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Contents

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Enhancing Farmers' Income through Climate Resilient Technologies

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ABSTRACT

Climate change has direct influence on quality and quantity of crop production. In response to changing climate, adaptation is becoming a vital component because reductions in negative impacts of climate change are possible when adaptation is fully implemented by the farmers. The present study was conducted with the purpose to evaluate the effect of climate resilient technologies on the production efficiency of rice and wheat crop in Punjab agriculture. The primary data collected from 200 farmers from different agro-climatic zones of Punjab became the study sample. The results revealed that laser leveller and improvement in irrigation structure are the most important adaptations in response to climate variability, which was adopted by 30 and 27 percent of total adoption respectively. In adaptation strategies for paddy cultivation, the variable cost ha^{-1} was less in Direct Seeded Rice (₹28417) as compared to non-adopters (₹36816), thereby resulting into a cost saving of 30 percent.This large difference between the adopters and non-adopters is due to large savings in labour in DSR at the time of planting, which has been a major driver in the adoption of this new technology in the state. Similarly, the adoption of Zero till wheat among different climate resilient technologies of wheat cultivation saved 5 percent net returns as compared to non-adopter. Data envelopment analysis was employed to work out the technical efficiencies of paddy and wheat cultivation among the adopters and non-adopters. The adopters of the climate resilient technologies are far more efficient than non-adopters. The results of technical efficiency revealed that the adopters of DSR in paddy and ZTW in wheat are the most efficient among all the adopters as well as non-adopters. The lack of knowledge about technology, lack of credit and low capacity building were the most important constraints in adoption of climate-resilient technologies. The majority of the sample respondents suggested that regular and more effective extension services about technology should be available to the farmers which might enable them to make farming a profitable venture.

Keywords
Agricultural production, climate variability, technical efficiency, technology adoption.

JEL Codes
Q10, Q16, Q54.

INTRODUCTION

Climate change and variability presents a major challenge to agricultural production and rural livelihoods and it affects approximately 2.5 billion people who derive their livelihood in part or in full from agricultural production systems. The impacts of climate change are being felt by both developed and developing nations; India is recognized as one of the developing countries very vulnerable to climate change. In India, the agricultural sector despite a significant decline in its share in national income (about 14 percent in 2014-15 from 37 percent in 1970-71), remains an important segment of the economy because of its strategic importance to food security, employment generation, and poverty alleviation. This sector still engages about 54 percent of the country's workforce either as farmers or agricultural labourers.

India is heavily dependent on the monsoon to meet its agricultural and water needs. Over 60 percent of India's population still being agriculture dependent (either directly or indirectly), even a small impact of climate change on monsoons, erratic occurrences of floods and droughts would enormously contribute to vulnerability of people. Rise in temperature and changes in precipitation are changing water availability and other stresses for crops with effects on crop yield, income, and poverty. Globally abnormal disasters have increased from 125 year^{-1} in 1980

to 400 to 500 year^{-1} in 2008 (Maon *et al.,* 2009).

In response to changing climate, adaptation is becoming an urgent priority because large reductions in negative impacts of climate change are feasible when adaptation is fully implemented. Adaptation refers to a process or processes through which societies make themselves better able to cope up with an uncertain future. Studies have shown that without adaptation, climate change is generally detrimental to the agriculture sector, but with adaptation, vulnerability can largely be reduced (Easterling *et al.,* 1993; Rosenzweig & Parry, 1994; Smith & Lenhart, 1996; Reilly & Schimmelpfennig, 1999; Smit & Skinner, 2002). Climate change adaptation strategies for agriculture include intercropping, mixed cropping, agroforestry, animal husbandry, and improved varieties. However, some of the adaptation methods are highly localized and cannot be directly adopted and implemented in other regions. In view of this, researchers are modifying and extending existing agricultural technologies to tolerate climate-related shocks. So, this study primarily focused on identifying various localized technologies adopted by the sample farmers in the study area to mitigate climate risks. The present study investigates that whether climate resilient technologies improve the production efficiency of paddy and wheat crops in Punjab agriculture, thereby increasing farmers' income.

