the produce is marketed through farm marketing, no marketing cost was incurred by the producer while in channel V, labour charges and transportation cost accounted for equal share in the marketing cost, i.e. 45.45 per cent. Marketing cost borne by wholesaler in channel II was ₹ 2.50/kg in which the labour charges accounted for 80 per cent of total marketing cost. The shop and rehri charges accounted for the maximum share in the marketing cost of the retailer i.e., 80 per cent, 71.43 per cent and 80.00 per cent in channel I, II and III, respectively whereas in channel IV, transportation cost accounted for maximum share in marketing cost, i.e. 62.50 per cent.

Table 2: Channel wise decomposition of marketing cost components for marigold flowers in Jammu district (₹/kg)

Functionary	Channel I	Channel II	Channel III
Marketing cost incurred at producer level	**6.50**	**5.50**	**5.50**
Cost of containers	0.50 (7.69)	0.50 (9.09)	0.00 (0.00)
Transportation cost	3.00 (46.15)	2.00 (36.36)	2.00 (36.36)
Labour engaged	3.00 (46.15)	3.00 (54.55)	3.00 (54.55)
Cost of carry bags	0.00 (0.00)	0.00 (0.00)	0.50 (9.09)
Marketing cost incurred at wholesaler level	0.00	2.50	0.00
Cost of carry bags/ Containers	0.00 (0.00)	0.50 (20.00)	0.00 (0.00)
Labour engaged	0.00 (0.00)	2.00 (80.00)	0.00 (0.00)
Marketing cost incurred at retailer level	**2.50**	3.50	3.00
Transportation cost	0.00 (0.00)	1.50 (42.86)	0.00 (0.00)
Cost of carry bags	0.50 (20.00)	0.50 (14.29)	0.50 (16.67)
Shop/ Rehri charges	2.00 (80.00)	2.50 (71.43)	2.50 (83.33)
Total marketing costs	**9.00**	**10.50**	**8.50**

Figures in parenthesis indicates percentage of total.

Price spread and marketing margin

As shown in table 4, the marigold growers of Jammu district received the net price of about ₹ 22.70/kg, ₹ 20.30/kg and ₹ 24.10/kg which were 37.83 per cent, 33.83 per cent and 40.17 per cent of the price paid by the consumer for channel I, II and III, respectively. The producers' sale price of

Table 3: Channel wise decomposition of marketing cost components for marigold flowers in Kathua district (₹/kg)

Functionary	Channel I	Channel II	Channel III	Channel IV	Channel V
Marketing cost incurred at producer level	**6.50**	**8.50**	**5.50**	**0.00**	**12.00**
1. Cost of containers	0.50 (5.26)	0.50 (3.23)	0.50 (5.55)	0.00 (0.00)	0.50 (4.55)
2. Transportation charges	3.00 (42.11)	5.00 (64.52)	2.00 (38.89)	0.00 (0.00)	5.00 (45.45)
3. Labour engaged	3.00 (52.63)	3.00 (32.26)	3.00 (55.56)	0.00 (0.00)	5.00 (45.45)
4. Cost of carry bags	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.50 (4.55)
5. Shop/rehri charges	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (0.00)
Marketing cost incurred at wholesaler level	**0.00**	**2.50**	**0.00**	**0.00**	**0.00**
1. Cost of carry bags/Containers	0.00 (0.00)	0.50 (20.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
2. Labour engaged	0.00 (0.00)	2.00 (80.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Marketing cost incurred at retailer level	**2.50**	**3.50**	**2.50**	**8.00**	**0.00**
1. Transportation charges	0.00 (0.00)	1.50 (42.86)	0.00 (0.00)	5.00 (62.50)	0.00 (0.00)
2. Cost of carry bags	0.50 (20.00)	0.50 (14.29)	0.50 (20.00)	1.00 (12.50)	0.00 (0.00)
3. Shop/rehri charges	2.00 (80.00)	2.50 (71.43)	2.00 (80.00)	2.00 (25.00)	0.00 (0.00)
Total marketing cost	**9.00**	**14.50**	**8.00**	**8.00**	**12.00**

Figures in parenthesis indicates percentage of total.

Table 4: Price spread of marigold flowers under different marketing channels in Jammu district (₹/kg)

Sl. No.	Particulars	Channel I	Channel II	Channel III
1	Net price received by the producer	22.70	20.30	24.10
2	Marketing cost incurred by the producer	6.50 (10.83)	5.50 (9.17)	5.50 (9.17)
3	Marketing loss of producer	2.80 (4.67)	2.20 (3.67)	2.40 (4.00)
4	Producer's sale price	32.00 (53.33)	28.00 (46.67)	35.00 (58.33)
5	Marketing cost incurred by the wholesaler	0.00 (0.00)	2.50 (4.17)	0.00 (0.00)
6	Marketing loss of wholesaler	0.00 (0.00)	3.28 (5.47)	0.00 (0.00)
7	Marketing margin of the wholesaler	0.00 (0.00)	8.22 (13.70)	0.00 (0.00)
8	Wholesaler's sale price or retailer's purchase price	0.00 (0.00)	42.00 (70.00)	0.00 (0.00)
9	Marketing cost incurred by the retailer	2.50 (4.17)	3.50 (5.83)	3.00 (5.00)
10	Marketing loss of retailer	5.85 (9.75)	4.04 (6.73)	4.51 (7.52)
11	Marketing margin of the retailer	19.65 (32.75)	10.46 (17.43)	17.49 (29.15)
12	Retailer's sale price	60.00 (100.00)	60.00 (100.00)	60.00 (100.00)
13	Price paid by the consumer	60.00 (100.00)	60.00 (100.00)	60.00 (100.00)
14	Producer's share in consumer's rupee	0.38 (37.83)	0.34 (33.83)	0.40 (40.17)
15	Total marketing margin	19.65	18.68	17.49
16	Total marketing loss	8.65	9.52	6.91

Figures in parenthesis indicates percentage of total.

marigold was ₹ 32.00/kg in channel I while it was ₹ 28.00/kg in channel II and ₹ 35.00/kg in channel III. The table further revealed that the per kg marketing cost incurred by the farmer was 6.50/kg in channel I followed by channel II (₹ 5.50/kg) and channel III (₹ 5.50/kg) which accounted for 10.83 per cent in channel I followed by channel II (9.17%) and channel III (9.17%). The marketing cost borne by the wholesaler was 4.17 per cent of the consumer rupee and his margin was about 13.70 per cent. The marketing loss incurred by the wholesaler was ₹ 3.28/kg (5.47%). The wholesalers' sale price to retailer was ₹ 42.00/kg. In case of retailer, marketing cost worked out to be ₹ 2.50/kg (4.17 per cent) in channel I while it was ₹ 3.50/kg (5.83%) in channel II and ₹ 3.00/kg (5.00%) in channel III. Margin of retailer was found maximum in channel I (₹ 19.65/kg i.e. 32.75%) followed by channel III (₹ 17.49/kg i.e. 29.15 per cent) and channel II (₹ 10.46/kg i.e. 17.43 per cent).

Table 5: Price spread of marigold flowers under different marketing channels in Kathua district (₹/kg)

Sl. No.	Particulars	Channel I	Channel II	Channel III	Channel IV	Channel V
1	Net price received by the producer	32.70	27.30	36.80	37.80	52.60
2	Marketing cost incurred by the producer	6.50 (9.28)	8.50 (12.14)	5.50 (7.86)	0.00 (0.00)	12.00 (17.14)
3	Marketing loss of the producer	2.80 (4.00)	2.20 (3.14)	2.70 (3.86)	2.20 (3.14)	5.40 (7.71)
4	Producer's sale price	42.00 (60.00)	38.00 (54.29)	45.00 (64.29)	40.00 (57.14)	70.00 (100.00)
5	Marketing cost incurred by the wholesaler	0.00 (0.00)	2.50 (3.57)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
6	Marketing loss of wholesaler	0.00 (0.00)	3.28 (4.69)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
7	Marketing margin of the wholesaler	0.00 (0.00)	8.22 (11.74)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
8	Wholesaler's sale price or retailer's purchase price	42 (60.00)	52.00 (74.29)	45 (64.29)	40.00 (57.14)	0.00 (0.00)
9	Marketing cost incurred by the retailer	2.50 (3.57)	3.50 (5.00)	2.50 (3.57)	8.00 (11.43)	0.00 (0.00)
10	Marketing loss of retailer	4.68 (6.69)	4.04 (5.77)	3.20 (4.57)	2.50 (3.57)	0.00 (0.00)
11	Marketing margin of the retailer	20.82 (29.74)	10.46 (14.94)	19.30 (27.57)	19.50 (27.86)	0.00 (0.00)
12	Retailer's sale price	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)
13	Price paid by the consumer	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)	70.00 (100.00)
14	Producer's share in consumer's rupee	0.47 (46.71)	0.39 (39.00)	0.53 (52.57)	0.54 (54.00)	0.75 (75.14)
15	Total marketing margin	20.82	18.68	19.30	19.50	0.00
16	Total marketing loss	7.48	9.52	5.90	4.70	5.40

Figures in parenthesis indicates percentage of total.

As shown in table 5, the marigold growers of Kathua district received the net price of about ₹ 32.70/kg, ₹ 27.30/kg, ₹ 36.80/kg, ₹ 37.80/kg and ₹ 52.60/kg which were 46.71 per cent, 39.00 per cent, 52.57 per cent, 54.00 per cent and 75.14 per cent of the price paid by the consumer for channel I, II, III, IV and V respectively. The producers' sale price of marigold was ₹ 42.00/kg in channel I while it was ₹ 38.00/kg in channel II and ₹ 45.00/kg in channel III, ₹ 40.00/kg in channel IV and ₹ 70.00/kg in channel V. The table further revealed that per kg marketing cost incurred by the farmer was maximum in channel V (₹ 12.00/kg) followed by channel II (₹ 8.50/kg), channel I (₹6.50/kg), channel III (₹ 5.50/kg) whereas in channel IV, there is no marketing cost incurred by the farmer. The marketing cost borne by the wholesaler was 3.57 per cent of the consumer rupee and his margin was about 11.74 per cent. The marketing loss incurred by the wholesaler was ₹ 3.28/kg (4.69%). The wholesalers' sale price to retailer was ₹ 52.00/kg. In case of retailer, marketing cost worked out to be ₹ 2.50/kg (3.57 per cent) in channel I while it was ₹ 3.50/kg (5.00%) in channel II, ₹ 2.50/kg (3.57%) in channel III, ₹ 8.00/kg in channel IV and 0.00/kg in channel V. Margin of retailer was found maximum in channel I (₹ 20.82/kg i.e. 29.74%) followed by channel IV (₹ 19.50/kg i.e. 27.86 per cent), channel III (₹ 19.30/kg i.e. 27.27%) and channel II (₹ 10.46/kg i.e. 14.94 per cent).

Marketing efficiency in different channels

The marketing efficiency of Jammu and Kathua district is shown in Table 6 and 7, respecgtively. Channel III with marketing efficiency 0.73 was found most efficient marketing channel for marigold farmers in Jammu district followed by channel I and channel II. Channel V with marketing efficiency 3.02 was found most efficient marketing channel for marigold farmers of Kathua district followed by channel IV, channel III, channel I and channel II.

Table 6: Marketing efficiency of different channels for marigold flowers in Jammu district

Particulars	Channel I	Channel II	Channel III
Net price received by the farmer	22.70	20.30	24.10
Marketing margin	19.65	18.68	17.49
Marketing cost	9.00	10.50	8.50
Marketing loss	8.65	9.52	6.91
Marketing efficiency	**0.61**	**0.52**	**0.73**

Table 7: Marketing efficiency of different channels for marigold flowers in Kathua district

Particulars	Channel I	Channel II	Channel III	Channel IV	Channel V
Net price received by the farmer	32.70	27.30	36.80	37.80	52.60
Marketing margin	20.82	18.68	19.30	19.50	0.00
Marketing cost	9.00	14.50	8.00	8.00	12.00
Marketing loss	7.48	9.52	5.90	4.70	5.40
Marketing efficiency	**0.87**	**0.64**	**1.11**	**1.17**	**3.02**

Marketing constraints faced by the farmers

Table 8 and Fig. 2 highlight the marketing constraints prevailing in the study area. The prevalent marketing related constraints were low prices prevalence in the market, lack of regulated markets, distant markets, high transportation cost, lack of market information, delayed payment by the traders and malpractices by the traders.

Table 8: Marketing constraints faced by the farmers

Sl. No.	Constraints	Farmers facing constraints* (per cent)
1	Low prices prevalence in markets	03
2	Lack of regulated markets	47
3	Distant markets	64
4	High transportation cost	38
5	Lack of market information	46
6	Delayed payment by the traders	05
7	Malpractices by the traders	02

** Multiple responses.*

It also revealed that the most serious problems were distant markets (64%) followed by lack of regulated markets (47%), lack of market information (46%) and high transportation cost (38%).

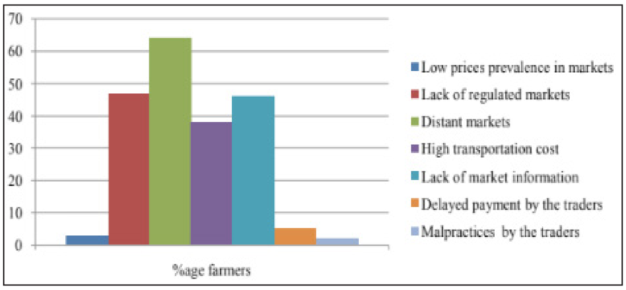


Fig. 2: Marketing constraints faced by the farmers

Table 9 compares the constraints faced by the farmers of Jammu and Kathua district.

Table 9: Comparison of marketing constraints faced by farmers of Jammu and Kathua district

Sl. No.	Marketing constraints	Farmers facing constraint (per cent)*		Chi square value
		Jammu	Kathua	
1	Low prices in the market	04	02	0.344
2	Lack of regulated markets	62	32	9.033*
3	Distant markets	48	80	8.734*
4	High transportation cost	22	54	10.86*
5	Lack of market information	48	44	0.161
6	Delayed payment by traders	10	00	5.263*
7	Malpractices by traders	04	00	2.041

** Multiple responses.*

While there was no significant differences in some problems like low prices in the market, lack of market information and malpractices by traders where farmers of both the districts are facing these problems with same severity, there were some problems where there was a significant difference between the severity like lack of regulated markets where 62 per cent farmers of Jammu and 32 per cent farmers of Kathua district felt the need, distant flower markets where only 48 per cent farmers of Jammu were facing the constraint while in Kathua district 80 per cent farmers were facing the constraint, high transportation cost where 54 per cent farmers of Jammu districts reported to face the constraint while 22 per cent farmer of Kathua were facing the constraint and delayed payment by traders where 10 per cent farmers of Jammu district were facing the constraint and no farmer of Kathua district was facing the constraint.

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A Financial Viability and Relative Profitability of Mango Orcharding in Lucknow District of Uttar Pradesh

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ABSTRACT

The existence of the wide range of natural endowment is very much favorable for growing a large array of horticultural crops throughout the country. The country observed a sharper increase in the area of horticultural crops compared to food grains. In the fruit industry, mango stands top in position. Due to perennial nature, the cost and return behavior has been estimated @ 10 percent opportunity cost of capital as like investment appraisal for the interest of development of mango entrepreneurs. The per hectare net present value (NPV), for the entire life period (55 years) of the mango orchard has been found to be ₹ 600237.34. Benefit-cost ratio is 1.76. The adjusted IRR is also worked out as 19.80 percent, which is sufficiently higher than the opportunity cost of the capital or the rate of interest charged by the financial institutions. The payback period was about 8.2 years. Thus, the evidence reveals that investments in mango orchard are highly profitable, economically feasible and financially viable. To overcome the question of risk and uncertainty in investment over a longer period the usual technique is how sensitive the investment if the cost or return increase/decrease due to economic or other change in the market. Some competing crop performed better in term of benefit-cost ratio, but in terms of average annual net return of ₹ 36030.60 ha^{-1} which was evidently higher than that of alternative crops. The mango cultivation is low input intensive as compared to food grain that means fewer requirements of resources for its production. So, we can say mango production is more profitable venture for resource-poor farmers.

Highlights

- Investments in mango orchard are highly profitable and economically feasible.
- Annual net return of mango orcharding is evidently higher than that of alternative crops.
- Mango orcharding is profitable venture for resource-poor farmers.

Keywords: Investment appraisal, interest, risk and uncertainty, feasibility, profitability

During the late 60's, the major thrust in agriculture was confined to crop centered seed oriented subsistence agriculture. From 2000 onwards, the traditional agriculture gradually transformed into capital-intensive business oriented agriculture, where the farming community is searching for new avenues to move out from traditional crop husbandry. At present, rural agrarian society has undergone significant phages of socio-economic transformation through the implementation of new liberalized economic policy. Therefore, agrarian base preferred non-farm employment and in some cases shifting of seasonal crop cultivation to high value assured fruit crops. Due to the existence of the wide range of natural endowment, it is very much favorable for growing a large array of horticultural crops throughout the country.

India has witnessed voluminous increase in horticulture production over the last few years.

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Significant progress has been made in area expansion resulting in higher production. Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%. During 2018-19, the production of horticulture crops was about 314.87 million tonnes which is 1.01 per cent higher than horticulture production in 2017-18. The area under horticulture crop also rose to 25.60 million hectare from 25.43 million hectare.

Under the horticulture crops, production of fruits is estimated to be around 97.38 million tonnes in 2018-19 compared to 97.36 million tonnes in the 2017-18. In the fruit industry, mango stands top in position. It covered about 34.92% of the total fruit crops area which holds the second rank in total fruits production of 21.20%; next to banana (DAC&FW, 2017). Mango is also one of the most consumed fresh fruits in the world and continues to dominate the Indian fruit basket. It comes first among the top-rated delicious fruits and farmers are used to get considerable income which plays a vital role in poverty reduction by providing additional employment opportunity near about 2 million people annually (MOA, 2004-2014). Apart from food security and income to the farmers, the values of foreign exchanges are also remarkable. Mangos occupies the premier position in exports with 46510.27 MT valued at ₹ 40649.55 lakhs (DGCIS, 2018). Keeping these facts in above, it is planned to access the financial viability and relative profitability of mango orcharding in Lucknow district of Uttar Pradesh.

MATERIALS AND METHODS

The study was conducted during 2016-17 in Lucknow districts of Uttar Pradesh. The third stage of sampling, two blocks were selected and then ten villages from each block were selected using the information received from the individual farm of mango growers. Thus, the sample consisted of 200 farmers of mango. The primary data were collected through personal interview using a pre-tested questionnaire. To study the Financial Viability, Sensitivity and Relative Profitability of mango orchard, project appraisal technique and simple cost and return accounting method were followed. The prices of input and output used in the analysis were the average for the crop harvesting period 2016-17.

Financial Viability Analysis

In order to determine the financial feasibility of mango orchard, both undiscounted and discounted method of project appraisal techniques have been used. The Benefit-Cost Ratio, Net Present Value and Internal Rate of Return are calculated at 10% discount rate.

Undiscounted Cash Flow Method

Undiscounted method is a naive method in which they are not weighed by discount rates. Under this method, Simple Payback Method is used. It is represent the length of time required to recover for the stream of cash proceeds produced by the initial investment to be equal to original cash outlay i.e., the time required for project to pay for itself. In the present study payback period of mango after fruit bearing was calculated. Under the consideration, shorter the payback period, better it will be, and then the investment in a project financially feasible. Symbolically:

$$\sum_{t=0}^{t} C_t = \sum_{t=0}^{t} R_t$$

Where,

C_t = Cost in period 't'

R_t = Return in period 't'

(A) Discounted Cash Flow Method

On the contrary to the undiscounted method, discounted methods are based on discount rate in which weights are given to the particular discount rate. The various methods under the discounted category are fallows:

(i) Net Present Value or Worth (NPV/W)

The Net Present Value of an investment is the discounted value of the net cash inflows (all cash inflows and cash outflows) to the project. In the present study a discount factor of 10 per cent was used to discount the net cash inflows representing the opportunity cost of capital. Mathematically, the net present value is estimated as follows:

$$NPV = \sum_{t=1}^{t=n} \frac{B^t - C^t}{\left(1+i\right)^t}$$

Where,

NPV = Net present value in period 't'

B^t = Benefit from mango orchard in each year

C^t = Cost of cultivation in each year

i = Interest rate (discount rate)

t = 1, 2, 3…, n, the entire life of plantation across the study regions

n = Number of years.

If the calculated NPV is positive it implies the investment is viable, and where the NPV is equal to zero implies that the investment breaks even. The rule with NPV is to accept all mutually exclusive investments with a zero or greater NPV (Gittinger, 1982).

(ii) Internal Rate of Return (IRR)

Internal Rate of Return is the discount rate at which the present values of the net cash flows are just equal to zero and B:C ratio equal to one, (NPV/W=0 and B-C ratio =1). It is most advanced technique to calculate the feasibility or desirability of the investment or project. The internal rate of returns is computed as:

$$IRR = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0$$

Where,

B_t = Total benefit (₹/ha) in time t

C_t = Total cost (₹/ha)) in time t

r = Rate of interest (discount rate)

t = Number of years (1, 2, 3,…………., 55).

The decision rule is to accept all independent projects having an Internal Rate of Return equal to or greater than the cost or opportunity cost of capital (Gittinger, 1982). Specifically, if the IRR is greater than the cost of capital it implies that the investment is viable, when it is equal to the cost of capital the project will break even and when smaller than the cost of capital the investment is not viable.

(iii) Benefit- Cost Ratio (B-CR)

The benefit-cost ratio of an investment is the ratio of the discounted value of all cash inflows to the discounted value of all cash outflows during the life of the project. The B-CR measures the social equity and economic efficiency of resource utilization. It can be estimated as follows:

$$B - CR = \sum_{t=1}^{t=n} \frac{B_t}{(1+r)^t} \Bigg/ \sum_{t=1}^{t=n} \frac{C_t}{(1+r)^t}$$

Where,

B_t = Benefits in each year

C_t = Cost in each year

n = Number of year

i = Interest rate (discount rate)

If B-CR > 1, then the total revenue is greater than the total cost, if B-CR = 1 then the total revenue is equal to the total cost and if B-CR < 1 then the revenue is less than the total cost. It was assumed as 10 percent for the analysis of the present study.

(iv) Sensitivity Analysis (Risk And Uncertainty Treatment)

In order to assess the effects of adverse changes in the project's Net Present Value of cash flow (cash inflow and outflow) for a given change in one variable (either cost or return) at a time. Although, we know that for making a logistic overview about mango production sensitivity analysis is necessary. For this financial measure, two discrete situations are made in order to find out effect of change (increase or decrease cost and return). In the first situation, the total cost of production of mango has been increased by 10 % and 20 % without changing the total return values and decline in total return by also 10 % 20 % with no change in total cost has been considered in the second situation in order to existing prices structure of inputs used and quantity produce.

Relative Profitability Analysis

In order to find out relative profitability of mango with some competing crops (wheat, paddy and vegetables) total cost of production, total return, net return and benefit-cost ratio were computed based on current market price of inputs and output has been taken into account.

Total cost = TFC_{ij}+ TVC_{ij}

Total return + TR_{ij} = $Y_{ij}P_{ij}$

Net return = TR_{ij} – TC_{ij}

Where,

TC_{ij} = Total cost (₹ ha.$^{-1}$)

TFC_{ij} = Total fixed cost (₹ ha.$^{-1}$)

TVC_{ij} = Total variable cost (₹ ha^{-1})

GR_{ij} = Total return (₹ ha.$^{-1}$)

P_{ij} = Price (₹ ha.$^{-1}$) of jth crops received by ith farmer

Y_{ij} = Quantity (qtl. ha^{-1}) produced

RESULTS AND DISCUSSION

Financial Viability of Investments in Mango Orchard

In order to determine the effectiveness and desirability of a new investment in mango orcharding, the financial viability of investment assessed by project appraisal technique taking four important parameters such as Pay Back Period (PBP), Net Present Value (NPV), Benefit-Cost Ratio (B-CR) and Internal Rate of Return (IRR). The results are presented in Table 1.

Table 1: Financial viability of investments in mango orchard

Sl. No.	Particulars	Units	Values
1	Present value of discounted cost at 10% discount factor	₹/ha	784889.58
2	Present value of discounted return 10% discount factor	₹/ha	1385126.93
3	Net present value or worth (NPV/W) 10% discount factor	₹/ha	600237.34
4	Benefit- Cost Ratio (B-CR) 10% discount factor	Ratio	1.76
5	Internal Rate of Return (IRR)	Per cent	19.80
6	Payback period (P)	Year	8.2

Net Present Value (NPV)

Net Present value of an investment is the difference between the present value of series of cash inflows or benefits (returns) and cash outflows (costs) over the productive or economic life period of the mango orchard. The results of the financial feasibility analysis in Lucknow district indicated that the per hectare NPV at 10 percent discount rate for the entire life period of the mango orchard (55 years) was found to be ₹ 600237.34. The NPV was positive indicating that the investments in mango orchard are financially feasible and economically viable.

Benefit-Cost Ratio

The benefit-cost ratio has been obtained by dividing the discounted net returns or benefit stream by the initial Investment or cost stream. This criterion indicates the rate of return per rupee invested in mango enterprise. The net present value of costs and returns were obtained by discounting the cost and return streams by the opportunity cost of capital. The benefit-cost ratio obtained in mango was 1.76 at 10 percent discount or interest rate. The formal criterion is to accept a project that the test if the benefit-cost ratio of 1 or greater at the opportunity cost of capital. Thus, if B-C ratio> 1 it implies that mango production is economically profitable. If B-C ratio <1, it implies non-profitability of the investment and when B-C ratio=1, then the investment is break even (Gittinger, 1982). The result of B-C ratios is greater than unity and marginally higher, therefore it considered economically preferred and financially viable.

Internal Rate of Return

The internal rate of return is a discount rate at which the present values of the net cash flows are just equal to zero and the benefit-cost ratio equal to one, (i.e., NPW=0 and B-C ratio=1). It is also known as marginal efficiency of capital (rate of profit expected from an extra unit of capital investment), internal rate of return is generally used to assess the desirability of investments or project. The adjusted IRR is observed to be 19.80 percent which is much higher than the opportunity cost of the capital and indicates the investment by orchardist in mango orcharding was economically feasible and financially viable. The decision criteria are to accept independent projects with the internal rate of return equal to or above the cut-off rate or opportunity cost of capital investment (Gittinger, 1982). This implies that when internal rate of return is greater than the cost of capital, the project is viable when internal rate of return is equal to the cost of capital; the project will be break even. However, when IRR is lesser than the cost of capital, the investment is not financially viable. Here, the result is concluded that in the study area the internal rate of return was observed to be above the current base rate or discount rate. Higher the projects internal rate of return, the more desirable it is to undertake the project.

Pay Back Period (PBP)

The payback period refers to the time required for the project to pay for itself. In other words, it is the length of the time period required to get back the investment on establishment cost of the orchard. In the present study, the payback period was about 8.2 years. This clearly indicated that it would take 8.2 years to recover the entire establishment cost of the orchard. The foregoing analysis revealed that NPV was positive, B-C Ratio was greater than one and IRR was higher than the opportunity cost of the capital (10%). The investments in mango crop could be recovered in about eight years after planting. Thus, the results of this study evidently revealed that investments in mango orchard were highly profitable, economically feasible and financially viable.

Sensitivity Analysis (Risk and Uncertainty Treatment)

One of the real advantages of careful economic and financial project analysis that is used to test is what happens to the earning capacity of the project if events differ from the prediction made about them in planning. How sensitivity is a project's net present worth at financial prices and economic values, or its financial and economic rate of returns or net benefit-investment ratio (B-I ratio), to increased investment costs and fall in returns. Reworking an analysis to see what happens under these changed circumstances is called sensitivity analysis. It is one means of drawing attention to a central reality of project analysis. Projections are inevitably subject to a high of risk and uncertainty about what will actually happen. In subject to the mango cultivation is sensitive to change two principal (cost and return) areas.

Under the financial analysis, it has been assumed that the value of costs and returns both in physical and monetary terms would remain constant throughout the entire economic lifespan of mango trees, but in grass root level, these values and too unstable or fluctuate overtime resulting an inappropriate decision making. In order to incorporate these changes, two discrete situations have been taken into account. In the first situation, the total cost of production of mango has been increased by 10 and 20 percent without changing the total return values and decline in total return by also 10 and 20 percent with no change in total cost has been considered in the second situation.

In the both situations, net present values were found to be positive, benefit-cost ratios were more than one and internal rate of returns or marginal efficiency of investment is also higher than the cut-off rate or opportunity cost of capital (Table 2). So, mango production appeared to be highly prospective or financially viable in the study area in terms of absolute values of net present worth of cash flow (cash outflow and inflow), benefit-cost ratio, internal rate of return, etc.

Table 2: Sensitivity analysis (risk and uncertainty treatment) of mango production in the study area

Sl. No.	Parameters	Units	10 Percent	20 Percent
Situation-I: Increase in total cost but return hold constant				
1	Present value of discounted cost at 10% df	₹/ha	863378.54	941867.50
2	Present value of discounted return at 10% df	₹/ha	1385126.93	1385126.93
3	Net present value or worth (NPV/W) at 10% df	₹/ha	521748.38	443259.42
4	Benefit Cost Ratio (B-CR) at 10% df	Ratio	1.60	1.47
5	Internal Rate of Return (IRR)	Per cent	18.15	16.65
Situation-II: Increase in total return but cost hold constant				
1	Present value of discounted cost at 10% df	₹/ha	784889.58	784889.58
2	Present value of discounted return at 10% df	₹/ha	1246614.23	1108101.54
3	Net present value or worth (NPV/W) at 10% df	₹/ha	461724.65	323211.96
4	Benefit Cost Ratio (B-CR) at 10% df	Ratio	1.59	1.41
5	Internal Rate of Return (IRR)	Per cent	17.97	15.95

Table 3: Relative profitability of mango production with some competing crops

Mango					
Sl. No.	**Growing Stages**	**Total cost ha^{-1}**	**Total return ha^{-1}**	**Net return (TC-TR) ha^{-1}**	**B-CR**
1	<7	16784.82	0.00	-16784.82	-1.00
2	8-17	21623.37	68375.26	46751.89	2.16
3	18-27	26366.21	88581.69	62215.48	2.36
4	28-37	30304.77	93116.36	62811.59	2.07
5	38-47	15913.00	44221.97	28308.97	1.78
6	<47	45276.10	75335.77	30059.67	0.66
	Overall	23450.68	59481.28	36030.60	1.54
Competing crops					
Sl. No	**Competing crops**	**Total cost of ha^{-1}**	**Total return ha^{-1}**	**Net return (TC-TR) ha^{-1}**	**B-CR**
1	Wheat	31785.53	63852.34	32066.81	1.01
2	Paddy	36659.82	71365.83	34706.01	0.95
3	Vegetables	28538.45	64382.74	35844.29	1.26
4	**Overall**	**32327.93**	**66533.64**	**34205.70**	**1.08**

Note: **Figures are the weighted averages of total value.*

Relative profitability of mango orchard

An attempt has been made to estimate the relative profitability of mango production with some dominant competing annual crop (wheat, paddy, vegetables) or crop combinations (wheat + paddy + vegetables) cultivated by farmers under the same agro-climatic condition in terms of annual net returns. For this reason, the net present value estimated earlier over the entire productive or economic life of orchard required to be converted into an average annual net margin or returns in order to make it unbiased comparable with that of annuals at a particular point in time where competing crop or crop combinations were fitted in annual sequence as alternative to mango orcharding by deflating net present value with the annuity factors for the life periods in question at same cut-off rate or discount rate.

Some of the major crop combinations including mango along with their respective average total cost and returns have been presented in table 3. It is observed that although some competing crops performed better in term of benefit-cost ratio, but in terms of net return over the total return of mango cultivation yielded an average annual net return of ₹ 36030.60 ha^{-1} which was noticeably higher than that of other alternative crop or crop combinations. The results implied that the mango cultivation is low input intensive that means fewer requirements of inputs for its production. So, we can say mango production is more financial viable or profitable venture for resource poor farmers.

CONCLUSION

Due to perennial nature, the cost and return behavior has been estimated @ 10 percent opportunity cost of capital as like investment appraisal for the interest of development of mango entrepreneurs. The per hectare net present value (NPV), for the entire life period (55 years) of the mango orchard has been found to be ₹ 600237.34. Benefit-cost ratio is 1.76. The adjusted IRR is also worked out as 19.80 percent, which is sufficiently higher than the opportunity cost of the capital or the rate of interest demand by the financial institutions. The payback period was about 8.2 years. Thus, the results of this study, evidence reveal that investments in mango orchard are highly profitable, economically feasible and financially viable. To overcome the question of risk and uncertainty in investment over a longer period the usual technique is how sensitive the investment if the cost or return increase/decrease due to economic or other change in market. For this reason, sensitivity analysis based on two basic discrete situations has been worked out. Here also, net present value found to be positive, benefit-cost ratio is more than one and the internal rate of returns are also higher than the cut-off rate or opportunity cost of capital. It is also observed that although some competing crop performed better in term of benefit-cost ratio, but in terms of average annual net return of ₹ 36030.60 ha^{-1} which was evidently higher than that of alternative crops.

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Performance of Palm Industry in Karnataka: A Case Study in Tumkur District

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ABSTRACT

The objective of the present study was to analyze the performance of palm industry in Karnataka. The total establishment cost of coconut orchard estimated at ₹ 1,58,842.82 per acre. The annual cost of cultivation of coconut was ₹ 55,933.91 per acre. The total cost incurred in copra making from 5,777.65 nuts (a unit from one acre) estimated at ₹ 69,400.33 and obtained 8.86 quintals of copra. Gross returns obtained from copra making were ₹ 1,17,265.05. Copra making in the study area is a profitable venture as indicated by B:C ratio (1.68). The study of marketing of copra identified three marketing channels. Producer's share in consumer's rupee was highest (75.02%) in channel III (Copra makers - Wholesaler - Retailer –Consumers) than channel I and II and considered as efficient marketing channel in the study area. Majority of the copra makers expressed that drastic climate change lead to decrease in production, fluctuation in price of coconut oil was the major marketing problem. The other problem faced by wholesalers was lack of consistent demand and in case of retailers high cost of transportation was the major problems. The copra manufactured in the study area was of good quality. Hence, efforts should made to export the copra. Government can promote artificial dryer unit under cooperative sector and it can provide financial help to construct proper infrastructure for copra making unit. Creating awareness to encourage online trading for better price realization for producers and better quality is the need of the hour.

Highlights

- Copra making is a economically profitable business.

Keywords: Copra making, marketing channel, price spread, marketing efficiency, constraints

Coconut palm, botanically known as "*Cocus nucifere*" is a unique among the horticultural crops raised in India because of the diverse uses of the coconut products in everyday life. Every part of the coconut tree is having great utility and hence is called as "Kalpavriksha" or the "Tree of Heaven". In India the total area under coconut is 2,082.11 thousand hectares with the production of 23,904.10 million nuts during 2016-17 (Coconut Development Board). Coconut is the second largest and important horticultural crop of Karnataka state, accounts for 24.67 per cent of area under coconut cultivation and 28.33 per cent of total production of coconut in the country (2016-17).

Karnataka is the major producer of ball copra in the country. In Karnataka both big and small farmers convert the coconut into ball copra particularly in Tumkur, Hassan, Chitradurga and Chikkamagalur districts. There are six APMC markets dealing in ball copra trading. Tiptur APMC is the major ball copra trading centre and the price determined at this market centre will be reflected in the other markets for fixing the trading price. The traditional processing of ball copra is done by storing the well matured coconuts for a period of 11-12 months in

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the residential building or exclusive store room of the farmers called "ATTA". In the recent days the practice has been developed by the farmers for the construction of godowns exclusively for storing coconut with sufficient air circulation. Nearly 80 per cent of copra from Tiptur is marketed in throughout the country markets like Delhi, Ahmadabad, Kolkata, Pune, Rajasthan, Mumbai, Jaipur, Patna, Nagpur, Cuttack, Indore, Puri and Guwahati (Nagaraju, 2013).

Tiptur taluk in Tumkur district of Karnataka is the traditional coconut growing area endowed with natural advantage and the leading variety is Arasikere tall (local variety). In spite of Kerala producing large quantity but it is not preferred for table purpose and mainly used for extraction of edible oil. Copra grown in and around Tiptur is known for its taste and more popular in the country mainly used for table purpose, sweet preparation and dried fruits. The Tiptur copra is in good demand in Northern India.

Tumkur district is known as the "Kalpatharu Naadu" (land of coconut trees). Majority of the farmers in Tumkur district are dependent primarily on coconut farming for their livelihood. Coconut is grown in all ten taluks of the district, except in some parts of rocky and hilly areas of Madhugiri and Pavagada taluks. However, drought has been affected over the past four years, as coconut trees have been hit by lack of water besides attack of diseases and pests. Hence, farmers are giving up coconut farming altogether and majority turning to non- farming activities. In the light of these, the study makes a modest attempt to investigate the performance of palm industry in Tumkur district of Karnataka state with the following specific objectives:

The specific objectives of the study are:

1. To estimate the cost and returns structure in coconut farming.
2. To workout out the economics of copra making.
3. To identify the channels of marketing of copra and estimation of price spread.
4. To analyse the marketing efficiency of different marketing channels.
5. To identify the constraints in coconut cultivation, copra making and marketing to provide measures to improve.

Hypothesis of the study

1. Coconut cultivation and copra making is profitable.
2. There are many channels in copra marketing.
3. Price spread in copra marketing is very high.
4. Many problems are faced in production and marketing of copra.

METHODOLOGY

The present study was conducted in Tumkur district of Karnataka state during the year 2016-17, as it is highly concentrated in Tumkur district. It ranks first in area (29.45%) and production of coconut (32.22%) in Karnataka state (2015-16). For evaluating the objectives of the study, the required data were collected through personal interview method with the help of a structured schedule. Data pertaining to cost of cultivation of coconut and copra making, the data was collected from 40 farmers randomly. The returns structure of coconut also worked out to compare with the copra returns to know the profitability but in reality producers used coconut in the making of copra. In the process of making of coconut into copra 5,777.65 number of coconut (nuts / acre) were used to make copra. Makers in the study area invested ₹ 18,672.59 to construct coconut storage unit (low cost). To estimate cost of making of copra, an amortized establishment cost of coconut storage unit worked out was ₹ 622.42. Tiptur taluk is important commercial centre for copra marketing and is more specialized in copra arrivals. Hence, Tiptur market was purposively selected for the study of marketing of copra. For identifying marketing channels, marketing cost, margin and price spread data was collected from various stakeholders like, commission agent (10), village traders (10), wholesalers (10) and retailers (10). Descriptive statistics was employed to analyse the data.

Concepts used

Copra making unit refers to storing the well matured coconuts for a period of 11-12 months in the store room. The unit consist of an acre of coconut (5,777.65 nuts).

Amortized establishment cost was calculated from the capital investment made in first 5 years for establishment was divided into equal annual instalments starting from 6th year till the economic life of coconut plantation which was taken as 50 years. To estimate the per acre cost of coconut, an amortized cost was worked out and added in to maintenance cost to estimate the annual cost in cultivation.

Amortization Established Cost =

$$\frac{\text{Total Establishment Cost}}{\text{Average prodcutive life span of coconut}}$$

Marketing channel refers to the alternate routes of product flow from the copra makers to final destiny. There are different channels in copra marketing but the channels which prevail in the domestic market are used for the study.

Marketing cost is the cost incurred by the copra makers-seller for bringing produce from farm gate to sale point in market.

Price spread is worked out by computing the differences between the prices received by the makers and prices paid by the consumer.

Price spread = Pc – Pp

Where, Pc = Price paid by the consumer

Pp = Price received by the makers

Producer's share in consumer's rupee

It is the price received by the makers expressed as a percentage of the retail price (i.e., the price paid by the consumer). If Pp is the retail price, the producer's share in consumer's rupee (Ps) may be expressed as follows:

$$PS = \left(\frac{PF}{PR}\right) * 100$$

where, PS = Producer's share in consumer's rupee

PF = Price received by the farmers (copra makers)

PR = Price paid by the consumer.