METHODOLOGY

To identify various on-farm practices adopted by farmers to lessen climate risks and hence its effect on productivity, a sample of 200 farmers was selected from different agro-climatic zones of Punjab namely Kandi Zone (Semi-Hilly), Central Zone, and South-western Zone. These agro-climatic zones are divided on the basis of homogeneity, rainfall distribution, soil texture, cropping pattern, underground water quality, and quantity. For the selection of the sample farmers' multi-stage sampling technique was followed. In the first stage two districts namely Ludhiana and SBS Nagar from Central Zone (as it has the highest area in the geographical area of the state), Gurdaspur from Kandi Zone and Faridkot from South-western Zone were selected respectively. Further, one block from each district and two villages from each block were selected randomly. Blocks Doraha, Balachour, Dhariwal, and Faridkot were selected from Ludhiana, SBS Nagar, Gurdaspur, and Faridkot districts respectively. At the third and last stage, from each village, 25 farmers were selected randomly. These farmers were interviewed personally and interview schedule was filled about their cropping pattern, inputs used, output obtained and their perceptions regarding climate change. They were enquired about the ways they have adopted on their farms to mitigate the effects of climate change during past five years and costs incurred and returns obtained thereon.

The analysis of the sample farmers revealed that the crops grown by them were paddy, sugarcane, maize, cotton, wheat etc. and they have adopted laser leveling of farms, direct seeded rice, change in variety and improvement in irrigation structure in respect of paddy cultivation and zero till wheat, change in variety in respect of wheat cultivation.

Further, data envelopment technique was used to find the technical efficiency of adopters versus non-adopters. Paddy and wheat dominated the cropping pattern of the sample farmers, therefore only two crops paddy and wheat were studied in detail and the adaptation technologies adopted to reduce climate risks in them.

Data Envelopment Analysis

Data Envelopment Analysis (DEA) was used to analyze the technical efficiency in other words ability of a unit to obtain maximum output from a given set of inputs. DEA calculates the relative efficiency scores of various Decision-Making Units (DMUs) in a particular sample. The DMUs are the individual sample farmers in this study, whether adopters or non-adopters of climate resilient technologies.

Only Input Oriented Model (IOM) version of the DEA technical efficiency measurement methodology was applied to the data. An input-oriented model is used in order to obtain the given level of output by input minimization. In order to specify the mathematical formulation of IOM, let us assume that we have K farmers (DMU) using N inputs to produce M outputs. Inputs are denoted by x_{jk} (j=1,2,…….,n) and the outputs are represented by Y_{ik} (i=1,2,……..,m) for each farmer k (k=1,2,……,K). The efficiency of the farmers can be measured as (Coelli, 1998; Worthington, 1999):

$$TE_k = \sum_{i=1}^{m} u_i y_{it} \Big/ \sum_{j=1}^{n} v_j x_{jk}$$

WhereY_{ik} is the quantity of the i^{th} output produced by the k^{th} farmer, x_{jk} is the quantity of j-th input used by the k^{th} farmer, and u_i and v_j are the output and input weights respectively. The farmer maximizes the technical efficiency, TE_k, subject to

$$TE_k = \sum_{i=1}^{m} u_i y_{it} \Big/ \sum_{j=1}^{n} v_j x_{jk} \leq 1$$

Where, u_i and $v_j \geq 0$

The above equation indicates that the technical efficiency measure of a farmer cannot exceed 1, and the input and output weights are positive. The weights are selected in such a way that the farmer maximizes its own technical efficiency which is executed separately. To select optimal weights the following linear programming (input-oriented) model is specified:

Min TE_k

Subject to

$$\sum_{i=1}^{m} u_i y_{it} - y_{jk} + w \geq 0$$

where, k=1,2,……,K

$$x_{jk} - \sum_{j=1}^{n} u_j x_{jk} \geq 0$$

Where u_i and $v_j \geq 0$

The above model shows TE under constant returns to scale (CRS) assumption if w = 0 and it changes into variable returns to scale (VRS) if w is used unconstrained. In the first case, it leads to technical efficiency (TE).