Marketing Efficiency by Shepherd's Method

The marketing efficiency is measured with the help of the formula given by Shepherd.

$$\text{ME} = \frac{CP}{\Sigma(MC + MM)}$$

Where, ME = Marketing efficiency

CP = Consumer's purchase price

MC = Marketing cost

MM = Marketing margins

Marketing Efficiency by Acharya and Agarwal's Method

The marketing efficiency is measured with the help of the formula given by Acharya and Agarwal i.e.,

$$\text{ME} = \frac{FP}{(MC + MM)}$$

Where, ME = Marketing efficiency,

FP = Price received by farmers (copra makers)

MC = Marketing cost

MM = Marketing margins

Garrett's ranking technique

In order to assess the constraints faced by the coconut producers, copra makers, wholesalers and retailers in making and marketing of copra the Garrett's ranking technique was used to prioritise the constraints. The order of the merits given by the respondents was changed into ranks by using the following formula

Percent position = 100 (Rij – 0.5)/ Nj

Where,

Rij = rank given for i^{th} factor by j^{th} individual.

Nj = number of factors ranked by j^{th} individual.

The percentage position of each rank was converted into scores by referring the table given by Garrett (Garrett and Woodworth, 1969). Then for each factor the scores of individual respondents were added together and divided by the total number of respondents for whom scores were added. These mean scores for all the factors were arranged in descending order and the constraints were ranked.

RESULTS AND DISCUSSION

Establishment cost of coconut orchard

The cost of establishment of coconut orchard up to bearing is broadly classified in to establishment cost and maintenance cost as the coconut orchard starts bearing generally after five years from the year of plantation (Table 1). The cost incurred in a period of five years for establishment of coconut orchard was estimated at ₹ 1,58,842.82 per acre. The establishment cost included not only the costs incurred in initial time of planting but also the cost incurred in maintaining the orchard till the time of bearing. Among the total establishment cost material cost constituted 22.46 per cent (₹ 35,673.46) and maintenance cost 77.54 per cent (₹ 1,23,169.36). The results are in line with the research conducted by Kerutagi *et al.* (2017) it was revealed that the share of maintenance cost was more than the material cost for establishment of mango orchard in Dharwad district of Karnataka.

Table 1: Investment pattern in coconut orchard in the study area (₹/Acre)

Sl. No	Particulars	Value	Percentage
(A)	Investment items		
1	Bore well	22,508.40	14.17
2	Sprayer	1,168.00	0.74
3	Planting material	10,843.31	6.83
4	Digging of pit and planting	1,153.75	0.73
	Sub Total	35,673.46	22.46
(B)	Maintenance cost up to bearing period		
1	Ist year	28,551.32	17.97
2	IInd year	26,477.98	16.67
3	IIIrd year	23,873.82	15.03
4	IVth year	22,367.47	14.08
5	Vth year	21,898.77	13.79
	Sub Total (I+II+III+IV+V)	1,23,169.36	77.54
	Total Establishment Cost (A+B)	1,58,842.82	100.00

A perusal of Table 2 reveals that maintenance cost as indicated in the results included the wages of labour, material cost which were utilized during maintenance period. The maintenance cost incurred during gestation period was ₹ 1,23,169.36. It was noticed that out of total maintenance cost the major component was variable cost (70.29%) followed by fixed cost (29.71%). Among the total variable cost (₹ 86,576.86), the labour cost formed an important cost accounting to 29.58 per cent, since the crops require labour involvement to prefer the important activity like formation of basin around the plants, application of manure and fertilizer etc. Among the material cost the major components are fertilizer ₹ 17,721.94 (20.47%) and manure ₹ 13,981.80 (16.15%) others are accounted to percentage. Out of total maintenance cost 23.18 per cent (₹ 28,551.32) was incurred during the first year, 21.50 per cent (₹ 26,477.98) in second year, 19.38 per cent (₹ 23,873.82) in third year, 18.16 per cent (₹ 22,367.47) in fourth year and 17.78 per cent (₹ 21,898.77) in fifth year. Maximum expenditure was incurred during the first year and relatively lesser expenditure in subsequent years. The findings are similar to the results of the research conducted by Srinivas (1989).

Maintenance cost of coconut orchard during bearing period presented in Table 3. Total cost of cultivation of coconut per acre was ₹ 55,933.91 of which share of variable cost was 70.55 per cent and fixed cost was 29.45 per cent. The similar results were observed in research conducted by Hasna Hassan (2010) reported that the total cost of production of per acre of arecanut, the share of variable cost was more than the fixed cost. In the present study, proportion of variable cost was ₹ 39,459.95 which was actual paid out cost by the farmers. Among the variable cost, the share of human labour cost was maximum ₹ 13,423 (34.02%) followed by fertilizer cost ₹ 9,529.00 (24.15%) and FYM cost ₹ 4,172 (10.57%) and others are accounted to percentage. Human labour cost was higher compared to other operational cost items, the results are in line with the earlier study conducted by Vinodhini *et al.* (2017). Total fixed cost was ₹ 16,473.96, of the fixed cost, the share of major cost items were rental value of land accounted to ₹ 6,147.18 (37.31%) followed by managerial cost ₹ 4,643.61 (28.19%) and amortized establishment cost ₹ 3,176.85 (19.28%) these were the major cost items of fixed cost.

Cost and returns from coconut enterprise

It was observed from Table 4 that the average quantity of coconuts obtained from an acre was 5,777.65 nuts. Cost of production of coconut incurred over total and paid out cost was ₹ 9.68 per nut and ₹ 6.82 per nut respectively. These results are

Table 2: Maintenance cost of coconut orchard during gestation period in the study area (₹/Acre)

Sl. No	Particulars	I[st] year	II[nd] year	III[rd] year	IV[th] year	V[th] year	Total
I	**Variable cost**						
A	**Labour cost**						
1	Land preparation	1,766.25	—	—	—	—	1,766.25 (1.43)
2	Gap filling	—	213.00	591.00	337.50	—	1,141.50 (0.93)
3	Preparation of basin	834.25	881.25	883.60	897.7	940.67	4,437.47 (3.60)
4	Soil application	840.00	1,125.00	—	—	—	1,965.00 (1.60)
5	Application of manure	989.56	1,045.31	1,109.20	1,118.60	1,172.15	5,434.82 (4.41)
6	Application of fertilizer	621.25	712.50	782.81	789.60	827.4	3,733.56 (3.03)
7	Inter cultivation	745.75	758.10	776.74	793.65	808.28	3,882.52 (3.15)
8	PPC spraying	355.00	487.50	526.40	564.00	591.00	2,523.90 (2.05)
9	Irrigation	102.06	145.31	150.40	157.60	172.37	727.74 (0.59)
	Total Labour Cost	6,254.12	5,367.97	4,820.15	4,658.65	4,511.87	25,612.76 (20.79)
B	**Material Cost**						
1	Seedling for gap	—	161.79	496.00	406.44	—	1,064.23 (0.86)
2	Mud /red earth	3,504.76	3,968.25	—	—	—	7,473.01 (6.07)
3	Manure	2,527.27	2,706.49	2,722.07	2,896.10	3,129.87	13,981.80 (11.35)
4	Fertilizer	4,676.77	2,483.41	3,553.53	2,570.71	4,437.52	17,721.94 (14.39)
5	PPC	43.86	84.28	50.21	51.95	43.43	273.73 (0.22)
6	Neem cake	705.19	891.77	890.95	442.42	527.27	3,457.60 (2.81)
7	Repairing of bore well	—	1,148.91	1,912.55	2,049.78	—	5,111.24 (4.15)
	Total Material Cost	11,457.85	11,444.90	9,625.31	8,417.40	8,138.09	49,083.55 (39.85)
	Managerial Cost (10% of TC)	3,520.85	2,346.61	2,109.86	1,972.92	1,930.31	11,880.55 (9.65)
	Total Variable cost	21,232.82	19,159.48	16,555.32	15,048.97	14,580.27	86,576.86 (70.29)
II	**Fixed Cost**						
1	Rental value of land	6,147.18	6,147.18	6,147.18	6,147.18	6,147.18	30.735.90 (24.95)
2	Land tax	10.00	10.00	10.00	10.00	10.00	50.00 (0.04)
3	Depreciation	496.00	496.00	496.00	496.00	496.00	2,480.00 (2.01)
4	Interest on fixed capital @ 10%	665.32	665.32	665.32	665.32	665.32	3,326.59 (2.70)
Total Fixed Cost		7,318.50	7,318.50	7,318.50	7,318.50	7,318.50	36,592.50 (29.71)
Total Maintenance Cost (I + II)		28,551.32 (23.18)	26,477.98 (21.50)	23,873.82 (19.38)	22,367.47 (18.16)	21,898.77 (17.78)	1,23,169.36 (100.00)

Figures in the parentheses indicates percentage of the total.

Table 3: Maintenance cost of coconut orchard during bearing period (VI year onwards) in the study area (₹/Acre)

Sl. No	Particulars		Unit	Quantity	Cost	Percentage
1	Human labour		Man days			
	Family	Male	Number	22.59	4,676.00	8.36
		Female	Number	4.7	577.00	1.03
	Hired	Male	Number	34.26	7,092.00	12.68
		Female	Number	8.78	1,078.00	1.93
2	Machine		Hrs	9.46	3,880.00	6.94
3	Bullock		Days	1.32	858.00	1.53
4	Sprayer		Days	0.51	56.00	0.10
5	FYM		Tractor load	2.5	4,172.00	7.46
6	Red earth		Tractor load	10.00	2,128.00	3.80
7	Fertilizer		Quintal	3.74	9,529.00	17.04
8	Pesticides		Litre	0.74	267.00	0.48
9	Interest on working capital		15%		5,146.95	9.20
A	**Total variable cost**				39,459.95	70.55
	Fixed cost					
1	Crop insurance				323.00	0.58
2	Land and water tax				10.00	0.02
3	Depreciation on machinery				496.00	0.89
4	Rental value of land				6,147.18	10.99
5	Interest on fixed cost		12%		1,677.32	3.00
6	Amortized establishment cost				3,176.85	5.68
7	Managerial cost		10% of all cost		4,643.61	8.30
B	Total fixed cost				16,473.96	29.45
C	**Total cost**				55,933.91	100.00

higher than the earlier study conducted by Sairam *et al.* (1997), it was revealed that cost of production of coconut was ₹ 3.30 and ₹ 2.60 per nut. Gross returns received by selling main and by product were ₹ 45,017.09 (main product ₹ 44,199.02 at a price of 7.65 per nut and by-product 818.07 at a price of 737 per tractor load). This indicated that returns from main produce 98.18 per cent and remaining 1.81 per cent of returns obtained from by-products of coconut tree. These results are same with the results of the study conducted by Vinodhini *et al.* (2017). B:C ratio of the coconut production was 0.80 which is less than unity. Due to monsoon failure, lack of irrigation facilities and less market price they incurred loss in coconut production. It was observed in earlier study conducted by Kishore *et al.* (2017) reported that B:C ratio of the coconut was 1.18 which is higher than the present study. It was witnessed that due to monsoon failure in the study area was the major drawback to realize negative returns otherwise coconut farming is profitable venture.

Table 4: Economics of coconut enterprise in the study area (₹/Acre)

Sl. No	Particulars	Amount (₹)
1	Cost of production of coconut (₹/Acre)	55,933.91
	(A) Returns from main product (5,777.65 No.s @ ₹ 7.65 /nut)	44,199.02
2	(B) Returns from by-product (1.11TL @ ₹ 737 /TL)	818.07
	Gross returns (A+B)	45,017.09
3	Net profit	-10.916.82
4	Cost of production over total cost (₹/Nut)	9.68
5	Cost of production over paid out cost (₹/Nut)	6.82
6	B:C ratio	0.80

It was observed during the study coconut trees have been hit by lack of water due to monsoon failure even ground water also depleted this was the major drawback for producers to incurred loss in coconut production. However, to overcome this problems producer should implement drip irrigation for coconut orchard is the best method to use available water in efficient way to improve the crop heath to increase yield of coconut.

Table 5 depicts that the time required to convert coconut in to copra was 12 months. The total cost incurred for copra making from 5,777.65 numbers of coconuts estimated was ₹ 69,400.33, out of which variable cost accounted to ₹ 68,703.22 (99.00%) and share of fixed cost was ₹ 697.11 (1.00%). Among the variable cost raw coconut cost was more which was ₹ 55,933.91 (81.41%), cost of production of coconut was taken as raw coconut cost, followed by interest on working capital was ₹ 8,961.29 (13.04%) worked out at 15 per cent and labour cost was ₹ 3,808.02 (5.54%). The results revealed that human labour involvement in copra making is an important variable cost. Among the fixed cost share of amortization cost was higher ₹ 622.42 (89.29%) and interest on fixed cost was ₹ 74.69 (10.71). Similar findings were observed in the research conducted by Kakkali (2013).

Table 5: Cost of structure in copra making in the study area

Sl. No.	Particulars	Amount (₹)	Percentage
	Variable cost		
1	Raw coconut	55,933.91	80.60
	Labour charge		
2	Drying of coconut	785.06	1.13
3	Removing of husk	2,311.06	3.33
4	Breaking and removing the shell from the nuts	711.90	1.03
	Sub total	3,808.02	5.49
	Interest on working capital (15%)	8,961.29	12.91
A	Total variable cost	68,703.22	99.00
	Fixed cost		
1	Amortized establishment cost	622.42	0.90
2	Interest on fixed cost (12%)	74.69	0.11
B	Total fixed cost	697.11	1.00
C	Total cost	69,400.33	100.00

Economics of copra making shown in Table 6 it was revealed that 8.86 quintal of copra and 1.11 tractor load of by-product obtained from 5,777.65 nuts. Cost incurred in copra making over total cost was ₹ 7,740.66 per quintal. Gross returns received by selling of 8.86 quintal of copra (₹ 1,16,446.98 at a price of ₹ 13,143.00 per quintal) and 1.11 tractor load of by-product (₹ 818.07 at a price of ₹ 737 per tractor load) was ₹ 1,17,265.05. The net returns obtained were ₹ 47,864.72. The results revealed that copra making in the study area is a profitable venture as indicated by benefit cost ratio (1.68).

These results indicated that the profit earned by selling of copra is better than selling of coconut. The earlier study conducted by Venkat Reddy *et al.* (2017) reported that the B:C ratio of the coconuts per acre was 1.23 which is lesser than the B:C ratio of copra in the present study. In another study carried out by Murthy (1999) and Remold (2000) reported that B:C ratio was 1.38 and 1.01 respectively. These results witnessed that copra making is economically profitable business compared to selling of coconut.

It was observed during the study most of the producers in the study area were selling coconut immediate harvest due to meet their financial need. However, some of the producers were making copra by storing coconut for a year to receive good returns for their produce. The results showed that the selling of copra is better than the selling of coconut is due to assess of higher returns in selling of copra.

Table 6: Economics of copra making in the study area

Sl. No	Particulars	Amount (₹)
1	Cost of making of copra (₹/ 5777.65 nuts)	69,400.33
2	(A) Returns from copra (8.86 Qtl @ ₹ 13,143/Qtl)	1,16,446.98
	(B) Returns from by-product (1.11TL @ ₹ 737 /TL)	818.07
	Gross returns (A+B)	1,17,265.05
3	Net return	47,864.72
4	Returns per quintal of copra	13,143.00
5	Cost of making of copra (₹/Qtl) over total cost	7,740.66
6	Cost of making of copra (₹/Qtl) over paid out cost	7,661.98
7	B:C ratio	1.68

Marketing of copra

The marketing of copra was studied in Tiptur market because this is the major copra market in Karnataka.

Channels involved in marketing of copra

It was observed during the study, in the process of marketing of copra, commission agent, village trader, wholesaler and retailers are the important intermediaries. Further, in the marketing of copra following three different marketing channels were observed in the study area and presented in Fig. 1.

1. Copra makers → Commission agent → Wholesaler → Retailer → Consumer
2. Copra makers → Village trader → Commission agent → Wholesaler → Retailer → Consumer
3. Copra makers → Wholesaler → Retailer → Consumer

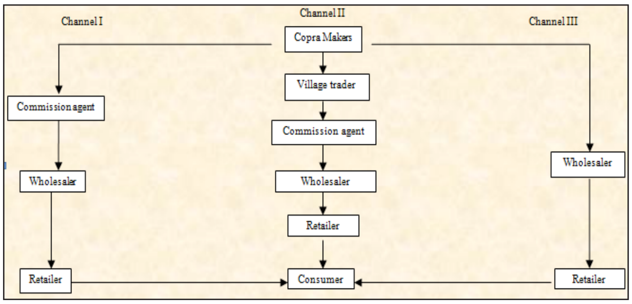

Fig. 1: Map of copa marketing channel in the study area

The copra makers in the study area sold their produce through different marketing channels. The cost incurred by them in marketing of one quintal of copra through different marketing channels was worked out and these are presented in Table 7 and Fig. 2.

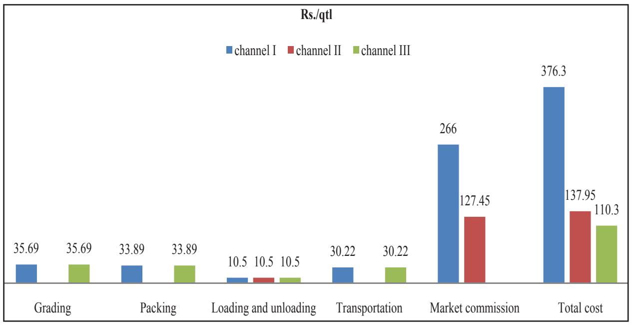

Fig. 2: Marketing cost of copra incurred by copra makers

The cost incurred by the copra makers in marketing of one quintal of copra estimated (Table 7) at ₹ 376.30 in channel I, ₹ 137.95 in channel II and ₹ 110.30 in channel III respectively. Among the various costs items in marketing of copra in Channel I, market commission (70.69%), grading (9.48%) and packing (9.01%) had a major share in total marketing cost. Market commission charges occupy major share in Channel II (92.39%) of the total marketing cost, followed by loading and unloading charges (7.61%). The grading, packing and transportation charges occupy more shares in channel III and together constitute 90.48 per cent and loading and unloading charges 9.51 per cent of

Table 7: Marketing cost of copra incurred by copra makers (₹/qtl)

Sl. No	Particulars	Channel I		Channel II		Channel III	
		Cost (₹/qtl)	%	Cost (₹/qtl)	%	Cost (₹/qtl)	%
1	Grading	35.69	9.48	—	—	35.69	32.35
2	Packing	33.89	9.01	—	—	33.89	30.72
3	Loading and unloading	10.50	2.79	10.50	7.61	10.50	9.51
4	Transportation	30.22	8.03	—	—	30.22	27.39
5	Market commission	266.00	70.69	127.45	92.39	—	—
	Total marketing cost	376.30	100.00	137.95	100.00	110.30	100.00

the total marketing cost. These results revealed that channel III was incurred less marketing cost than other channels in the study area. Similar results were observed in the study conducted by Narendra Kumar (2017) on study of marketing of coconut in Raigad district of Maharashtra state.

Price spread in copra marketing

The costs incurred and margin earned by the various market intermediaries, in different channel, in the process of marketing of copra per quintal, in the study area are presented in Table 8.

The price spread in the marketing channel I (Table 8) copra maker was selling produce through commission agent to wholesaler then it move to retailers to consumers. Copra makers incurred marketing cost for selling of copra was ₹ 376.30 per quintal and received net amount ₹ 12,923.70 against the market price ₹ 13,300.00 per quintal. Marketing cost received by the commission agent, wholesalers and retailers was ₹ 319.20, ₹ 365. 08 and ₹ 335.07 per quintal respectively. Among the intermediaries, retailers earned profit margin ₹ 2,439.98 per quintal and they sold produce to consumer at the price of ₹17,693.48 per quintal. The price spread worked out was ₹ 4,769.78 per quintal and producer's share in consumer's rupee was 73.04 per cent of the consumer price with a net price ₹ 12,923.70 per quintal. The rest 26.96 per cent was comprised of marketing cost and profit margin of the market functionaries.

Further, it was observed from the Table 8 that the price spread in the marketing channel II. In this channel village trader approaches the copra makers or copra makers approaches the village trader for marketing of copra. The village trader sell the produce to wholesalers through commission agent, then produce move through retailers to consumers. Price spread in the marketing channel was ₹ 5,086.43 which was more than the channel I. copra makers received net price ₹ 12,607.05 against market price ₹ 12,745.00 per quintal. Among the stakeholders wholesalers incurred more marketing cost ₹ 363.96 compared to village trader ₹ 330.74, commission agent ₹ 330.81 and retailers ₹ 335.07 per quintal of copra in the study area. Marketing cost incurred in this channel was more compared to other channels in the study area was due to presence number of intermediaries. The marketing cost worked out was more for this channel for coconut in Raigad district of Maharashtra (Narendra Kumar, 2017). Producer's share in consumer's rupee was 71.25 per cent of the consumer price with a net price ₹ 12,607.05 per quintal. The rest 28.75 per cent was comprised of marketing cost and profit margin of the market functionaries.