The production of paddy and wheat crops per hectare (in quintals) was taken as the output (Y). The different inputs considered for the analysis were as follows:

X_1 = Total Fertilizers (kg ha^{-1})

X_2 = Plant protection (₹ ha^{-1})

X_3 = Seed/Seedling (₹ ha^{-1})

X_4 = Hired labour (hr ha^{-1})

X_5 = Tractor use (hr ha^{-1})

X_6 = Irrigation (hr ha^{-1})

U= Random term

The independent variables were tested for their stochastic independence

Garrett Ranking Method

This technique was used to evaluate the constraints of climate change adaptation faced by the farmers. The order of merits assigned by the respondents was converted into ranks by using the following formula:

$$Percentage\ Position = \frac{100\ (R_{ij} - 0.5)}{N}$$

Where,

R_{ij} = Rank given for the i^{th} item by the j^{th} individual

N_j = Number of items ranked by the j^{th} individual

The percentage position of each rank thus obtained was converted into scores by referring to the table given by Garrett and Wood Worth (1971). Then for each factor, the scores of individual sample farmers were added together and divided by the total respondents for whom scores were added. Thus, mean score for each problem was ranked by arranging them in the descending order. By this method, the accuracy in determining the preference was obtained.

RESULTS AND DISCUSSION

Adoption of Climate Resilient Technologies

The various on-farm adaptation strategies being used by farmers in response to changing climate are presented in Table 1. The results revealed that laser leveller and improvement in irrigation structure are the most important adaptations in response to climate variability, which was adopted by 30.00 and 27.00 percent of sample farmers respectively. To cope up with climate variability farmers have adopted other management practices such as change in variety (21.50 percent), direct seeded rice (7.50 percent) and zero till wheat (8.50 percent), respectively. Out of a sample of 200 farmers, 65 farmers have not adopted any adaptation technology to cope up with climate change.

Table 1. Adoption of climate resilient technologies by sample respondents, 2016-17

(Multiple response)

Adaptation	Respondents	
	Number	Percentage
Change in variety	43	21.50
Improvement in irrigation structure	54	27.00
Direct seeded rice (DSR)	15	7.50
Zero till wheat (ZTW)	17	8.50
Laser leveller	60	30.00
No adaptation	65	32.50
Total sample size	200	

Economics of Adopters Vis-À-Vis Non-Adopters of Climate Resilient Technologies in Paddy Crop

Direct seeded rice

Direct Seeded rice (DSR) was introduced in Punjab in 2009-2010, as an alternative to conventional manual puddled transplanted rice. Direct seeded rice offers major benefits that have significant influence on climate change such as reduced emissions of methane, reduced demand for water, and less use of human labour. It is estimated that 24 to 30 percent of freshwater resources are used to irrigate paddy fields. With the method of direct seeding irrigation requirement for paddy cultivation reduces by 19 percent (Tabbal *et al.,* 2002). Reduced water requirement for paddy means availability of more water for other crops, human requirement etc. It can be a opportunity to strengthen food security, ensure environmental sustainability and improve farmers' adaptability to climate change.

A perusal of Table 2 revealed that the expenditure borne by non-adopters of DSR technology for hired labour came out to be ₹9743 ha^{-1}.On the other hand, under the adopters of DSR technology, the hired labour came out to be ₹3678 per hectare which was about 165 percent lower as compared to non-adopters. This large difference between the adopters and non-adopters is due to large savings in labour in DSR at the time of planting, which has been a major driver in the adoption of this new technology in the state.The expenditure on plant protection was ₹4352ha^{-1} on DSR farms which was 17 percent higher as compared to non-adopter. Irrigation is the most critical input for paddy cultivation. Irrigation charges comprised the usage of diesel in the diesel engine and generators for the irrigation purpose. The per hectare expenditure spend on diesel was ₹227, which was ₹567 lower than non-adopter. The variable cost per hectare was less in DSR (₹28417) as compared to non-adopters (₹36816), thereby resulting into a cost saving of 30 percent. Due to less variable cost, the net returns were greater in case of DSR as compared to non-adopters. Hence, with the adoption of DSR technology, the profit was amplified by 7.69 per cent.

Change in variety

Identification of varieties that fits well into changed climatic conditions is common denominator for sustainable crop production in all land use conditions. Sowing right variety at right time under right land use conditions makes a significant difference towards higher

yields. With regard to the adoption of climate tolerant paddy varieties, the expenditure spend on seed was ₹1827.19 as compared to ₹1529.54 ha^{-1} in the case of non-adopters, which was 16 percent higher than the farmers using old varieties (Table 1). The expenditure on plant protection chemicals (weedicides, herbicides, and insecticides) for paddy cultivation of improved varieties was observed less (₹3372.32 ha^{-1}) than non-adopter (₹3636.70 ha^{-1}) respectively. The yield of paddy with improved varieties was 73.42 quintal ha^{-1}which was more as compared to 70.02 quintal ha^{-1} with conventional varieties leading to higher net returns by 1.35 percent than non-adopters.

Laser land leveller

Laser leveling of agricultural land is a recent resource conservation technology initiative in India. It has the potential to change the way food is produced by enhancing resource-use efficiency of critical inputs

Table 2. Operational cost and net returns of adopters vis-à-vis non-adopters of climate resilient technologies for paddy cultivation in Punjab, 2016-17

Particulars	Change in variety	Improvement in irrigation structure	Direct seeded rice	Laser leveller	No adaptation
Laser leveling	994.04	1004.30	1066.66	1287.03	-
Seed/seedling (₹ha^{-1})	1827.19 (16.29)	1662.23 (7.98)	1024.55 (-49.29)	1595.57 (4.14)	1529.54
Fertilizer					
Urea (₹ha^{-1})	1574.41 (-0.16)	1572.47 (-0.29)	1710.95 (7.83)	1578.16 (0.07)	1577.00
DAP (₹ha^{-1})	1774.74 (-4.85)	1747.52 (-6.48)	921.95 (-101.84)	1723.24 (-7.98)	1860.83
MOP (₹ha^{-1})	455.10 (-3.27)	456.85 (-2.88)	364.00 (-29.12)	450.80 (-4.26)	470.00
Irrigation charges	769.89 (-3.24)	736.84 (-7.87)	227.31 (-249.68)	591.21 (-34.45)	794.86
Agro-chemical/ weedicides (₹ha^{-1})	3372.32 (-7.84)	3470.88 (-4.78)	4351.66 (16.83)	3505.06 (3.76)	3636.70
Human labour					
Hired labour charges	9657.87 (-0.09)	9366.76 (-4.03)	3678.01 (-164.92)	9266.84 (-5.15)	9743.90
Family labour charges	7459.31 (3.57)	7302.42 (1.50)	5567.81 (-29.19)	7325.35 (1.81)	7192.86
Tractor					
Own tractor charges	2121.45 (-1.20)	2043.85 (-5.04)	3003.56 (28.52)	2044.53 (-5.00)	2146.85
Hired tractor charges	921.61 (2.92)	990.68 (9.69)	-	980.24 (8.73)	894.67
Harvesting	3030.45 (-0.18)	3020.97 (0.50)	2969.33 (-2.24)	3026.57 (-0.31)	3035.94
Transportation to market	1208.08 (-1.15)	1216.27 (-0.47)	1210.17(-0.97)	1207.07 (-1.23)	1221.95
Marketing cost	1180.67 (4,63)	1144.57 (1.62)	1097.67 (-2.58)	1142.43 (1.44)	1125.98
Interest @ 9% per half of the period of crop on variable cost	1766.07 (10.23)	1608.15 (1.41)	1223.71 (-29.56)	1611.18 (1.60)	1585.40
Total variable cost	41012.17 (10.23)	37344.77 (1.41)	28417.38 (-29.56)	37415.26 (1.60)	36816.49
Yield (q ha^{-1})	73.42 (4.63)	71.18 (1.63)	68.26 (-2.58)	71.05 (1.45)	70.02
Gross returns	110871.00 (4.63)	107481.40 (1.63)	103077.30 (-2.58)	107280.43 (1.45)	105735.40
Net returns	69858.82 (1.35)	70136.61 (1.74)	74659.94 (7.69)	69865.16 (1.35)	68918.87