Price spread in marketing channel III (Table 8) revealed that this was the shortest marketing channel identified in the study area. Copra makers sell copra directly to wholesalers and it move through retailers to consumers. Copra makers received net price ₹ 13,274.00 per quintal against market price ₹ 13,385.00 and they incurred less marketing cost (₹ 110.30 per quintal) compared to other stakeholders. Producer's share in consumer's rupee was 75.02 per cent of consumer price with a net price ₹ 13,274.70 per quintal which was higher than the channel I and II. Namasivayam *et al.* (2006) conducted study on the price spread in marketing of coconut in Tamil Nadu with the reference to Theni district, it was revealed that producer's share in the consumer's rupee was the maximum in this channel (Producer → wholesaler → retailer → consumers) than other marketing channels in the study area.

Price spread analysis showed that, channel I is best from copra maker's point of view. However, copra makers prefer wholesalers between channel I and II, channel III is more profitable to copra makers due to price spread in this channel was less (₹ 4,418.78 per quintal) because of less marketing cost and higher producer's price among the other marketing channels. The results of the study is in line with the study conducted by Mabel Sulochana (2009).

Table 8: Price spread in marketing channels in the study area (₹/qtl)

Sl. No	Particulars	Channel-I	Channel-II	Channel-III
		Amount	**Amount**	**Amount**
1	Price of copra received by copra makers	13,300.00	12,745.00	13,385.00
2	**Marketing Charges incurred by copra makers**			
	Grading	35.69	—	35.69
	Packing	33.89	—	33.89
	Loading & unloading	10.50	10.50	10.50
	Transportation	30.22	—	30.22
	Commission charges	266.00	127.45	—
3	Total marketing charges incurred by the copra makers	376.30	137.95	110.30
4	Net amount received by copra makers	12,923.70	12,607.05	13,274.70
5	**Marketing charges incurred by village trader**			
	Purchase price	—	12,745.00	—
	Packing	—	64.50	—
	Transportation	—	42.50	—
	Loading & unloading	—	10.00	—
	Grading	—	22.57	—
	Commission charges	—	191.17	—
	Total marketing charges incurred by the village trader	—	330.74	—
	Marketing margin of the village trader	—	487.50	
	Sale price	—	13,232.50	—
6	**Marketing charges incurred by the commission agent**			—
	Purchase price	13,300.00	13,232.50	—
	Commission	319.20	330.81	—
	Sale price	13,619.20	13,563.31	—
7	**Marketing charges incurred by the wholesaler**			
	Purchase price	13,619.20	13,563.31	13,385.00
	Commission charge	272.38	271.26	267.7
	Loading and unloading	11.20	11.20	11.20
	Packing	47.00	34.50	47.00
	Transportation	34.50	47.00	34.50
8	Total marketing charges incurred by the wholesaler	365.08	363.96	360.4
9	Marketing margin of the wholesaler	1634.30	1690.19	1868.5
10	Wholesaler price	15,253.50	15,253.50	15,253.50
11	**Marketing charges incurred by the retailer**			
	Purchase price	15,253.50	15,253.50	15,253.50
	Loading and unloading	11.60	305.07	11.60
	Commission charges	305.07	11.60	305.07
	Transportation	18.40	18.40	18.40
12	Total marketing cost incurred by the retailer	335.07	335.07	335.07
13	**Marketing margin of the retailer**	2439.98	2439.98	2439.98
14	**Consumer price**	17,693.48	17,693.48	17,693.48
15	**Total marketing cost**	1395.45	1498.53	805.77
16	**Total marketing margin**	4074.28	4617.67	4308.48
17	**Price spread**	4769.78	5086.43	4418.78
18	**Producer's share in consumer's rupee**	73.04	71.25	75.02

These results witnessed that existence of more number of intermediaries in the marketing channel accounted higher price spread it leads copra makers to receive less net price. Selling of copra directly to wholesalers is profitable but it was perceived by very few copra makers in the study area. Maximum number of copra makers sold copra to commission agent or village traders because of lack of knowledge of market information, so that it is necessary to provide market information to copra makers to select best market channel. Government should encourage online trading of copra to avoid middleman activities in marketing, it helps to reduce marketing cost and increase producer's share in consumer's rupee and also it helps to reduce the price spread by shortening the marketing channel.

Marketing efficiency: Marketing efficiency of the different marketing channels was studied by using Shepherd's method and Acharya and Agarwal method is presented in Table 9.

The results presented in the Table 9 revealed that in case of Shepherd's method, among the three channels, channel III was observed to be efficient marketing channel for copra in the study area. The efficiency index for channel III was the maximum with 3.46 followed by channel I was 3.23. Further, it is also observed from table indicated that marketing efficiency analysis using Acharya and Agarwal method. Marketing efficiency index of channel III (2.60) was greater than that of channel I (2.36) and channel II (2.06) for copra marketing. Because of less marketing charges incurred in channel III marketing efficiency was more than other channels in the study area. The research conducted by Namasivayam *et al.* (2006) revealed that the marketing efficiency was higher in channel III (similar to marketing channel III in the present study) compared to other channels. In another research carried out by Sulthan Mohideen *et al.* (2016) reported that the marketing efficiency is greater in this channel Growers – wholesalers –retailers -consumers for mango in Theni district of Tamilnadu.

Table 9: Marketing efficiency analysis using shepherd's and Acharya and Agarwal Method (₹/qtl)

Particulars	Channel I	Channel II	Channel III
Price received by the copra makers	13,300.00	12,745.00	13,385.00
Net price received by the copra makers	12,923.70	12,607.05	13,274.70
Consumer's purchase price (CP)	17,693.48	17,693.48	17,693.48
Marketing cost (MC)	1,395.45	1,498.53	805.77
Marketing margins (MM)	4,074.28	4,617.67	4,308.48
ME (Shepherd's method)	3.23	2.89	3.46
ME (Acharya and Agarwal method)	2.36	2.06	2.60

Constraints in coconut cultivation, copra making and marketing in the study area

Constraints faced by producers in coconut and copra making are presented in Table 10 and marketing constraints faced by copra makers, wholesalers and retailers are presented in Table 11.

Major constraints faced by producers in coconut production were incidence of pest and diseases. Monsoon failure leads to reduction in the yield due to lack of irrigation facility, so that water problem was opined as the second vital problem followed by shortage of tree climber during harvesting time and financial problems were considered as major problems in coconut cultivation. Climatic condition, high cost of inputs and labour problems were least expressed by the producers.

Further, it was observed from the Table 10 indicates that constraints faced by copra makers. It was noticed that monsoon failure during the study, as production of copra depends on production of coconut. Due to poor and unfavourable climatic condition the coconut production is affected. Hence climatic condition and decreasing production was ranked first and second respectively. Due to lack of irrigation in the study area poor quality of copra was obtained so that poor quality of produce ranked third. The conversion of coconut into copra is a time consuming process (12 months required), so copra makers have to wait so long to get returns this was quite problematic in case of marginal and small farmers because of their financial requirement to meet their needs. Even though selling of copra receiving more profit than selling of coconut due to financial problems of the farmers tends to sell some portion coconut so that financial problems ranked fourth. Lack of knowledge of new technology, lack of proper infrastructure for copra making and labour problem was least expressed by the copra makers.

Marketing constraints faced by copra makers were that majority of the respondents expressed that the problem in fluctuation of price followed by world price of coconut oil, bullish pattern, exploitation of middle man and high cost of transportation in the study area (Table 11). It was observed that most of the producers expressed lack of market information and inadequate storage facility were the minor problems faced by the copra makers in the study area.

Constraints faced by the wholesalers (Table 11) opined that fluctuation in market price, lack of consistent demand and high commission charges were considered as major problems. Lack of infrastructure facilities in the market, high cost of transportation, poor quality of produce and lack of market information were the minor problems faced by the wholesalers in the study area.

It was evident that fluctuation in price was reported as major constraint faced by wholesalers due to varied production of copra over a year and world price of coconut oil influences on price of copra. During the festival season copra demand will be more than normal days so that demand is inconsistent.

Table 10: Constraints faced by the coconut producers and copra makers in the study area

Coconut production constraints				Copra making constraints		
Sl. No	**Particulars**	**Mean score**	**Rank**	**Particulars**	**Mean score**	**Rank**
1	Incidence of pests and diseases	69.53	I	Climatic conditions	73.13	I
2	Water problem	64.98	II	Decreasing production	69.88	II
3	Shortage of tree climbers	62.88	III	Poor quality of produce	54.38	III
4	Financial problem	42.45	IV	Financial problem	48.65	IV
5	Climatic condition	40.53	V	Lack of knowledge of new technology	44.78	V
6	High cost of input	34.83	VI	Lack of proper infrastructure for copra making	29.68	VI
	Labour problem	31.83	VII	Labour problem	26.53	VII

Table 11: Marketing constraints faced in the study area

	Copra makers			Wholesalers			Retailers		
Sl. No	**Particulars**	**Mean score**	**Rank**	**Particulars**	**Mean score**	**Rank**	**Particulars**	**Mean score**	**Rank**
1	Price fluctuation	75.73	I	Fluctuation in market price	72.15	I	Fluctuation of market price	75.08	I
2	World price of coconut oil	65.68	II	Lack of consistent demand	68.65	II	High cost of transportation	63.20	II
3	Bullish pattern	54.78	III	High commission charges	52.15	III	Poor keeping quality of produce	54.80	III
4	Exploitation by middlemen	51.63	IV	Lack of infrastructure facilities in the market	46.75	IV	High commission charges	49.35	IV
5	High cost of transportation	43.15	V	High cost of transportation	43.93	V	Lack of consistent demand	47.78	V
6	Lack of market information	32.13	VI	Poor quality produce	38.40	VI	Lack of market information	29.63	VI
7	In-adequate storage facility	23.93	VII	Lack of market information	24.58	VII	Distant market place	27.18	VII

Majority of the retailers expressed the major problem (Table 11) were fluctuation of market price followed by high cost of transportation, poor keeping quality of produce and high commission charges in the study area. It was observed that most of the retailers expressed the lack of consistent demand, lack of market information and distant market place were the minor problems and they have been assigned lower ranks.

These results revealed that fluctuation in market price was considered as major problems for both wholesalers and retailers in the study area. The results of the study are in line with the research conducted by Nagaraju (2013).

CONCLUSION AND POLICY IMPLICATIONS

The present study indicated that the performance of palm industry in Karnataka. The total establishment cost of coconut orchard was estimated at ₹ 1,58,842.82 per acre. The annual cost of cultivation of coconut was ₹ 55,933.91 per acre. Due to monsoon failure, lack of irrigation facilities and less market price they incurred loss in coconut production. The total cost incurred in copra making from 5,777.65 nuts estimated at ₹ 69,400.33 and obtained 8.86 quintal of copra. Copra making in the study area is a profitable venture as indicated by benefit cost ratio (1.68). Three important marketing channels identified in the study area among these, channel III found to be more efficient than other channels in the market. Majority of the copra makers expressed that drastic climate change lead to decrease in production, fluctuation in price of coconut oil was the major marketing problem. The other problem faced by wholesalers was lack of consistent demand and in case of retailers high cost of transportation was the major problems. To overcome these problems government can promote artificial dryer unit under cooperative sector, as traditional method of copra making consuming more time and it can provide financial help to construct proper infrastructure for coconut storing unit. Creating awareness to encourage online trading for better price realization for copra makers and better quality is the need of the hour. The copra manufactured in the study area was of good quality. Hence, efforts should made to export the copra.

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Analysis of Energy Input Use Efficiency in Punjab Agriculture

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ABSTRACT

The present study measured the energy efficiency at various sizes of farms in relation to their energy use pattern with special reference to wheat and paddy crops in relevance to electricity and fertilizer efficiency, identified the factors responsible for levels of efficiency on Punjab Farms and given the implications for future energy demand scenario and usage pattern in Punjab agriculture. A significant decline in per hectare use of commercial and non- commercial energy with the rise in the level of efficiency was observed. Per hectare use of commercial and non-commercial energy was comparatively low in zone III to zone I and zone II. Per hectare use of both commercial and non-commercial energy was more in paddy crop as expected in comparison to wheat crop. Paddy alone consumes three-fourth of total electricity consumption in agriculture. Only 20 per cent decrease in area under rice cultivation would decrease the energy use to a great extent. So, there is also a need of shifting from present wheat-paddy cropping system to less energy intensive cropping system.

Highlights

- Percent use of non- commercial energy at all levels of efficiency decreased with the increase in the size of farms.
- Fertilizer plus agrochemicals and electric motor plus diesel engine were the major source of commercial energy used on Punjab farms.

Keywords: Commercial and non commercial energy use, per hectare, paddy, wheat

Enhanced inputs of energy and improvements in its quality have played a key role in the development of all technologies including those associated with agriculture production. Agricultural productivity and consumption of commercial energy based inputs in the agricultural sector in Punjab are relatively high. The problem of energy, particularly, the depletion of non-renewable resources, kept engaged the attention of scientists, planners and research workers for quite some time in the past. Efforts have been made to study various aspects of its application in different fields and also to devise ways and means to meet the challenges of its increasing demand. Some useful work has also been done on different energy aspects in the field of agriculture. Efficiency is expressed as the ability to produce the outputs with a minimal required resource level (Sherman, 1988). In production, efficiency is a normative measure and is defined as the ratio of weighted sum of outputs to inputs ratio. The weights for inputs and outputs are estimated to the best advantage for each unit so as to maximize its relative efficiency. In order to measure the optimal input/ output, it is mandatory to first specify the production frontier (Mukherjee, 2008). The consumption pattern of both direct and indirect sources of commercial energy was analysed using time series data from 1980-81 to 2006-07 to explain the direction and the extent of energy-use in Indian agriculture (Jha, 2012). On the basis of commercial and non-commercial classification the main sources of commercial energy are coal, hydro

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and nuclear power while the non-commercial forms of energy are firewood, agricultural wastes and animal dung etc. Among the renewable energy sources, agricultural wastes can play a vital role for meeting the large scale energy requirements of different sectors of the economy (Energy statistics of Punjab 2015-16).

Efficient use of energy resources in agriculture is one of the principal requirements for sustainable agricultural production as it provides financial savings, fossil resources preservation and air pollution reduction and attempts should be made to raise the production yield or to sustain the energy input without affecting the output in order to enhance the energy efficiency (Singh *et al.* 2004). Therefore, energy saving has been a vital subject for sustainable development in agricultural systems. Improvement of energy efficient agricultural systems with low input energy compared to the output of food can reduce the greenhouse gas emissions from agricultural production systems.

Development in the efficiency of resource use in agriculture requires the definition of spatial and temporal use of current resources as well as development of tightly defined and broadly suitable indices (Topp *et al.* 2007). In some studies the indicators of output energy to input energy ratio and energy productivity in crop production systems have been used to evaluate the performance of farmers. Energy productivity is an important indicator for more efficient energy usage although higher energy productivity does not mean more economic feasibility (Mohammadi *et al.* 2010). The energy input-output analysis is usually made to measure the energy efficiency and environmental aspects. This analysis determines efficiency of energy to be used. In current years, several researches have been conducted on energy use for production of different agricultural crops (Jianbo, 2006; Meul *et al.* 2007 and Kizilaslan, 2009).

The importance of energy use efficiency has increased as the share of commercial energy use in total energy utilization has increased manifold. The problem of measuring productive efficiency at farms has become important to both the economic theorists and policy makers. If the theoretical argument that some farmers are relatively more efficient than others is subjected to empirical testing then it becomes all the more important to make some actual measurement of efficiency. Hence new technologies should be developed and transferred to farmers. However, for farms operating at lower levels of efficiency, sufficient potential also exists for improving the productivity of rice by proper management and allocation of the existing resources and technology (Samarpitha *et al*. 2016). Therefore, there is need to access these energy trends in agriculture and to know how far can farms increase their output simply by increasing their efficient utilization of the given resources.

Punjab State is viewed as the most prosperous state in India. With the passage of time, Punjab farmers started using more and more of commercial energy and became highly energy intensive. So, it becomes the need of the hour to study the energy use pattern in Punjab agriculture with a view to check on the appropriate/ excessive use of energy on the farms. So, the present study was undertaken to examine the energy use efficiency of different inputs in Punjab agriculture with special reference to wheat and paddy crops.

METHODOLOGY

The study focuses on the energy input use pattern and its efficiency in the agricultural sector of the Punjab state.

The primary data has been collected from three agro- climatic zones of Punjab i.e. Sub- mountainous zone, Central plain zone and South- western zone. The data has been collected for the period 2014- 15 of principal crops in Punjab.

Punjab state is divided into following three crop homogenous zones on the basis of soil type, cropping pattern, irrigation, rainfall and temperature.

- Zone I (Sub – mountainous zone): Wheat, paddy and maize area.
- Zone II (Central plain zone): Wheat, paddy, potato and oilseeds area.
- Zone III (South – Western zone): Wheat, paddy and cotton area.

Multistage random sampling techniques have been used for the selection of the sample households, six districts in all have been selected randomly, comprising two districts from each zone at the first stage of sampling. At the second stage, two blocks from each selected district have been randomly selected and two villages have been randomly selected from the each block in the third stage. Thus 24 villages have been selected from the entire state for the purpose of study. From each selected village, fifteen farmers have been selected randomly. From each village, four small, seven medium and four large farmers have been taken purposely based on the size of their operational holding. Thus, the ultimate sample consists of 360 farms. For the present study, five farm size categories were regrouped into three as under:

Size limits of farm with category of size group

Size group	Size limit of holdings (in ha)	Number of farmers
Small farmers	Upto 2	96
Medium farmers	2-10	168
Large farmers	Above 10	96
Total		**360**

Collection of Data

The data on 360 sample farms have been collected for the period 2014- 15. The detailed data on farm input use were collected which has been utilized to develop Best Practice Productivity Frontier for measuring the efficiency of farms. The data were collected for all the major crops namely wheat, paddy, maize, potato, cotton, and sarson. The data have been collected on the following parameters:

1. Area under the crops and the total cropped area (hectares).
2. Human labour (hours): family, permanent worker and casual.
3. Tractor used (hours): owned and hired.
4. Irrigation: power used with electric motor/ diesel engine (kwh)
5. Thrashing: type of thrashing and its quantity (hours).
6. Seed: quantity (kg)
7. Fertilizer: quantity of NPK (kg)
8. Agro-chemicals (kg)
9. Production: quantity of main product and by product (quintals).

In this study, using a Cobb- Douglas functional form, the production function model used and the definition of variables considered are described as under:

$$Y = a_0 \prod_{i=1}^{n} Xi^{bi} e^{u}$$

$$\text{Log } Y = \log a + \sum_{i=1}^{n} b_i \log X_i + u$$

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \ldots\ldots\ldots + b_n \log X_n + u$$

Where,

Y = Yield in (q/ha)

X_1 = human labour (MJ)

X_3 = Seed used (MJ)

X_4 = Fertilizer + agrochemicals (MJ)

X_5 = Tractor+ thrashing (MJ)

X_6 = Power used for irrigation with electric motor / diesel engine (MJ)

a_o= constant term

u = error term

b_1 through b_6 are the regression coefficients for X_1 through X_6, respectively.

The efficiency level of an individual farm is defined by the following expression;

$$[\exp(-U_i)]$$

$$1 - [Q_i / Q_i^*]$$

Where Q_i* is the maximum possible output, and Q_i is the actual output.

The study has utilized the energy equivalence of different items of inputs to agricultural production and of main products from published information by School of Energy Studies for Agriculture, Punjab Agricultural University, Ludhiana (Index I).