Figures in parentheses indicates percent change in value for adopters over non-adopters.

without any disturbing and harmful effects on the productive resilience of the ecosystem. Because groundwater use is unpriced, farmers have minimal incentives to conserve on it. However, the collective benefit from conserving groundwater in India is substantial. Decline in rainfall may reduce net recharge and affect groundwater levels. So, there is a need for developing efficient techniques to conserve underground water by increasing irrigation efficiency. Laser leveller can support farmers to adapt to climate change through efficient use of water. As the electricity supply is totally free in Punjab state, the irrigation charges includes the diesel/oil consumption for irrigating the paddy crop. The per hectare expenditure spend on diesel (laser levelled farm) was 34 percent less than non-laser levelled farms (non-adopters). Due to higher productivity, the gross returns were also greater in case of adoption of laser leveller (₹107280.43) as compared with non-adopter (₹105735.40). The returns over variable cost were also higher in the case of laser land levelled fields (₹69865.16 ha^{-1}), while in the case of non-adopter, the returns over variable cost worked out to be ₹68918. Hence, with the use of laser land leveling technology, the profit increased by 1.35 percent (₹946.29 ha^{-1}) (Table 2).

Improvement ~~of~~irrigation structure

The majority of the sample farmers perceived that irrigation is important strategy to mitigate the harmful effects of climate change. The rate of decline in groundwater level in Punjab state which was 17 cm per year in 1990s rose to 91 cm in 2005, thereafter reduced to 55 cm in 2013. This declining water table depth has necessitated the farmers to increase the horsepower of irrigation extracting structure so as to fetch the groundwater from more depth in the study area to cope up with climate risks. In this technology adoption, the farmers saved 8 percent of irrigation charges as compared to the non-adopters. Overall, net returns were higher (1.74 percent) in case of those farmers who had more productivity due to assured groundwater irrigation by increasing the capacity of the installed electric motor as compared to the non-adopters (Table 2).

Economics of adopters vis-à-vis non-adopters of climate resilient technologies in wheat crop

Zero tillage wheat

Zero tillage implies planting crops in previously unprepared soil. It is also known as zero till, no-till or direct planting. The farmers of Punjab are in hurry to sow next crop wheat after paddy and therefore dispose of the straw immediately by burning. Burning causes serious environmental pollution. The crop residue is a good source of essential plants nutrients. The burning of residue causes a complete loss of nutrient and sulfur. The Indian Council of Agricultural Research (ICAR) and State Universities has given priority to develop zero tillage wheat as an alternative to burning. The major farm inputs used for the production of wheat in zero tillage and conventional tillage (non-adopters) are mentioned in Table 3. A perusal of Table 3 revealed that farmers saved 14 percent of seed cost, 4 percent of hired labour, 5 percent of family labour, 43 percent of owned tractor charges and 64 percent of hired tractor charges by cultivating zero till wheat. The net returns zero till wheat was five percent higher as compared to conventional method of wheat cultivation due to higher yield. Several studies have highlighted the advantages of zero till wheat such as saving of irrigation water, reduction of labour and timely establishment of crops, resulting in improved crop yield and higher net income (Laxmi *et al.,* 2007; Farooq *et al.,* 2006; Erenstein *et al.,* 2007).

Change in variety

Adoption of climate tolerant wheat varieties have led to the increased expenditure on seed amounting to ₹2548.59 as compared to ₹2160.00 ha^{-1} in case of non-adopters, which was 15 percent higher than the farmers who adopted old wheat varieties. A savings of ₹389 per hectare was realized in cultivating new improved varieties instead of old wheat varieties. The profit was amplified by 2 to 5 percent in all adoptions vis-à-vis non-adoption during wheat cultivation (Table 3).

~~Improved irrigation structure~~

The operational cost of the farmers with and without improved irrigation structure was compared to visualize the savings in cost. The table revealed that cost of hired labour and own tractor charges was less in wheat cultivation with improved irrigation structure than non-adopters (without improved irrigation structure), about 5 and 33 percent with the sample farmers respectively. Overall, difference of ₹696$ha^{-1}$was observed in total variable cost of farmers with improved irrigation structure, whereas cost of seed, urea, DAP, MOP, and agro-chemicals was little bit more in wheat cultivation with improved irrigation structure as compared to non-adopters (Table 3).

Resource-use Efficiency

The technical efficiency evaluates the ability of the farm to obtain the maximum possible output from a given level of input. A technical efficient farm operates on production frontier and one that operates below frontier could operate on frontier either by increasing output with same input bundle or using less input to produce the same output. The closer a farm gets to the frontier, the more technically efficient it becomes.

Average technical efficiency of the adopters vis-à-vis non-adopters of climate resilient technologies in paddy and wheat crop

To obtain efficiency levels of farms as decided by the physical inputs (quantities), DEA model (input oriented) was used under the assumption of constant returns to scale (CRS). The variety-wise input-output data collected on paddy production for the year 2016-17 was used to estimate the technical efficiency of the adopters vis-à-vis non-adopters of climate resilient technologies using DEA discussed in Table 4 and 5. The productivity of paddy and wheat in quintals per hectare was taken as output to

Table 3. Operational cost and net returns of adopters vis-à-vis non-adopters of climate resilient technologies for wheat cultivation in Punjab, 2016-17

Particulars	Change in variety	Improvement in irrigation structure	Zero tillage wheat	No adaptation
Seed (₹ha^{-1})	2548.59 (15.25)	2496.13 (13.47)	1898.00 (-13.80)	2160.00
Fertilizer				
Urea (₹ha^{-1})	1966.01 (1.36)	1968.23 (1.47)	1959.25 (1.02)	1939.29
DAP (₹ha^{-1})	2721.94 (2.20)	2732.26 (2.57)	2795.00 (4.76)	2662.00
MOP (₹ha^{-1})	247.16 (-4.04)	253.96 (-1.25)	271.67 (5.35)	257.14
Agro-chemical/ weedicides (₹ha^{-1})	1499.87 (-4.37)	1571.63 (0.40)	1697.79 (7.80)	1565.38
Human labour				
Hired labour charges	2405.49 (-4.36)	2401.13 (-4.54)	2424.38 (-3.54)	2510.26
Family labour charges	3169.33 (-4.90)	3113.13 (-6.80)	3152.92 (-5.45)	3324.71
Tractor				
Own tractor charges	1966.54 (-27.68)	1890.85 (-32.79)	1753.13 (-43.22)	2510.81
Hired tractor charges	745.97 (-32.90)	820.81 (-20.78)	603.50 (-64.27)	991.38
Harvesting	2780.45 (-0.20)	2787.47 (0.05)	2774.48 (-0.41)	2785.95
Transportation to market	830.45 (-0.66)	837.48 (0.18)	824.48 (-1.39)	835.95
Marketing cost	581.74 (0.48)	583.42 (0.76)	590.81 (2.01)	578.96
Interest @ 9% per half of the period of crop on variable cost	965.86 (-3.07)	965.56 (-3.10)	933.54 (-6.64)	995.52
Total variable cost	22429.40 (-3.07)	22422.43 (-3.10)	21678.62 (-6.64)	23118.23
Yield (qha^{-1})	51.03 (0.47)	51.18 (0.76)	51.83 (2.01)	50.79
Gross returns	82922.90 (0.47)	83162.44 (0.76)	84215.63 (2.01)	82526.79
Net returns	60493.50 (1.79)	60740.01 (2.19)	62536.69 (5.00)	59408.56

Figures in parentheses indicates the percent change in value for adopters over non-adopters.

measure the technical efficiency. The inputs were taken on per hectare basis including seed quantity, total fertilizers, plant protection chemicals, total hired labour, and tractor use. The overall technical efficiency included the quantity of different inputs used for the crop taken on per hectare basis.