Index I Energy Equivalence of Inputs:

1. Commercial

(A)	**Direct**	
	Fuel oil	46.3 MJ/kg or 44.5 MJ/l
	Electricity	3.6 MJ/Kwh
(B)	**Indirect**	
(i)	Fertilizer	
	(a) N	60.0 MJ/kg
	(b) P_2O_5	14.0 MJ/kg
	(c) K_2O	6.0 MJ/kg
	(d) Agro-Chemicals	250.0 MJ/kg

(ii)	Farm Equipments	
	(a) Diesel Engine (5 HP)	2460 MJ/yr/unit
	(b) Electric Motor (5 HP)	328 MJ/yr/unit
	(c) Thresher (small)	2733 MJ/yr/unit
	(d) Tractor (35 Hp)	34167 MJ/yr/unit

2. Non-Commercial

(A) Direct	
Labour	0.18 MJ/man hour or 432 MJ/worker/yr of 300 working days
(B) Indirect	
Farm yard manure (on the basis of nitrogen content	0.3 MJ/kg of dry matter
Seed	16.73 J/kg

**Source: School of Energy Studies for Agriculture, PAU, Ludhiana; MJ: Mega Joules (1 × 10^6 Joules)*

RESULTS AND DISCUSSION

Energy Efficiency Analysis

The study attempted to use the Best Practice Frontier Efficiency Model to work out the efficiency of farms using various energy inputs. The various crop outputs were converted into energy through appropriate energy transforms. Both main products and by- products were converted into energy output using energy equivalents. This facilitated the adding up of various outputs and their by-products. Similarly various inputs were converted into their energy equivalents. The entire data was thus transformed into their energy equivalents. The energy inputs were further divided by the area cropped and also by the energy output. This provided us with various energy inputs used for production of one unit of energy output per hectare. For want of generalized algorithms of multifactor analysis to arrive at efficiency ratio the energy inputs were classified into two categories.

1. Non-commercial energy inputs
   (a) Human labour
   (b) Seed
2. Commercial energy inputs
   (a) Fertilizer + agrochemicals
   (b) Machines used
   (c) Electric motor + Diesel engine (irrigation)

In order to present the comparison of different sizes of farms with regard to their efficiency level and energy use pattern, per hectare use of energy in MJ was calculated for different sources of energy for three groups of the farmers representing different levels of efficiency. The efficiency of all the farmers was measured as already discussed in methodology. This ranged between zero per cent to 100 per cent (Table 1). These farmers were classified in three groups according to their efficiency level.

Table 1: Classification of the farmers in different groups on the basis of efficiency score

Groups	Efficiency Score (%)
I	Less than 60
II	60 to 80
III	Above 80

The analysis was done for small, medium and large farms functioning at three levels of efficiency zone- wise. As already discussed, energy supplied through various sources i.e. human labour and seed was classified as non- commercial energy whereas fertilizer plus agrochemicals, machinery and electric motor plus diesel engine (irrigation) as commercial energy. The results are presented in the different zones for three groups of farmers i.e. small, medium and large at three levels of efficiency in the tables.

In zone I (Table 2), it was observed that percent use of non- commercial energy decreased with the increase in the farm size whereas percent use of commercial energy increased with increase in the farm size. The seed energy constituted a significant part of total non- commercial energy use. The energy used through fertilizer plus agrochemicals and electric motor plus diesel engine constituted a major part of the total commercial energy used on farms in this zone. Per hectare use of human labour on medium and large farms in group I, on large farms in group II and on small farms in group III was low on account of more use of machine energy on these farms.

The energy use per hectare varied significantly between different levels of efficiency and also according to the size of farms. Table 2 reveals that while moving from lower level of efficiency to higher level of efficiency, as expected, per hectare use of non- commercial and commercial energy inputs decrease.

Table 2: Energy used per hectare from different sources at different levels of efficiency on small, medium and large farms (Zone I) (MJ/ha), 2014-15

Efficiency level	Size of farms	Non- commercial energy			Commercial energy			
		Human labour	Seed	Total	Fertilizer + agrochemicals	Machines used	Electric motor + diesel engine	Total
Group I < 60	Small	1308.88 (2.62)	4624.62 (9.24)	5933.5 (11.86)	17808.75 (40.37)	9668.68 (21.92)	16637.23 (37.71)	44114.65 (88.14)
	Medium	1054.45 (1.86)	4529.03 (7.99)	5583.48 (9.85)	16144.7 (31.59)	14993.58 (29.34)	19961.83 (39.06)	51100.10 (90.15)
	Large	1074.33 (1.78)	3643.93 (6.03)	4718.26 (7.81)	21993.58 (39.48)	14010.03 (25.15)	19700.10 (35.37)	55703.70 (92.19)
Group II 60- 80	Small	1249.10 (2.92)	3023.80 (7.06)	4272.9 (9.98)	17497.1 (45.39)	8120.38 (21.06)	12933.13 (33.55)	38550.60 (90.02)
	Medium	1267.77 (2.66)	3085.64 (6.49)	4353.41 (9.15)	19340.18 (40.67)	9672.95 (20.34)	14181.73 (29.83)	43194.85 (90.84)
	Large	1071.30 (2.19)	2670.55 (5.45)	3741.85 (7.64)	21019.20 (46.44)	10203.63 (22.54)	14042.05 (31.02)	45264.88 (92.36)
Group III ≥ 80	Small	1085.63 (2.66)	2450.91 (6.02)	3536.54 (8.69)	12735.13 (31.30)	10717.75 (26.35)	13692.75 (33.66)	37145.63 (91.31)
	Medium	1297.44 (2.77)	2309.78 (4.94)	3607.22 (7.71)	17164.25 (36.71)	11231.85 (24.02)	14759.18 (31.56)	43155.28 (92.29)
	Large	1138.04 (2.24)	2293.96 (4.52)	3432.00 (6.77)	18486.85 (39.11)	14015.00 (29.65)	14767.68 (31.24)	47269.53 (93.23)

Figures in parentheses indicate percentage.

Table 3: Energy used per hectare from different sources at different levels of efficiency on small, medium and large farms (Zone II) (MJ/ha), 2014-15

Efficiency level	Size of farms	Non- commercial energy			Commercial energy			
		Human labour	Seed	Total	Fertilizer + agrochemicals	Machines used	Electric motor + diesel engine	Total
Group I < 60	Small	1635.75 (2.32)	2059.63 (2.92)	3695.38 (5.24)	27414.18 (40.99)	10526.68 (15.74)	28938.13 (43.27)	66878.98 (94.76)
	Medium	1727.21 (2.31)	1531.27 (2.05)	3258.48 (4.36)	25725.98 (35.98)	15955.03 (22.31)	29825.13 (41.71)	71506.13 (95.64)
	Large	1267.23 (1.45)	2660.54 (3.05)	3927.77 (4.50)	24772.90 (29.72)	27045.53 (32.45)	31525.33 (37.83)	83343.75 (95.50)
Group II 60- 80	Small	1410.08 (2.16)	1723.37 (2.64)	3133.45 (4.80)	21932.28 (35.32)	17414.93 (28.04)	22749.65 (36.64)	62096.85 (95.20)
	Medium	1298.81 (1.98)	1318.15 (2.01)	2616.96 (3.99)	23008.63 (36.53)	15258.63 (24.22)	24724.63 (39.25)	62991.88 (96.01)
	Large	2238.56 (3.23)	1528.14 (2.20)	3766.7 (5.43)	25808.63 (39.35)	14911.78 (22.74)	24869.05 (37.92)	65589.45 (94.57)
Group III ≥ 80	Small	2128.99 (3.38)	2352.75 (3.73)	4481.74 (7.11)	21694.68 (37.05)	14318.30 (24.45)	22542.83 (38.50)	58555.80 (92.89)
	Medium	1576.42 (2.39)	1661.82 (2.52)	3238.24 (4.92)	25844.10 (41.28)	15398.08 (24.59)	21367.25 (34.13)	62609.43 (95.08)
	Large	1249.61 (1.76)	2194.13 (3.09)	3443.74 (4.86)	25433.83 (37.70)	20024.63 (29.68)	22004.38 (32.62)	67462.83 (95.14)

Figures in parentheses indicate percentage.

Table 3 represents that percent share of non-commercial energy went on declining and that of commercial energy increased (except in few cases) while moving from small to medium to large farms at each level of efficiency. In zone II, the share of commercial energy was greater compared to zone I and zone III on account of cropping pattern in favour of crops consumed more commercial energy.

Similarly in zone II, out of commercial energy use, the share of electric motor plus diesel engine and fertilizer plus agrochemicals was greater and almost same among different categories of farms at different levels of efficiency. The energy used through tractor plus thrashing also constituted a greater part of the total energy used. Per hectare use of commercial energy increased while moving from small size of holding to large size holding. While moving from lower efficiency group to higher efficiency group, per hectare use of commercial energy decreased with the increase in size of farms which was very much expected. As far as non-commercial energy inputs concerned, the percent share of non- commercial energy was comparatively low in zone II to zone I.

Zone III analysis also indicated that per hectare use of commercial and non- commercial energy was different at each level of efficiency according to the size of farms (Table 4). The energy used through human labour constituted a greater part followed by seed out of non- commercial energy use. The share of fertilizer plus agrochemical energy was more pronounced as compared to other commercial energy inputs. In zone III, per hectare use of non-commercial energy was low as compared to zone II and zone I due to different cropping pattern among the zones. Moreover, per hectare use of commercial energy inputs was low in zone III as compared to zone I and zone II. Table also reveals that while moving from lower level of efficiency to higher level of efficiency and from small to medium to large farms, percent share of commercial energy increased and that of non- commercial energy decreased.

It was observed in Table 5 and 6 that per cent use of non- commercial at all levels of efficiency decreased with the increase in the size of farms whereas the percent use of commercial energy increased with the increase in the farm size for wheat and paddy crops in Punjab. Moreover, commercial energy constituted a significant part of total energy in both the crops. Further, the per hectare use of energy for different sources of energy inputs indicated that the energy used per hectare varied significantly between levels of efficiency and also according to size of farms in wheat and paddy cultivation in Punjab. Per hectare use of commercial and non- commercial energy decreased with the increase in the level of efficiency from small to medium to large farms except in one case in wheat crop on medium farms (1014.20 MJ/ha) in the efficiency group III (Table 5). Per hectare use of commercial and non- commercial energy

Table 4: Energy used per hectare from different sources at different levels of efficiency on small, medium and large farms (Zone III) (MJ/ha)

Efficiency level	Size of farms	Non- commercial energy			Commercial energy			
		Human labour	Seed	Total	Fertilizer + agrochemicals	Machines used	Electric motor + diesel engine	Total
Group I < 60	Small	1935.55 (4.57)	1901.69 (4.49)	3837.24 (9.06)	19381.63 (50.34)	8951.85 (23.25)	10169.73 (26.41)	38503.20 (90.94)
	Medium	2452.25 (5.59)	1179.48 (2.67)	3631.73 (8.28)	20807.15 (51.73)	7250.20 (18.03)	12165.35 (30.24)	40222.70 (91.72)
	Large	1483.39 (2.85)	1761.37 (3.39)	3244.76 (6.24)	21249.13 (43.59)	13312.08 (27.31)	14190.60 (29.11)	48751.80 (93.76)
Group II 60- 80	Small	1325.20 (3.65)	1347.94 (3.72)	2673.14 (7.37)	18217.48 (54.22)	8436.03 (25.11)	6944.53 (20.67)	33598.03 (92.63)
	Medium	1254.20 (3.30)	1113.26 (2.93)	2367.46 (6.23)	17951.13 (50.39)	8288.83 (23.27)	9382.08 (26.34)	35622.03 (93.77)
	Large	1190.39 (2.83)	1147.11 (2.73)	2337.5 (5.56)	18710.70 (47.16)	12965.63 (32.68)	7995.18 (20.15)	39671.50 (94.44)
Group III ≥ 80	Small	1495.57 (4.78)	1228.15 (3.93)	2723.72 (8.71)	14991.08 (52.52)	8565.63 (30.01)	4986.90 (17.47)	28543.60 (91.29)
	Medium	1231.74 (4.48)	926.23 (3.37)	2157.97 (7.85)	14534.25 (57.34)	6479.30 (25.56)	4333.03 (17.10)	25346.58 (92.15)
	Large	1099.18 (3.51)	962.49 (3.07)	2061.67 (6.58)	14216.18 (48.55)	12065.45 (41.21)	2997.48 (10.24)	29279.10 (93.42)

Figures in parentheses indicate percentage.

Table 5: Energy use per hectare from different sources at different levels of efficiency on small, medium and large farms for wheat crop in Punjab (MJ/ ha), 2014-15

Efficiency level	Size of farms	Non- commercial energy			Commercial energy			
		Human labour	Seed	Total	Fertilizer + agrochemicals	Machines used	Electric motor + diesel engine	Total
Group I < 60	Small	433.07 (2.50)	965.86 (5.57)	1398.93(8.07)	5967.89 (34.42)	3094.82 (17.85)	6875.23 (39.66)	15937.94 (91.93)
	Medium	404.94 (2.37)	628.90 (3.67)	1033.83 (6.04)	5730.27 (33.48)	2711.19 (15.84)	7640.78 (44.64)	16082.23 (93.96)
	Large	300.86 (1.49)	737.81 (3.65)	1038.67 (5.14)	6388.59 (31.63)	4705.34 (23.29)	8067.98 (39.94)	19161.91 (94.86)
Group II 60- 80	Small	320.55 (2.37)	625.73 (4.63)	946.28 (7.01)	5109.78 (37.84)	2189.80 (16.22)	5257.37 (38.93)	12556.94 (92.99)
	Medium	326.83 (2.29)	431.10 (3.03)	757.93 (5.32)	5436.99 (38.16)	2097.18 (14.72)	5955.57 (41.80)	13489.75 (94.68)
	Large	410.53 (2.68)	401.52 (2.62)	812.05 (5.31)	6003.08 (39.24)	2696.66 (17.63)	5785.11 (37.82)	14484.85 (94.69)
Group III ≥ 80	Small	335.88 (2.74)	614.45 (5.01)	950.33 (7.74)	4095.24 (33.37)	2144.21 (17.47)	5084.11 (41.42)	11323.55 (92.26)
	Medium	416.30 (3.16)	597.90 (4.53)	1014.20 (7.69)	5096.92 (38.66)	2083.47 (15.80)	4990.00 (37.85)	12170.39 (92.31)
	Large	263.34 (1.83)	394.44 (2.74)	657.78 (4.56)	5170.21 (35.86)	3686.29 (25.57)	4904.91 (34.02)	13761.41 (95.44)

Figures in parentheses indicate percentage.

Table 6: Energy use per hectare from different sources at different levels of efficiency on small, medium and large farms for paddy crop in Punjab (MJ/ ha), 2014-15

Efficiency level	Size of farms	Non- commercial energy			Commercial energy			
		Human labour	Seed	Total	Fertilizer + agrochemicals	Machines used	Electric motor + diesel engine	Total
Group I < 60	Small	732.03 (2.99)	1287.89 (5.27)	2019.92 (8.26)	9690.68 (39.64)	4372.08 (17.89)	8361.76 (34.21)	22424.52 (91.74)
	Medium	785.09 (2.99)	1085.97 (4.13)	1871.05 (7.12)	9401.67 (35.75)	5729.82 (21.79)	9292.85 (35.34)	24424.34 (92.88)
	Large	573.74 (1.92)	1209.88 (4.04)	1783.62 (5.95)	10202.34 (34.06)	8155.14 (27.23)	9812.40 (32.76)	28169.89 (94.05)
Group II 60- 80	Small	597.66 (2.76)	914.27 (4.22)	1511.92 (6.98)	8647.03 (39.94)	5095.70 (23.54)	6394.10 (29.54)	20136.82 (93.02)
	Medium	573.12 (2.52)	902.56 (3.97)	1475.67 (6.49)	9044.99 (39.76)	4983.06 (21.91)	7243.26 (31.84)	21271.31 (93.51)
	Large	675.04 (2.81)	801.87 (3.33)	1476.91 (6.14)	9830.78 (40.87)	5712.15 (23.75)	7035.94 (29.25)	22578.87 (93.86)
Group III ≥ 80	Small	706.53 (3.50)	829.77 (4.11)	1536.30 (7.62)	7413.13 (36.75)	5040.25 (24.99)	6183.37 (30.65)	18636.75 (92.38)
	Medium	615.84 (2.91)	884.67 (4.18)	1500.51 (7.09)	8631.39 (40.78)	4966.38 (23.46)	6068.92 (28.67)	19666.69 (92.91)
	Large	523.02 (2.28)	817.59 (3.56)	1340.61 (5.84)	8720.53 (38.01)	6915.76 (30.14)	5965.43 (26.00)	21601.72 (94.16)

Figures in parentheses indicate percentage.

Table 7: Percentage factor shares in the efficiency of various sized farms in different zones

Variables	Zone I			Zone II			Zone III		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Human labour	2.55	2.35	1.93	2.48	2.13	4.00	4.00	4.14	2.88
Seed	6.95	6.27	4.97	2.95	2.11	2.65	3.74	2.78	2.88
Total- I	9.50	8.62	6.90	5.43	4.24	4.69	7.74	6.92	5.76
Fertilizer + agrochemicals	36.37	35.17	38.80	35.56	36.32	33.92	48.31	49.47	43.75
Machine used	21.53	23.78	24.00	21.57	22.70	26.96	24.10	20.75	31.78
Electric motor + diesel engine	32.60	32.43	30.30	37.44	36.74	34.43	19.85	22.86	18.68
Total- II	90.50	91.38	93.10	94.57	95.76	95.31	92.26	93.08	94.21
Grand Total I +II	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

was greater on rice crop as compared to wheat and that was very much expected as rice crop required more energy inputs to wheat crop. Both fertilizer plus agrochemicals and electric motor plus diesel engine energy use played significant role in total commercial energy use.

Table 7 shows that contribution of these energy inputs indicated that in the class of non- commercial energy inputs, seed contributed the most in zone I whereas fertilizer contribution was the highest of the commercial energy inputs.

Seed contributed to the extent of 6.95, 6.27 and 4.97 per cent on small, medium and large farms respectively in zone I. Contribution of non-commercial energy inputs declined with the increase in size of the farms in zone I i.e. 9.50, 8.62 and 6.90 per cent on small, medium and large farms respectively. The contribution of commercial energy inputs increased with the increase in size i.e. 90.50, 91.38 and 93.10 per cent on the three different sizes of farms in zone I. In zone II, 93.10, 94.57 and 95.76 per cent contribution of commercial energy inputs was observed in small, medium and large farms respectively. Similarly, the contribution of commercial energy input increased with increase in size i.e. 92.26, 93.08 and 94.21 per cent was on small, medium and large farms respectively, in zone III.

CONCLUSION

The energy use per hectare varied significantly between different levels of efficiency and also according to the size of farms. While moving from lower level of efficiency to higher level of efficiency, as expected, per hectare use of non- commercial and commercial energy inputs decreased. In zone III, per hectare use of non- commercial energy was low as compared to zone II and zone I due to different cropping pattern among the zones. Per hectare use of commercial energy inputs was low in zone III as compared to zone I and zone II. From lower level of efficiency to higher level of efficiency and from small to medium to large farms, percent share of commercial energy increased and that of non-commercial energy decreased. Commercial energy constituted a significant part of total energy in wheat and paddy crops. Percent use of non- commercial energy at all levels of efficiency decreased with the increase in the size of farms whereas the percent use of commercial energy increased with the increase in the farm size for wheat and paddy crops in Punjab. Per hectare use of commercial and non- commercial energy was greater on rice crop as compared to wheat and that was very much expected as rice crop required more energy inputs to wheat crop. Fertilizer plus agrochemicals and electric motor plus diesel engine were the major source of commercial energy used on Punjab farms.

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Price Analysis and Forecasting of Basmati Rice Crop in Karnal District of Haryana

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ABSTRACT

The present study was conducted in Assandh and Karnal Blocks of Karnal district, Haryana which was selected purposively on the basis of maximum production under basmati rice crop. Further, four regulated markets in Karnal district, *i.e.*, Karnal, Gharunda, Assandh and Taraori markets were purposively selected for the market study. The results showed that average prices forecast for the year 2017 to be about Rs. 1567 per quintal with upper and lower limit ₹ 1567 to 1329 per quintal in Karnal market, ₹ 1652 per quintal with upper and lower limit ₹ 1652 to 1259 per quintal in Gharunda market, ₹ 1667 per quintal with upper and lower limit ₹ 1667 and 1515 per quintal in Assandh market and ₹ 1701 per quintal with upper and lower limit ₹ 1701 to 1680 per quintal in Taraori market, respectively.

Highlights

- Trend analysis for average price of basmati rice for the period of 2005 to 2016. Forecasting of basmati rice was made from the historical data using ARIMA models.