Technical efficiency in paddy

The mean average technical efficiency of adopters of all the climate resilient technologies in paddy was higher than non-adopters. Overall, highest mean average technical efficiency score was observed in adoption of DSR among all the adopters, which indicate that direct seeding of rice farms could reduce the use of inputs by up to eight percent, whereas, the non-adopters will have to reduce by up to 14 percent to reach the optimum scale efficiency (Table 4).

The perusal of Table 4 revealed that the adopters of direct seeding of rice farms are more efficient as regards the expenditure on seed as their mean technical efficiency score is 0.90 as compared with all other adoptions of climate resilient technologies as well as non-adopters. This was due to fact that on direct seeding of rice farms

seeds are directly sown. Those farmers using improved rice varieties are more efficient as regards the use of plant protection chemicals as their mean technical efficiency score is 0.70 as compared to 0.63 for non-adopters. The adopters of laser leveller are more efficient in ~~tractor labour~~ as their mean score is ~~0.85~~ as compared to all climate resilient technologies as well as non-adopters. ~~That~~ means the laser land leveling technology improved the irrigation efficiency of paddy crop.

Technical efficiency in wheat

In wheat, highest mean average technical efficiency score was observed in adoption of ZTW among all the adopters, whereas the non-adopters will have to reduce by up to 13 percent to reach the optimum scale efficiency (Table 5). The farmers using improved wheat varieties are less efficient as regards the use of seed as their mean technical efficiency score is 0.63 as compared to 0.68 for non-adopters, whereas these farmers are more efficient regarding the use of pesticides. On the other hand, non-adopters farms are more efficient as regards the use of plant protection chemicals as their mean technical efficiency score is 0.69 as compared to 0.63 for ZTW farms. This strengthens the fact that use of weedicides was high by ZTW adopters which made them less efficient as compared to non-adopter.

On the other hand, the use of tractor, that is, machine

Table 4. Average technical efficiency among adopters vis-à-vis non-adopters of climate resilient technologies for paddy cultivation in Punjab, 2016-17

Particular	Change in variety	Improvement in irrigation structure	Direct seeded rice	Laser leveller	No adaptation
Seed (₹ha^{-1})	0.63	0.61	0.90	0.70	0.66
Fertilizer (kg ha^{-1})	0.80	0.86	0.59	0.86	0.65
Plant protection chemicals (₹ha^{-1})	0.70	0.68	0.53	0.69	0.63
Hired labour (hr ha^{-1})	0.77	0.79	0.86	0.76	0.73
Tractor use (hr ha^{-1})	0.77	0.74	0.82	0.85	0.72
Irrigation (hr ha^{-1})	0.65	0.63	0.67	0.66	0.60
Mean efficiency	0.90	0.89	0.92	0.91	0.86

Table 5. Average technical efficiency among adopters vis-à-vis non-adopters of climate resilient technologies for wheat cultivation in Punjab, 2016-17

Particular	Change in variety	Improvement in irrigation structure	Zero tillage wheat	No adaptation
Seed (₹ha^{-1})	0.63	0.68	0.74	0.68
Fertilizer (kg ha^{-1})	0.83	0.83	0.86	0.78
Plant protection chemicals (₹ha^{-1})	0.71	0.76	0.63	0.69
Hired labour (hr ha^{-1})	0.84	0.76	0.89	0.83
Tractor use (hr ha^{-1})	0.76	0.75	0.80	0.71
Irrigation (hr ha^{-1})	0.69	0.68	0.71	0.72
Mean efficiency	0.90	0.91	0.93	0.87