Keywords: Forecasting average price, basmati rice, ARIMA, ACF, PACF, Karnal

Market information is critical to the social and economic activities that comprise the development process. Developing economy has witnessed agricultural (green, white, yellow, blue and now rainbow), industrial and information technology revolutions. Good communication system and information system reinforce commitments to sustainable productivity. The Government of India has given more thrust on agriculture, food and information technology sectors towards achievement of economic reforms for achieving high growth rate in production (Dhankar, 2003). Marketing Information System is an interacting structure of people, equipments and procedures to arrange, analyze, evaluate, distribute, timely and right information for use by proper marketing decision makers to improve their marketing design, implementation, and control (Kotler and Keller, 2012). Singh *et al.* (2011) observed that market information and intelligence were crucial to help farmers in making appropriate marketing decisions, the data on monthly modal prices of basmati for period from January, 2000 to October, 2010 were analyzed by time series method. The estimated ARIMA model used to forecast the likely basmati prices in post-harvesting months and found that these would not increase significantly as compared to those during the harvesting. Based on this along with subjective review of traders' views and government policy, the farmers were advised not to store their produce and sell it immediately on harvesting. About half of the farmers who got this advisory followed it and got benefitted significantly as compared to those who did not make their decision accordingly and stored their produce in anticipation of fetching higher prices. Looking at the usefulness of market intelligence in raising the farm

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income especially for high value crops, there is need to strengthen the agricultural marketing intelligence component in national agricultural research system along with sanitization of agricultural extension system in this regard. The specific objective of the study was:-

1. To estimate the price forecasts and long term relationship in prices among domestic markets.

MATERIALS AND METHODS

The study is based on average prices of basmati rice in Haryana, data for the period of 2005 to 2016 were analyzed the time series methods. Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) were calculated for the data. Appropriate Box-Jenkins Auto Regressive Integrated Moving Average (ARIMA) model was fitted. Validity of the model was tested using standard statistical techniques. ARIMA (0, 1, 0) and ARIMA (1, 1, 2) model were used to forecast average prices in Karnal for one leading years. The annual data on average price for the period from 2005 to 2016 were used for forecasting the future values using ARIMA models. The ARIMA methodology is also called as Box Jenkins methodology. The Box-Jenkins procedure is concerned with fitting a mixed Auto Regressive Integrated Moving Average (ARIMA) model to a given set of data. The main objective in fitting this ARIMA model is to identify the stochastic process of the time series and predict the future values accurately. These methods have also been useful in many types of situation which involve the building of models for discrete time series and dynamic systems. But, this method was not good for lead times or for seasonal series with a large random component (Granger and Newbold, 1970). Originally ARIMA models have been studied extensively by George Box and Gwilym Jenkins during 1968 and their names have frequently been used synonymously with general ARIMA process applied to time series analysis, forecasting and control. However, the optimal forecast of future values of a time-series are determined by the stochastic model for that series. A stochastic process is either stationary or non-stationary. The first thing to note is that most time series are non-stationary and the ARIMA model refer only to a stationary time series. Since, the ARIMA models refer only to a stationary time series, the first stage of Box-Jenkins model is reducing non-stationary series to a stationary series by taking first order differences.

The main steps in setting up a Box-Jenkins forecasting model are as follows:

Step 1: Identification

Appropriate value of p,d and q are found first. The tools used for identification are the Autocorrelation Functions (ACF) and Partial Autocorrelation Functions (PACF).

The ARIMA process has the algebraic form:

$$Y_t = C + \phi_t Y_{t-1} + \phi_2 Y_{t-2} + \dots\dots\dots + \phi_p Y_{t-p} - \theta_1 a_{t-1} - \theta_2 a_{t-2} \dots\dots\dots\dots \theta_q a_{t-q} + a_t$$

Where, C is a constant term related to the mean of the process. This is called a mixed auto regressive moving average model of order (p, q). It contains both AR and MA terms.

The general functional forms of ARIMA model used are:

(i) Moving Average model of order q; MA (q)

$$Y_t = C - \sum_{i=1}^{a} \theta_i a_{t-i} + a_t$$

Where, a_t belongs to NID (0, σ^2_a)

(ii) Autoregressive model of order p; AR (p)

$$Y_t = C - \sum_{j=1}^{p} Y_{t-i} + a_t$$

(iii) Autoregressive Moving Average Model ARMA (p, q)

$$Y_t = C + \sum_{j=1}^{p} \phi_j Y_{t-j} - \sum_{i=1}^{a} \theta_i a_{t-t} + a_t$$

(iv) Autoregressive Integrated Moving Average Model ARIMA (p, d, q)

$$\phi_p (B) \Delta^d Y_t = C + \theta_q(B) a_t$$

(v) Seasonal ARIMA model ARIMA (p, d, q) (P,D,Q)^s

$$\phi_p (B) \phi^*_p (B^s) \Delta^d \Delta^{sD} Y_t = \phi^*_Q(B^s) \theta_q(B) a_t$$

Where,

Y_t = Variable under forecasting

B = Lag operator

a = Error term (Y_t–Y_t, where Y_t is the estimated value of Y_t)

t = time subscript

$\phi_p(B)$ = Non-seasonal AR

$\phi^*_p(B^s)$ = seasonal AR operator

$(1-B)^d$ = Non-seasonal difference

$(1-B^s)^d$ = seasonal difference

$\theta_q(B)$ = Non-seasonal MA

$\phi^*_p(B^s)$ = seasonal MA operator

s = order of season (4 in quarterly data, 12 in monthly data etc.)

The above model contains p+q+P+Q parameters, which need to be estimated. The model is non-linear in parameters.

Step 2: Estimation

For estimating the parameters of the ARIMA model, the algorithm is as follows:

For p, d, q, P, D and Q each = 0 to 2

Execute SPSS ARIMA with the set parameters.

Record the parameters and corresponding fitting error until all possible combinations are tried. Select the parameters that produce the least fitting error. This algorithm tries all combinations of parameters, which are limited to an integer lying between zero and two. The combination with the least fitting error will be searched. The range limitations of the parameters are set to restrict the searched to a reasonable scope. Parameters greater than two are rarely used in practices as per literature.

Step 3: Diagnostic checking

Having chosen a particular ARIMA model and having estimated its parameters the fitness of the model is verified. One simple test is to see if the residuals estimated from the model are white noise, if not we must start with other ARIMA model. The residuals were analyzed using Box- Ljung statics.

Step 4: Forecasting

One of the reasons for the popularity of the ARIMA modeling is its success in forecasting. In many cases, the forecasts obtained by this method are more reliable than those obtained from the traditional econometrics modeling, particularly for short–term forecasts. An Autoregressive Integrated Moving Average process model is a way of describing how a time series variable is related to its own past value. Mainly an ARIMA model is used to produce the best weighted average forecasts for single time series (Rahulamin and Razzaque 2000). The accuracy of forecasts for both Ex-ante and Ex-post were using the following test (Markidakis and Hibbon, 1979) such as Mean absolute percentage error (MAPE).

RESULTS AND DISCUSSION

In this study, we used the data average prices for the period 2005 to 2016. As we have earlier stated that development of ARIMA model for any variable involves four steps: Identification, Estimation, Verification and Forecasting. Each of these four steps is now explained for basmati rice average prices as follows.

Model Identification

For forecasting Basmati rice average price, ARIMA model estimated only after transforming the variable under forecasting into a stationary series. The stationary series is the one whose values over time only around a constant mean and constant variance. In this difference of order 1 was sufficient to achieve stationarity in mean. The newly constructed variable X_t can now be examined for stationary. The graph of X_t was stationary in mean. The next steps are to identify the values of p, d and q. For this, the auto correlation and partial auto correlation coefficients of various orders of X_t are computed. The model statistics showing goodness fit for Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), Normalized Bayesian Information Criterion (Normalized BIC), Ljung-Box statistics are depicted in Table 1. The Box-Ljung statistics of ARIMA model for cotton in Karnal, Gharunda, Assandh and Taraori markets of Karnal district are presented in Table 2 and shown significant statistics. The model statistics are given in Table 1. The table shows that the seasonal ARIMA models in orders of (0, 1, 1) (1, 1, 2) were found satisfactory for prices of Basmati rice crop.

Model Estimation and Verification

Basmati rice average prices model parameters were estimated using SPSS package. Results of estimation are reported in Table 2. The model verification is concerned with checking the residual of the model to see if they contain any systematic pattern which

Table 1: Model statistics of different markets in Karnal district of Haryana

	Karnal market			Ljung Box(18)		
Model	**RMSE**	**MAPE**	**N-BIC**	**Statisitcs**	**Df**	**Sig.**
Model (0,1,1)(1,1,2)	265.885	4.814	11.315	13.172	15	0.589
	Gharunda market			**Ljung Box(18)**		
Model	**RMSE**	**MAPE**	**N-BIC**	**Statisitcs**	**Df**	**Sig.**
Model (0,1,1)(1,1,2)	267.409	5.046	11.326	8.886	15	0.883
	Assandh market			**Ljung Box(18)**		
Model	**RMSE**	**MAPE**	**N-BIC**	**Statisitcs**	**Df**	**Sig.**
Model (0,1,1)(1,1,2)	285.146	4.974	11.455	14.561	15	0.483
	Taraori market			**Ljung Box(18)**		
Model	**RMSE**	**MAPE**	**N-BIC**	**Statisitcs**	**Df**	**Sig.**
Model (0,1,1)(1,1,2)	285.231	5.105	11.455	11.887	15	0.688

Table 2: Model parameters of different markets in Karnal district of Haryana

Karnal market					
Model	**Parameters**	**Estimated Parameters**	**Asymptotic S.E.**	**Asymptotic t-value**	**P**
	MA1	-0.098	0.088	-1.108	0.270
Model (0,1,1)(1,1,2)	SAR1	-0.841	0.149	-5.631	0.000
	SMA2	0.892	0.364	2.448	0.016
Gharunda market					
Model	**Parameters**	**Estimated Parameters**	**Asymptotic S.E.**	**Asymptotic t-value**	**P**
	MA1	-0.124	0.088	-1.401	0.164
ARIMA(0,1,1)(1,1,2)	SAR1	-0.747	0.092	-8.103	0.000
	SMA2	0.649	0.127	5.095	0.000
Assandh market					
Model	**Parameters**	**Estimated Parameters**	**Asymptotic S.E.**	**Asymptotic t-value**	**P**
	MA1	-.030	0.089	-0.337	0.737
Model (0,1,1)(1,1,2)	SAR1	-.834	0.188	-4.428	0.000
	SMA2	.988	4.086	0.242	0.809
Tararori market					
Model	**Parameters**	**Estimated Parameter**	**Asymptotic S.E.**	**Asymptotic t-value**	**P**
	MA1	-0.021	0.089	-0.232	0.817
Model(0,1,1)(1,1,2)	SAR1	-0.841	0.133	-6.305	0.000
	SMA2	0.845	0.252	3.359	0.001

still can be removed to improve on the chosen ARIMA. This is done through examing the auto correlations and Partial auto correlations of the residuals of various orders. The ACF and PACF of residual also indicate good fit of the model. The time series plot of the residual showed a scattered trend, therefore, models were fitted properly by residual analysis. The model parameters have been presented in Table 2. The results showing that there was no transformation accounted for the model fitting. It is showing that none of series was found stationary and having volatile trend. In Karnal, Gharunda and Tarori markets, the data set only first order differentiation was found to be fit and seasonal AR(p) of Lag 1 and seasonal MA(q) of Lag 2 were fitted with the degree of differentiation. From Assandh market the data set only first order differentiation was found to be fit and seasonal AR(p) of Lag 1 were fitted with on degree of differentiation. The tentative models were identified based on Autocorrelation functions (ACF) and Partial Autocorrelation functions (PACF) at fixed interval, showing significant for price of basmati rice crop in Karnal district markets (Table 3 to 6).

Forecasting with Arima Model

ARIMA models are developed basically to forecast the corresponding variable. To judges the forecasting ability of the fitted ARIMA model important measure of the sample period forecasts accuracy was computed. Forecasting performance of the model was judged by computing Mean Absolute

Table 3: Autocorrelation and partial autocorrelation functions of average monthly prices in Karnal market of Karnal district

Autocorrelations						Partial Autocorrelations		
Lag	Autocorrelation	Std. error[a]	Box-Ljung statistic			Lag	Partial autocorrelation	Std. error
			Value	Df	Sig.[b]			
1	0.970	0.082	138.469	1	0.000	1	0.970	0.083
2	0.936	0.082	268.153	2	0.000	2	-0.102	0.083
3	0.902	0.082	389.589	3	0.000	3	0.009	0.083
4	0.875	0.082	504.552	4	0.000	4	0.082	0.083
5	0.848	0.081	613.332	5	0.000	5	-0.021	0.083
6	0.821	0.081	715.916	6	0.000	6	-0.022	0.083
7	0.792	0.081	812.240	7	0.000	7	-0.018	0.083
8	0.763	0.080	902.133	8	0.000	8	-0.039	0.083
9	0.734	0.080	985.950	9	0.000	9	-0.001	0.083
10	0.706	0.080	1064.247	10	0.000	10	0.009	0.083
11	0.685	0.080	1138.478	11	0.000	11	0.081	0.083
12	0.667	0.079	1209.379	12	0.000	12	0.028	0.083
13	0.637	0.079	1274.414	13	0.000	13	-0.233	0.083
14	0.608	0.079	1334.280	14	0.000	14	0.088	0.083
15	0.587	0.078	1390.487	15	0.000	15	0.106	0.083
16	0.569	0.078	1443.652	16	0.000	16	-0.036	0.083

Table 4: Autocorrelation and partial autocorrelation functions of average monthly prices in Gharunda market of Karnal district

Autocorrelations						Partial autocorrelations		
Lag	Autocorrelation	Std. error[a]	Box-Ljung statistic			Lag	Partial autocorrelation	Std. error
			Value	Df	Sig.[b]			
1	0.969	0.082	138.092	1	0.000	1	0.969	0.083
2	0.932	0.082	266.767	2	0.000	2	-0.116	0.083
3	0.898	0.082	387.013	3	0.000	3	0.035	0.083
4	0.870	0.082	500.711	4	0.000	4	0.078	0.083
5	0.842	0.081	608.019	5	0.000	5	-0.032	0.083
6	0.815	0.081	709.129	6	0.000	6	-0.002	0.083
7	0.786	0.081	803.926	7	0.000	7	-0.026	0.083
8	0.756	0.080	892.170	8	0.000	8	-0.043	0.083
9	0.727	0.080	974.495	9	0.000	9	0.022	0.083
10	0.701	0.080	1051.595	10	0.000	10	0.012	0.083
11	0.681	0.080	1124.837	11	0.000	11	0.072	0.083
12	0.663	0.079	1194.803	12	0.000	12	0.019	0.083
13	0.630	0.079	1258.443	13	0.000	13	-0.264	0.083
14	0.598	0.079	1316.332	14	0.000	14	0.086	0.083
15	0.573	0.078	1369.876	15	0.000	15	0.069	0.083
16	0.552	0.078	1419.904	16	0.000	16	-0.022	0.083

Table 5: Autocorrelation and partial autocorrelation functions of average monthly prices in Assandh market of Karnal district

Autocorrelations						Partial autocorrelations		
Lag	Autocorrelation	Std. error[a]	Box-Ljung statistic			Lag	Partial autocorrelation	Std. error
			Value	Df	Sig.[b]			
1	0.969	0.082	138.140	1	0.000	1	0.969	0.083
2	0.936	0.082	267.807	2	0.000	2	-0.062	0.083
3	0.904	0.082	389.673	3	0.000	3	0.013	0.083
4	0.877	0.082	505.162	4	0.000	4	0.059	0.083
5	0.850	0.081	614.385	5	0.000	5	-0.022	0.083
6	0.822	0.081	717.269	6	0.000	6	-0.024	0.083
7	0.794	0.081	813.984	7	0.000	7	-0.007	0.083
8	0.764	0.080	904.202	8	0.000	8	-0.051	0.083
9	0.737	0.080	988.781	9	0.000	9	0.034	0.083
10	0.709	0.080	1067.744	10	0.000	10	-0.030	0.083
11	0.687	0.080	1142.385	11	0.000	11	0.071	0.083
12	0.668	0.079	1213.409	12	0.000	12	0.033	0.083
13	0.639	0.079	1278.860	13	0.000	13	-0.179	0.083
14	0.611	0.079	1339.314	14	0.000	14	0.048	0.083
15	0.592	0.078	1396.434	15	0.000	15	0.115	0.083
16	0.574	0.078	1450.577	16	0.000	16	-0.033	0.083

Table 6: Autocorrelation and partial autocorrelation functions of average monthly prices in Taraori market of Karnal district

Autocorrelations						Partial autocorrelations		
Lag	Autocorrelation	Std. error[a]	Box-Ljung statistic			Lag	Partial autocorrelation	Std. error
			Value	Df	Sig.[b]			
1	0.967	0.082	137.570	1	0.000	1	0.967	0.083
2	0.932	0.082	266.134	2	0.000	2	-0.060	0.083
3	0.896	0.082	385.905	3	0.000	3	-0.019	0.083
4	0.868	0.082	498.951	4	0.000	4	0.090	0.083
5	0.840	0.081	605.668	5	0.000	5	-0.010	0.083
6	0.812	0.081	706.103	6	0.000	6	-0.023	0.083
7	0.784	0.081	800.453	7	0.000	7	-0.001	0.083
8	0.755	0.080	888.642	8	0.000	8	-0.029	0.083
9	0.726	0.080	970.817	9	0.000	9	-0.018	0.083
10	0.698	0.080	1047.347	10	0.000	10	0.000	0.083
11	0.679	0.080	1120.240	11	0.000	11	0.116	0.083
12	0.663	0.079	1190.293	12	0.000	12	0.031	0.083
13	0.633	0.079	1254.573	13	0.000	13	-0.245	0.083
14	0.605	0.079	1313.777	14	0.000	14	0.073	0.083
15	0.582	0.078	1369.015	15	0.000	15	0.085	0.083
16	0.563	0.078	1421.064	16	0.000	16	-0.022	0.083

[a] - The underlying process assumed is independence (white noise); [b] - Based on the asymptotic chi-square approximation.

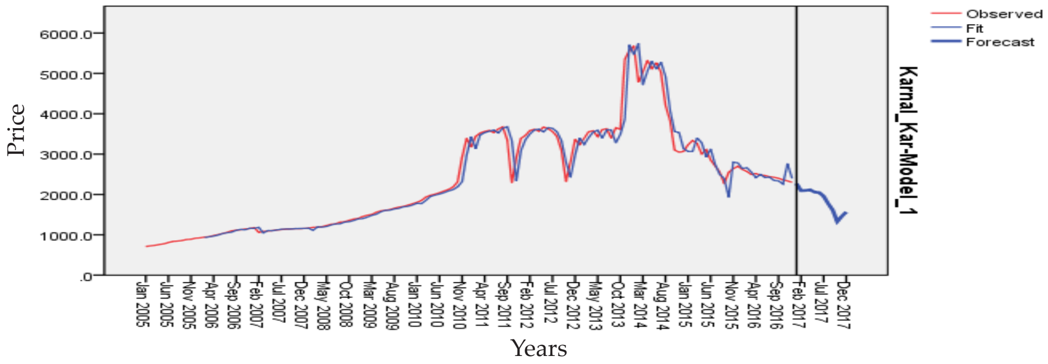
Percent Error (MAPE). The model with less MAPE was preferred for forecasting purposes. Forecasting was done through indentified models for the variable prices of Basmati rice crop in selected district markets. Using the obtained model, the ex-post forecasted values, considering the January 2005 to December 2016 were computed and have been presented in Fig. 1 to 4. The figs. observed that the forecasted of price in Karnal, Gharunda, Assandh and Taraori markets moved in same direction with observed values.

Price forecasts for basmati rice

The price forecasts in main market of Karnal district, *i.e.,* Karnal market obtained for the year 2017 for arrival season in September to December were observed between ₹ 1567 to 1329, ₹ 1652 to 1259 in Gharunda market, ₹ 1637 to 1515 in Assandh market and ₹ 1701 to 1680 per quintal in Taraori market. While, in the forecasts for the remaining months, *i.e.*, from January to August were in the range ₹ 2269 to 1615 in Karnal market, ₹ 2215 to 1593 in Gharunda market, ₹ 2314 to 1637 in Assandh market and ₹ 2304 to 1680 per quintal Taraori market. Therefore, it is advisable to the farmers to store their produce and sell in the months where they realize the better/ higher price (Figs. 1 to 4).

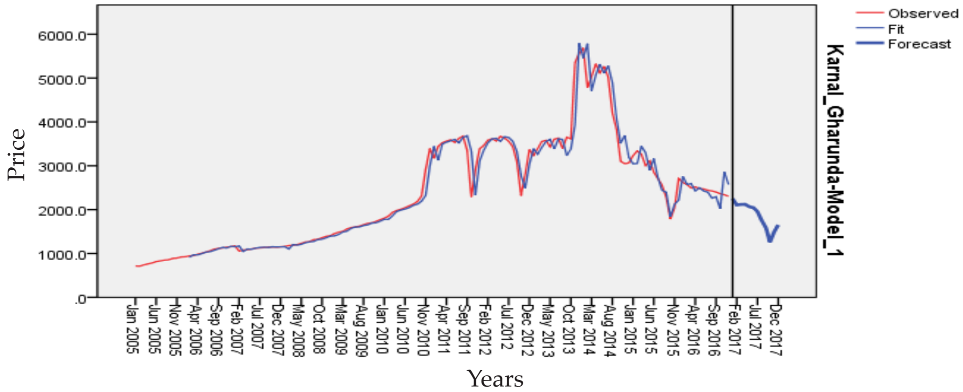
Co-integration between selected markets for basmati rice agricultural commodities in Karnal district of Haryana (at zero order integration)

Co-integration is a statistical property obtained by given time series data set that is defined by the concepts of stationarity and the order of integration of the series. The stationary series is one with a mean value which will not change during the sampling period. For an illustration, the mean of a subset of a given series does not vary significantly from the mean of any other subset of the same series. Further, the series will constantly return to its mean value as fluctuations occur. In other words, a non-stationary series will shows a time-varying mean. The order of integration of a series is given by the number of times the series must be differenced in order to produce a stationary series. Co-integration analysis was carried out to study the long run relationship of average price of basmati rice for Karnal districts in all four markets. The Dickey-Fuller test was used to study the order co-integration of prices among different markets.



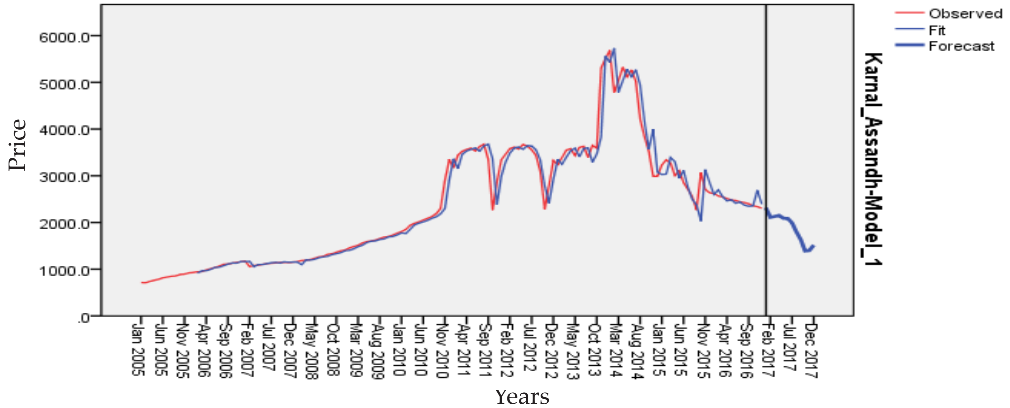
Month	Jan.-2017	Feb.-2017	Mar.-2017	Apr.-2017	May-2017	Jun.-2017	Jul.-2017	Aug.-2017	Sep.-2017	Oct.-2017	Nov.-2017	Dec.-2017
Prices ₹/q	2269	2094	2099	2117	2057	2046	1957	1771	**1615**	**1329**	1454	1567

Fig. 1: Forecasting of Basmati rice for average monthly price of Karnal market for Karnal district (Main market)



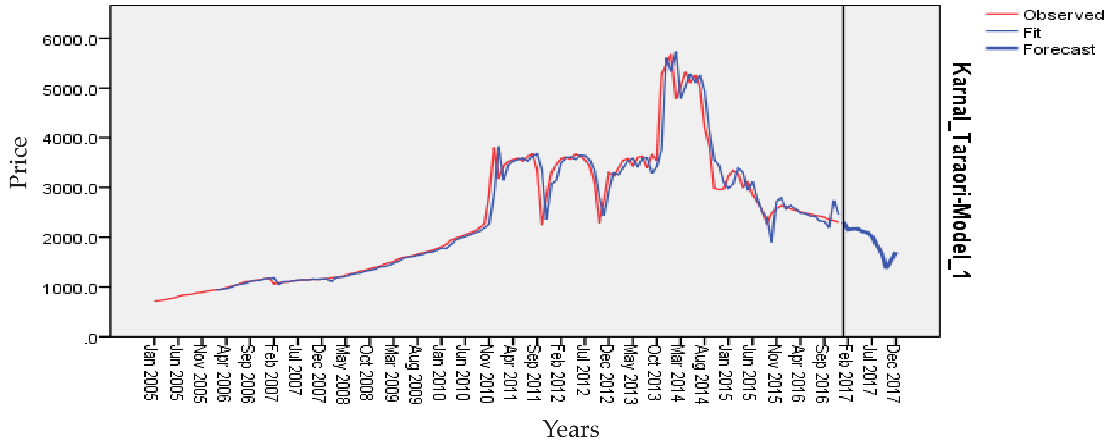
Month	Jan.-2017	Feb.-2017	Mar.-2017	Apr.-2017	May-2017	Jun.-2017	Jul.-2017	Aug.-2017	Sep.-2017	Oct.-2017	Nov.-2017	Dec.-2017
Prices ₹/q	2215	2107	2118	2121	2067	2045	1954	1751	**1593**	**1259**	**1487**	**1652**

Fig. 2: Forecasting of Basmati rice for average monthly price of Gharunda market for Karnal district (Reference market)



Month	Jan.-2017	Feb.-2017	Mar.-2017	Apr.-2017	May-2017	Jun.-2017	Jul.-2017	Aug.-2017	Sep.-2017	Oct.-2017	Nov.-2017	Dec.-2017
Prices ₹/q	2314	2110	2129	2150	2090	2086	1992	1800	**1637**	**1390**	**1401**	**1515**

Fig. 3: Forecasting of Basmati rice for average monthly price of Assandh market for Karnal district (Main market)



Month	Jan.-2017	Feb.-2017	Mar.-2017	Apr.-2017	May-2017	Jun.-2017	Jul.-2017	Aug.-017	Sep.-2017	Oct.-2017	Nov.-2017	Dec.-2017
Prices ₹/q	2304	2150	2168	2169	2113	2097	2012	1832	**1680**	**1374**	**1534**	**1701**

Fig. 4: Forecasting of Basmati rice for average monthly price of Taraori market for Karnal district (Reference market)

Table 7: Co-integration between selected markets for basmati rice selected agricultural commodities in Haryana

Name of district	Name of Market	Name of Crops	Dickey-Fuller test	Dickey-Fuller value	Order of integration
Karnal	Karnal	Basmati rice	-1.407	-0.836	0
	Gharunda		-1.417	-0.836	0
	Assandh		-1.421	-0.836	0
	Taraori		-1.467	-0.836	0

The Table 7 revealed that dickey-fuller test 'tau' was found highly significant for all the Karnal district markets of the basmati rice. That is clearly shown that there is a long relationship and this shows that the price will remain constant over the change of time.

In our study, the developed model for average prices for basmati rice in Karnal district was found to be ARIMA (0, 1, 0) (1, 1, 2) respectively. From the forecast variable by using the developed model, it can be seen that forecasted average price increases the next years. The validity of the forecasted value can be checked when data for the lead periods become available. The model can be used by researchers for forecasting average prices in Karnal. However, it should be updated from time to time with incorporation of current data.

CONCLUSION

In this study the development model for average prices for basmati rice in Karnal district was found to be ARIMA (0,1,0) (1,1,2) respectively. From the forecast variable by using the developed model, it can be seen that forecasted value can be checked when data for the lead periods become available. The model can be used by researchers for forecasting average prices in Karnal. However, it should be updated from time to time with incorporation of current data.

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Resource Use Efficiency and Constraint Analysis of Summer Mungbean Cultivation in Rice-Wheat Cropping System

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ABSTRACT

The study was conducted in eastern and western zones of Haryana in 2017-18. From eastern zone Kurukshetra and Panipat and from western zone Hisar district were selected on basis of acreage under summer mungbean. The outcomes of production function analysis reveal that there is scope for reorganization of resources used in cultivation of summer mungbean to optimize their use to enhance returns in the study area. In all the districts, the usage of resources which are showing negative production elasticity should be decreased to achieve the resource optimality and the use of resources viewing more than unity production elasticity should be encouraged to enhance the profitability condition. The analysis of constraints in cultivation of summer mungbean as opined by the sampled farmers recite that non-availability of suitable machine for harvesting, non-procurement of produce by Govt. agencies, harvest price less than MSP were recorded as the major constraints in the study area. Keeping in view the findings of the study, it is suggested that there is need to re-orient the usage of resources for attaining higher returns from summer mungbean cultivation, multiplication of short duration varieties seed, need to develop suitable and low cost harvesting machinery and procurement arrangement of produce at MSP.

Highlights

- There is need to develop suitable harvesting machinery and incentivise it for faster adoption and assured procurement of produce at MSP by the govt. agencies. There is need for adequate availability of seed of short duration varieties of 55-60 days like Virat (IPM25) and SML 668 for promotion in rice-wheat growing areas to suit best in existing space available in summer season.

Keywords: Resource Use Efficiency, Marginal Value Product, Marginal Factor Cost, Minimum Support Price, Return to scale, Elasticity of production, B:C Ratio

Pulses are important for nutritional security and for alleviating malnutrition among the poor masses in India. These are rich sources of energy, dietary fibre, protein, minerals and vitamins as required for human health. In addition, pulses also contain significant amounts of other essential nutrients like calcium, iron and lysine (Gowda *et al*. 2013). Recent research studies suggested that consumption of pulses may have potential health benefits by reduced risk of many chronic diseases like cardiovascular diseases, cancer, diabetes, osteoporosis, hypertension and gastrointestinal disorders (Jacobs and Gallaher, 2004). Mungbean requiring low input, short duration pulse crop fits very well in the rice-wheat cropping system during summer season in Haryana. After harvesting of wheat, fields remain vacant for 65-70 days till planting of succeeding crop *i.e.* rice. There is huge potential of cultivation short cultivars of pulses like mungbean by utilizing fallow land. No doubt cultivation of summer mungbean helps to generate additional farm income with short time span but also to overcome shortage of pulses, improve/

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maintain soil fertility and avoid early planting of rice for saving of irrigation water. Mungbean adds 33-37 kg of nitrogen (N) to the soil after harvest and thus helps in saving of about 25 per cent nitrogen for the succeeding crop (Sekhon *et al.* 2007). The leading pulses states i.e.Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan and Andhra Pradesh contributed over 75 per cent of total pulses production in India. Madhya Pradesh is the highest pulse-producing state (3.2 million tonnes/annum) followed by Maharashtra and Uttar Pradesh. In terms of productivity, Haryana has the highest yield of 824 kg/ ha followed by Madhya Pradesh, Uttar Pradesh and Bihar (Gowda *et al.* 2013). No doubt, the share of pulses to total food-grain production in the country in terms of area and production has declined since with evolution of high viewing cultivars of food crops like wheat and paddy. The continuous decline in production level forced the country to import pulses of around 4-5 million annually to meet demand of vegetarian population. The higher price of pulses in domestic and international markets caused attention for enhancing production of pulses in the country in 12th Plan by cultivating pulses in fallow areas, replacing less remunerative crops like coarse cereals, inclusion of pulse crop as catch crop in existing cropping systems as well as productivity enhancement through adoption of improved production technologies. Further, higher increase in MSP of pulses, procurement arrangement through government agencies and incentivization of pulses cultivators led to record production of 25.42 million tonnes of pulses in the country. However, still the productivity level of pulses (853 kg ha^{-1}) in India is far below than global average productivity (1023 kg ha^{-1}) due to low adoption of improved cultivars, cultivation of poor fertility, less use of nutrients etc (Anonymous, 2017-18).

In Haryana, the cropping pattern twisted towards rice and wheat due to profitability, amount of risk involved, procurement at MSP and expanded irrigated facilities. The area under pulses was 1150 thousand ha. at the time of formation of state in 1966 reduced to level 72.20 thousand ha in 2017-18 due to low profitability of pulse crops (Statistical Abstract of Haryana, 2017-18). The prevailing rice-wheat system in the state resulted into contamination and depletion of ground water, stagnation in yield level, deterioration of soil health, heavy occurrence of biotic stresses etc. has posed threat to sustainability of cultivation of crops in future. Keep in view; the inclusion of pulses in existing cropping systems in the state is only option at one hand for improving soil fertility and use of recommended doses of inputs and use of quality seed on other hand to improved productivity level of pulses. Therefore, the paper is attempted to analyse the extent of resources use and constraints in cultivation of summer mungbean in Haryana.

MATERIALS AND METHODS

The present study was confined to one district (Hisar) from western zone and two districts (Kurukshetra and Panipat) from eastern zone of the state on basis of acreage under summer mungbean. Form each identified district, 20 mungbean cultivators of three villages were selected randomly from the list of mungbean growers incentivized by State Department of Agriculture & Farmers' Welfare and Krishi Vigyan Kendras of CCS Haryana Agricultural University. The relevant information pertaining to various resources like seed, farm machinery, human labour, irrigation, farm operation etc. were extracted from personal interaction with cultivators using well-structured interview schedule.

Analytical tools

Cobb-Douglas function was employed with four exogenous variables i.e. human labour (X_1), machine labour (X_2), seed (X_3), irrigation (X_4) in monetary term. The model adopted was as follows:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + \ln \mu$$

Y = Returns (per hectare in ₹)

a = Intercept

X_1 = Human labour

X_2 = Machine labour

X_3 = Seed

X_4= Irrigation

b_1 to b_4 = Respective elasticity co-efficients

Returns to scale (RTS) was calculated by summing production elasticities of all the inputs ($\sum bi$). If, $\sum bi$: = 1, $\sum bi$: > 1 and $\sum bi$: < 1 it indicates constant, increasing and decreasing returns to scale.

Marginal value productivity (MVP) indicates the expected increase in gross returns forthcoming from the use of an additional unit of relevant input, while the level of other inputs remaining unchanged.

A resource or input factor is considered to be used most efficiently if its marginal value product (MVP) is just sufficient to offset its input marginal cost (IMC). Equality of MVP to factor cost is the basic condition that must be satisfied for resource use efficiently. If the ratio of MVP to IMC is less than one, it indicates that excess use of the particular resource is being used under the existing price conditions and vice versa. Resource-use efficiency is worked out by computing the difference of MVP to opportunity cost.

A list of all the important constraints in summer mungbean was prepared with help of literature, scientists of various departments of university, development officials, progressive farmers etc. Thus, a opinion of 60 respondents were recorded to elicit the major constraints in the cultivation of mungbean. The collected data were tabulated and analysed using Garrett ranking technique to interpret the obtained result.

Garrett's Ranking Technique

To find out the most significant factor which influences the respondent, Henry Garrett's (1969) ranking technique was used. As per this method, respondents have been asked to assign the rank for each constraints and the outcome of such ranking has been converted into score value with the help of the following formula:

$$\text{Percent position} = \frac{100(Rij - 0.3)}{Nj}$$

Where;

Rij = Rank given for the ith variable by jth respondents

Nj = Number of variable ranked by jth respondents

With the help of Garrett's table, the per cent position estimated is converted into scores. Then for each factor, the scores of each individual are added and then total value of scores and mean values of score is calculated. The factors having highest mean value is considered to be the most important factor. The final ranking of the factor in order to fix their relative priority was done on the basis of their mean score.

RESULTS AND DISCUSSION

The decision for use of a particular resource in cultivation of farm enterprise is very pertinent for attaining optimum yield with incurring least expenses on procurement of input. The wisdom of cultivator lies on level of use of resources, their purchase at reasonable price, timely application of resources and follow up recommended agronomic practices for realizing higher returns from cultivation of farm enterprise. The resource use analysis give an idea about usage of resources and needs to improve the use of particular resource for increasing returns from farm business.

Therefore, based on data collected from mungbean growers of three districts; Hisar, Kurukshetra and Panipat, Cobb Douglas production function was employed to determine the efficiency level of individual resource used. The resources like seed, human labour, machine labour and irrigation were identified as major contributing exogenous variables in cultivation of mungbean. The production function analysis fitted for resource use in study area districts reveals that the regression co-efficients of human labour and irrigation resources were positive and machine labour and seed were negative for Kurukshetra and Hisar districts (Table 1). Whereas in case of Panipat district, human labour and machine labour were positive while seed and irrigation were negative.

Table 1: Resource use efficiency of summer mungbean in Haryana

	Kurukshetra district				
Particulars	**GM**	**Bi**	**MVP**	**MFC**	**r**
Constant	1093616				
Human labour	2365.37	0.36**	2.88	1	2.88
Machine labour	3467.77	-0.65**	-3.51	1	-3.51
Seed cost (Kg)	996.70	-0.24	-4.46	1	-4.46
Irrigation	832.12	0.04**	0.09	1	0.09
R-square value :	0.479				
RTS = ∑bi = -0.52 = Decreasing return to scale, (Over-utilization of resources)					
Particulars	**Panipat district**				
	GM	**Bi**	**MVP**	**MFC**	**r**
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 (Kg)	880.27	-0.06	-1.23	1	-1.23
Irrigation	912.99	-0.005	-0.09	1	-0.09
R- square value	0.94				

RTS=∑bi = 0.38= Decreasing return to scale, (Over-utilization of resources)

Particulars	Hisar district				
	GM	Bi	MVP	MFC	r
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 (Kg)	647.40	-0.34	-8.39	1	-8.39
Irrigation	1212.71	0.03**	0.42	1	0.42
R- square value	0.68				

RTS=∑bi = -0.63= Decreasing return to scale, (Over-utilization of resources)

In Kurukshetra and Hisar districts, human labour and irrigation coefficients were found to be statistically significant at 5 per cent level. While in case of Panipat district, human labour and machine labour were found to be statistically significant at 5 per cent level. This implied that every five per cent increase in human labour and irrigation would increase gross return by 0.36 and 0.04 per cent for Kurukshetra, 0.02 and 0.03 per cent for Hisar, respectively. While in case of Panipat human labour and machine labour would increase gross return by 0.29 and 0.16 per cent, respectively. Whereas all other resource coefficients were non-significant indicating that expenditure on these inputs were of not much influence on total returns attained from cultivation of mungbean .The summation of regression coefficients worked out for Kurtukshetra, Panipat and Hisar districts to be -0.52, 0.38 and -0.63, respectively indicates decreasing returns to scale. The estimated co-efficient of multiple determinations (R^2) revealed that selected inputs (human labour, machine labour, seed cost and irrigation) were capable of explaining 47.90, 94.70 and 68.20 per cent variation in summer mungbean production in Kurukshetra, Panipat and Hisar districts, respectively.

The human labour for Kurukshetra (2.88) and Panipat (1.99) were greater than unity. It indicates that the human labour was underutilized in both the districts. Hence, there is needed to be increase the use of inputs to attain optimum level of output. On the other side, the ratios of MVP to MFC were less than unity for machine labour, seed and irrigation for Kurukshetra, Panipat and Hisar districts. It reflects that all the inputs 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 mungnean resulted into higher yield while reduce the use of over utilized inputs caused in reduction of expenses incurred. This ultimately stemmed into higher profitability from cultivation of mungbean. Similar results were obtained by Saikumar *et al.* (2013) in their study.

Constraints faced in cultivation of summer mungbean

Although mungbean cultivation in study area is getting momentum with sincere effort of development officials and research scientists but still mungbean cultivation is facing several hindrance for attaining potential yield and large area coverage. The constraint analysis of mungbean cultivation was done using theGarrett's ranking technique for 60 sampled farms and on basis of scores, the rank of particular constraint was decided. The feedback of mungbean cultivators in study area indicates that non-availability of suitable harvesting machine was most important constraint due to shortage and higher wages of labour as well as delay in timely harvesting of crop and timely planting of succeeding crop.

The constraints as ranked on basis of information extracted form mungbean cultivators in order of priority were non-procurement of produce by Govt. agencies, harvest price less than Minimum Support Price (MSP), shortage of labour for harvesting operation, inadequate availability of quality seed.

The other hindrances noticed in interaction of mungbean cultivators at field level were, lack of market information, inferior quality of seed purchased from different sources, non-availability of seed of short duration varieties, stray animals, poor demand of produce in market, synchronous maturity etc. of crop at rank fourth, fifth, sixth, seventh, eighth, ninth, tenth and eleventh with total score 659, 513, 464, 447, 439, 420, 373 and

Table 2: Constraints faced by the mungbean growers in Haryana

Sl. 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	Non-purchase of produce by Govt. agencies	242	2	242	2	244	2	728	2
3	Harvest price is 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	Non-availability of quality seed	170	5	170	4	173	5	513	5
6	Lack of market information.	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	Cultivation of mungbean delays the sowing of next crop	34	14	34	14	35	14	103	14

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 study area s and overall basis with a total score 239, 156, and 103, respectively (Table 2). Similar outcome were obtained by Bhatia, (1991) and Grover, *et al.* (2005) in their respective study.

CONCLUSIONS AND POLICY IMPLICATIONS

The results of production function analysis unveils that there is scope for reorganisation of resources to optimise their use to enhance returns in the study area. In all the districts, the use of resources which are showing negative production elasticity should be decreased to achieve the optimality in the resource use and the use of resources showing more than unity production elasticity should be encouraged to enhance the profitability condition. The analysis of constraints encountered by the sampled farmers in reveals that non-availability of suitable machine for threshing, non-procurement of produce by Govt. agencies, less remunerative price were found the foremost constraints in the study area. Keeping in view, the findings of the study, it is suggested that cultivation of summer mungbean cultivation and efficient utilization of resources should be encouraged. There is need to develop suitable harvesting machinery and incentivise it for faster adoption and procurement arrangement of produce at MSP by the govt. agencies. There is urgent need for multiplication of seed of short duration varieties of 55-60 days like Virat (IPM25) and SML 668 for promotion in rice-wheat growing areas to suit best inexisting space available in summer season.

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Inter-Linkage between Credit Source and Marketing Pattern of Farm Produce

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ABSTRACT

The present study has been undertaken in three agro-economic zones of Punjab to examine the linkages between the credit source and marketing pattern of farm produce. Multistage random sampling technique was used for the selection of 90 farmers. Inter-linkages between the source of credit and marketing pattern refer to the inter-linkage between farmers and moneylender indulged in trading activities. Majority of the sampled farmers i.e. 65 per cent were found trapped in linked transactions. Participation of medium farmers in linked credit contracts was found to be higher i.e. 72.22 per cent as compared to large (57.14%) and small farmers (51.72%). Credit-input-product inter-linkage emerged as dominant type in the study area i.e. 33.33 per cent followed by credit-product type (31.11 per cent).

Highlights

- It was concluded that there were inter-linkage between the source of credit and marketing pattern of farm produce among the sampled farmers.
- Participation of medium farmers in linked credit contracts was found to be higher due to large size of marketable surplus.

Keywords: marketing pattern, farm produce,credit,linkages

Existence of inter linkages among the land, labour, credit and product markets is one of the often noted feature of less developed agrarian economies. The functioning of informal credit market in the rural credit system leads to development of linkages with other markets such as labour, input, output and land lease market (Bell *et al.* 1988 and Reddy, 1992). Inter-linkage between the source of credit and market produce refers to the linkage between farmers and moneylenders indulged in trading activities. These moneylenders may be landlords who finance his tenants or workers engaged on land; he may be a trader called commission agent in modern nomenclature, financing the cultivator only to obtain exclusive rights to purchase his crop; or he may be an input dealer who lent money on the condition that inputs for cultivation were purchased only from him. The concept of inter-linkage has probably been borrowed from anthropology, where the multi-stranded nature of relationships in small, face-to-face communities has often been emphasized. Such societies have been called multiplex, and multiplex relationships between the same economic agents in poor agrarian community are often described as interlinked contracts encompassing several markets, particularly those of land, labour and credit (Gill, 2004).

Inter-linked transaction is the one that involves the individuals in trade, in at least two markets to join on the condition that the terms of all trade transactions between them are jointly determined (Bardhan, 1980 and Bell, 1988). The nature of linkages depends on the relative bargaining power of the parties involved

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in the credit transactions, relative urgency of availing credit and availability of alternative source of credit. Hence, the linkage may be either beneficial to both the parties involved in credit transaction or disadvantageous to the weaker party (Reddy, 1992).

The pattern and consequences of inter linked credit markets have been a subject of controversy for quite some time. There were two major arguments on the effect of inter linkages. One was that the inter linkages have been utilized as an exploitive device by stronger parties to extract surplus out of the weaker ones (Bhaduri, 1986; Bharadwaj, 1974). The other one, while rejecting inter linkage being necessarily exploitive, explained it's rationale in terms of information asymmetry and uncertainty (Braverman and Stiglitz, 1982). It has also been used as enhanced enforcement device for execution of contracts and reducing the transaction costs in the requirement of wage labourers (Bardhan, 1984 and Ray, 1998). Further, it has been pointed out that inter linking is a flexible market response to growing commercialization (Bell and Srinivasan, 1989).

Moneylender provides tied loan to the farmers, who finances the cultivator with some binding to buy the output or sell the inputs or to get assured supply of labour. This observation about the dual role of the moneylender is not new, References having been made to it, wayback as in 1925 by Darling. Moneylenders further sell this produce to the government agencies. Payment on sale of crop is also made through moneylenders, who deduct their loan amount before finally paying to the cultivators their returns. In this way credit gets linked with the output .These links have got strengthened with growing commercialization in agriculture of Punjab. In this way, commission agents have displayed a greater foresight than institutional sources of finance, and inter linkages have been continuously emerging between rural credit market and input/product markets. So, the purpose of this study was to have an in depth analysis of these inter-linkages in the state.

MATERIAL AND METHODS

The present study was conducted in all the three agro-economic zones of Punjab state during the year 2015-16. Multistage random sampling technique was used to select the respondent farmers. At first stage, one district was selected randomly from the each zone. Shaheed Bhagat Singh Nagar (erstwhile Nawanshahr) was selected from the Zone-I i.e. sub-mountainous zone, Barnala was selected from the Zone-II which is the central zone and Bathinda was selected from the Zone-III i.e. south-western zone of the state. At the second stage of sampling, one block was selected from the selected district. At next stage two villages were selected from each selected block. At the last stage, fifteen farmers were selected from each village falling under three categories based on the size of operational holding defining small (up to 5 acres), medium (>5 acres up to 25 acres) and large (>25 acres) farmers. Thus, a sample of 90 farmers covering six villages, three blocks and three districts of Punjab was finally chosen for the ultimate analysis.

In order to identify the factors influencing probability of inter-linkage between credit market and input/output market, logit regression analysis was undertaken by applying the following algebraic equation:

$$\log \frac{P_i}{1-P_i} = \beta_0 + \sum_{j=1}^{k} \beta_j . X_{ij}$$

Where,

P_i = Probability of being linked

1-P_i = Probability of not being linked

This dependent variable was taken as dummy variable,

1 if the household is linked; 0 otherwise

β_0 = Constant term

X_{ij} = Explanatory variables

β_j = Regression coefficients of X_{ij}

The explanatory variables were taken as under:

X_1 = Size of operational holding (owned land + leased in-leased out)

X_2 = NFI: FI (ratio of non-farm income to farm income)

X_3 = MW: TW (ratio of male worker to total workers)

X_4 = NLIGA (amount of per capita income generated by non-land assets/day)

X_5 = General household expenditure other than routine family expenditure/day

X_6 = Education level of the head of the family (year of schooling)

RESULTS AND DISCUSSION

Socio-economic profile of sampled farm households

Socio economic profile of the sampled households clearly brought out that majority of respondent farmers (56.67 per cent) belonged up to 40 years of age group, while 54.44 per cent were having a family size up to five members. On overall basis, average size of operational holding of the sampled farmers was worked out to be 11.56 acres. Out of this, owned area comprised 9.8 acres, while leased in was 2.38 acres andleased out was only 0.62 acres. The extent of average annual net income earned by the sampled households from all sources came out to be ₹ 376354 per household comprising farm income at 91.16 per cent and rest of non-farm income. The average annual expenditure worked out to be ₹ 236303 per household of sampled farmers. On the other hand, average annual general expenditure (other than routine household expenditure including social/religious ceremonies, construction of house, major medical expenses, purchase of durables etc.) was measured at ₹ 180618 per household per annum of the sampled farmers. Out of the total general expenditure, the proportion of expenditure on marriage ceremonies was maximum at 40.48 per cent. It was found that sampled farmers were borrowing more from institutional sources for both the short and long term credit needs and commercial banks were their main suppliers of credit. Farmers were found to be selling their produce through different channels such as commission agents, directly to the consumers and to others as well (shellers, atta chakkies) in the study area. Majority of the farmers were found selling their produce through commission agents (81.11 per cent) followed by direct sale to consumers (13.33 per cent) and rest to others (5.56 per cent). The farmers who sold their produce through commission agents, were also found borrowing and purchasing inputs from them. In this way they were found to be trapped in linked contracts.

Sources of agricultural credit availed by sampled farm households

Source and category wise credit availed by sampled farms for short term credit needs has been shown in Table 1. Table 1 showed that on the overall basis, 25.56 per cent of the sampled farmers were borrowing only from institutional sources, while 14.44 per cent only from non-institutional sources and 60 per cent of the sampled farmers were found to be availing credit from both the sources. So, incidence of borrowing in terms of number of borrowers from institutional sources was found to be higher on sampled farmers as compared to non-institutional sources.

Category-wise 31.03 per cent of the small farmers were borrowing from the institutional sources whereas the respective figures for the medium and large farmers were 22.22 per cent and 28.57 per cent. On the other hand, 27.58 per cent small farmers were tapping the non-institutional sources of credit, whereas the respective figure for the medium farmers was 9.26 per cent. None of the large farmer was found to be borrowing only from non-institutional sources. In case of both (those farmers which were borrowing from both institutional as well as non-institutional sources), 41.38 per cent were in small farm category, while 68.51 per cent and 71.43 per cent in medium and large farms respectively. So, it was concluded that sampled farmers belonging to all the farm categories borrowed more from institutional source of credit for short term credit needs.

Table 1: Source and category wise sampled borrower farmers for short term credit needs in Punjab, 2015-16 (Number)

Household category	Source of borrowing		
	Institutional	**Non-institutional**	**Both**
Small	9 (31.03)	8 (27.58)	12 (41.38)
Medium	12 (22.22)	5 (9.26)	37 (68.51)
Large	2 (28.57)	—	5 (71.43)
Total	23 (25.56)	13 (14.44)	54 (60.00)

Figures in the parentheses indicate the percentages to total number of farmer of respective farm category.

Types of inter-linkages

In this section some important types of inter-linkages have been discussed which emerged between source of credit and marketing pattern of sampled farmers.

1. Credit-product linkage

It was noticed that marketing of the farm products was linked with availing of non-institutional credit. Under this system of inter-linkages, borrowers get credit from the commission agents (Arthiyas) to fulfill his production as well as consumption needs. Lenders supply credit on the condition that produce would be sold through them. The repayment of loan amount was done by selling the produce through commission agents in regulated market. In this way lender gets dual benefit, one by selling the produce on commission basis and second by charging high rate of interest from the borrower. An often noted feature of rural economies is that returns from agriculture were low and insufficient for internal financing. Under such conditions money lenders secure these clients by providing them credit on the condition that marketing of produce wouldbe routed through them. Thus, more commonly, availing of non-institutional credit turns to be a tied loan leading to credit-product inter-linkage.

2. Credit-input-product linkage

Another form of inter-linkage, associating in both backward and forward directions was found to be prevalent to a large extent in the study area. This was linking of farmers with input supply source as well as with marketing of produce through credit. Here, the lender was either a commission agent or a trader. Lender was supplying credit not only in cash terms but also in kind, in the form of inputs like fertilizers, pesticides, seeds etc. Sometimes they were also dealing in household items or utilities like grocery, jewellery articles, clothing etc. and forcing the borrowers to get these utilities from their outlets. Loan was supplied on the condition that sale of the produce will be made through them and in this way, repayment of the loan was realized at the time of sale of crop. This is again a type of tied loan. In this form of inter-linkage, advantage of trader/commission agents gets trebled in the way, one by charging high price of inputs and the other by selling the produce in regulated market on commission basis besides charging exorbitant rate of interest. They were also getting assured supply of marketed surplus.

The types of inter-linkages existing between credit and marketing pattern in the study have been highlighted in Table 2. On overall basis, out of total sampled farmers 64.44 per cent farmers were trapped in linked contracts. Participation of medium farmers in linked credit contract was found to be higher at 72.22 per cent as compared to large (57.14 %) and small farmers (51.72%). The reason could be traced to the size of marketable surplus of the produce, thus leading to bargaining power of the farmer.It was observed that medium and large farmers sold 74.70 and 89.23 per cent of their total produce during the rabbi season while the respective figure for small farmers were 32.17 per cent.

Table 2: Types of inter-linkages in the credit market of the Punjab, 2015-16 (Number)

Types of inter-linkages	Farm-categories			Overall
	Small	Medium	Large	
Credit-product	3 (10.34)	23 (42.59)	2 (28.57)	28 (31.11)
Credit-input-product	12 (41.37)	16 (29.62)	2 (28.57)	30 (33.33)
Total	15 (51.72)	39 (72.22)	4 (57.14)	58 (64.44)

Figures in the parentheses indicate the percentages to total.

It was found that on overall basis about 31 per cent of the sampled farmers were committed in credit-product contracts. Category wise 42.59 per cent of medium farmers and 28.57per cent large farmers and about 10.34 per cent of small farmers were found to be interlinked with non-institutional credit source and marketing of their produce. This showed that medium and large farmers were more inter-linked to credit source for marketing of farm produce as compared to small farmers. The large quantity of marketable surplus could be the reason behind it, while marketable surplus with small farm category is normally less and so extent of this type of inter-linkage could get diluted.

On the other hand, input-credit-product inter-linkage comprised a share of 33.33 per cent in the study area as a whole. It was found to be higher in small farm category, where 41.7 per cent of sampled farmers were interlinked in purchase of inputs as well as to dispose of their produce. The extent of interlinked farmers in this type was 29.62 per cent among medium and about 28.57 per cent in large farm categories respectively. It showed that large farmers were less tied in this type of inter-linkage as compared to small and medium farmers.

Similar type of result found by Gill (2004) in her study that the inter linkage of credit to output was strongest in Punjab. The commission agents or arthiyas were the most dominant source of the credit in the study region. The dominant mode of lending was cash and inputs (seeds, fertilizers, etc.), while crop was the main mode of repayment. The tying of credit with both input and output was also observed. This could be due to the relatively difficult access of cultivator to the input outlets, and hence greater control of lenders over borrowers. It was observed from the study that lenders prefer crop as collateral than other form of surety. Recovery had thus been made easier, because it was done at the time of sale of crop. By shifting to a better collateral (crop, instead of land) these lenders not only strengthened their bargaining power in their principal activity, but were also able to exploit the borrowers to the hilt by charging exorbitant rates of interest.

Analysis of inter-linkages of sampled farmers across the zone

Punjab is divided into three broad agro-economic zones namely sub-mountainous zone (zone I) having cropping pattern of wheat-maize, central zone (zone II) having cropping pattern of wheat-paddy and south-western zone (zone III) with wheat-cotton as the dominant cropping pattern. A comparative status of interlinked farmers in terms of credit and marketing pattern across the zones has been given in Table 3.

Table 3: Inter-zonal analysis of inter-linkages of sampled farmers in Punjab, 2015-16 (Number)

Inter-linkages	Zones of Punjab			Overall
	Zone I	Zone II	Zone III	
Credit-product	5 (16.66)	12 (40.00)	11 (36.66)	28 (31.33)
Credit-input-product	7 (23.33)	12 (40.00)	11 (36.66)	30 (33.33)
Total	12 (40.00)	24 (80.00)	22 (73.33)	58 (64.44)

Figures in the parentheses indicate the percentages to total.

It showed that percentage of linked household was more in zone II i.e. 80 per cent, where as it was 73.33 per cent in zone III and 40.00 per cent in zone I. A similar trend was observed in both types of inter-linkages existing between credit sources and marketing pattern of farm produce/inputs i.e. both were found to be higher in zone II. Zone II was pre-dominantly the wheat-paddy zone and majority of the farmers were selling their produce through the commission agents, whereas marketing of cotton and maize crops was not regulated with no effective MSP (Minimum Support Price) existing in other two zones of the state.

Factor affecting inter-linkage between credit source and marketing pattern of farm produce

The factors affecting probability of linkages were identified by applying Logit form of regression. The results for overall sampled respondents in Punjab have been presented in Table 4.

Table 4: Regression analysis of factors affecting the probability of linkages

Variables	Regression coefficients
Constant	21.88** (0.018)
Size of operational holding	-0.19** (0.04)
Ratio of non-farm income to farm income (NFI:FI)	-9.90* (0.002)
Ratio of male workers to total workers (MW:TW)	-32.04*** (0.10)
Income generated by non-land assets (NLIGA)	-0.03* (0.006)
General household expenditure	0.003*** (0.077)
Education (Years of schooling)	-0.18^{NS} (0.23)
R^2	0.654

*Figure in the parenthesis indicate calculated p-value; NS- non significant; *, **and*** significance at one per cent, five per cent and ten per cent respectively.*

The value of R^2 in the model has come to be 0.654, it showed that factors included in the model explained 65.4 per cent probability of farmers getting linked with credit source for market transaction. The role of operational holding came out to be negative but statistical significant (-0.19) meaning thereby that probability of linkages gets diminished with the increase in the size of operational holding as it may be argued that farmer with higher operational holding would receive better credit support, in both the formal and informal credit market as well as remunerative prices for the large quantity of marketable surplus. The ratio of non-farm income to farm income was also negative and statistical significant (-9.90). This illustrated that as the proportion of non-farm income to farm income increased, the probability of linkage gets decreased because the household having higher ratio of non-farm income to farm income were likely to have higher gross family income and having lesser dependence on commission agents for their routine expenditure, so less chances to enter into linked credit contracts. Further, the ratio of male workers to total workers was also found to be a negatively significant factor (-32.04) and it depicted that as the proportion of male workers to total workers was increasing, probability of linkages was decreasing because the probability of getting employment by the male workers was higher, possibly because they are absorbed for varied types of work and at distant locations as well. So, the household with higher ratio of male workers to total workers were likely to have higher income and hence they were unlikely to borrow under unfavorable terms and conditions. Similar was the case of income generated by non-land assets. Its results were negative and statistical significant (-0.03), thereby showing that as the income from non-land assets gets increased, probability of linkage gets decreased, because the households having some non-land income generating asset such as livestock, poultry or goats were having some regular cash flow through-out the year. These households thus were less likely to go for tied loans. The general household expenditure incurred by sampled farmers other than their routine family expenditure was found to be a positively significant factor (0.003). This showed that as the expenditure on general household item heads like marriages, major medical expenditure, house construction etc. gets increased, probability of linkages gets increased, as farmers were borrowing more from non-institutional sources for these purposes and prevalent mode of repayment was interlinked contracts. This further leads to sort of vicious circle i.e. current borrowing leading to contract, repayment through sale of output, next borrowing and so on. In this way they get trapped in linked contracts. The regression coefficient of education was non-significant. This indicated that education had no significant effect on probability to be linked or otherwise.

CONCLUSION

The marketing pattern of farm produce (major two crops i.e. wheat and paddy) of sampled farmers showed that majority (81.11 %) were selling their produce through commission agents in regulated markets due to convenience in sale and ease in repayment of loans. None of the sampled farmers was found to be selling the farm produce directly to government agencies despite the provision allowed by government. Majority of the sampled farmers i.e. 64 per cent were found trapped in linked transactions. Credit-input-product inter-linkage was found to be of dominant type followed by credit-product inter-linkage. Size of operational holding, ratio of non-farm income to farm income, ratio of male workers to total workers and income from non-land assets were the factors inversely affecting the probability to be in linked transactions, whereas the general household expenditure (social/ religious ceremonies, house, purchase of durables etc.) was having a positive effect. So, the need is to go for building of non-land assets and to improve the share of non-farm income to break the vicious circle of inter linkage and improve the competitive strength of farmers in the marketing transactions of both output as well as inputs,

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