Table 6. Constraints of climate change adaptations in agriculture

Reasons	Percent position	Garrett's score	Rank
Lack of knowledge about technology	49.48	7.04	I
Lack of finance and credit facility	20.36	6.79	II
Inadequate training and demonstrations	58.97	5.01	III
Lack of technical skills	60.58	4.49	IV
High cost of adaptation	16.93	4.40	V
Inadequate size of landholding	70.15	3.73	VII

Table 7. Suggestions given by the sample farmers to mitigate the effect of climate change

(Multiple response)

Suggestions	Respondents	
	Number	Percent
Regular and more effective extension services about technology interventions	159	88.82
Accurate and timely weather forecast	136	75.98
Development of heat tolerant varieties	114	63.69
Strengthening of crop insurance sector	88	49.16
Regular electricity supply	79	44.13
Proper enactment of legislation regarding burning of paddy straw	38	21.23

labour was low by ZTW adopters which made them more efficient as compared to non-adopter.

Constraints to Climate Change Adaptations

The sample farmers were asked to specify the constraints faced for non-adoption of new localized technologies to reduce climate risks. Because of the multiple constraints, their responses were ranked in ascending order. The Garrett ranking technique was used for ranking the constraints for non-adoption (Table 6).

The lack of knowledge about technology has been found to be the most important constraint (Garrett's score 7.04) followed by the lack of finance and credit availability. Lack of demonstrations, technical skill, extension lectures and small holding size were other major obstacles in the adoption. Strengthening of agricultural credit and extension for effective transfer of technologies have been found to be the important components to cope with climate variability.

Suggestions to Overcome the Constraints Faced by the Adopters

The farmers of the study area were also asked about their suggestions to overcome constraints faced by them in coping to climate change and findings have been presented in Table 7. Majority (88.82 percent) of the sample respondents suggested that regular and more effective extension services about technology should be available to the farmers, whereas, 75.98 and 63.69 percent of them said that weather forecast should be more accurate and heat and drought tolerant varieties should be developed which might enable them to make farming a profitable venture.

The other important suggestions given by respondents include proper policy formulation by the government in crop insurance sector which will help the farmers to get easy and timely claims in case of crop damage due to unfavourable weather.

CONCLUSIONS

The study primarily focused on various localized climate resilient technologies adopted by the sample farmers from major provinces of Punjab. The results revealed that majority of the sample households adapted to one or the other climate resilient technologies. In adoption strategies for paddy cultivation, per hectare net returns were higher in case of DSR (₹74659.943) followed by ₹69865.16 and 69858.82 in laser land leveller and improved varieties respectively than non-adopters. On the contrary in wheat cultivation, the per hectare net returns were higher in case of ZTW (₹62536.69) followed by improved varieties (₹60493.50) than non-adopters. The technical efficiency in crop production has been found higher for technology adopters than non-adopters. Strengthening of agricultural credit and extension for effective transfer of technologies has been found to be the important components to cope up with climate variability.

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Appendix
Cropping pattern among the sample farmers, Punjab, 2016-17

Crop	Average	Percent
Kharif		
Paddy	3.29	77.99
Cotton	0.10	2.41
Maize	0.28	6.55
~~Summer~~ Moong	0.09	2.23
Sugarcane	0.12	2.86
Fodder	0.21	5.01
Others*	0.12	2.95
Total *Kharif* cropped area	4.22	100.00
Rabi		
Wheat	3.57	84.60
~~Spring maize~~	~~0.00~~	~~0.00~~
Fodder	0.19	4.50
Sugarcane	0.12	2.86
Potato	0.21	4.98
Others*	0.13	3.06
Total *Rabi* cropped area	4.22	100.00

Others include area under ~~popular~~ in Kharif season and in Rabi season, it also includes vegetables like ~~potato,~~ tomato, and beans.

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Motivational Elements Effect on Labour Productivity and Retention: The Case of Jei River Farms in Central Region of Ghana

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ABSTRACT

This study estimated and analysed factors affecting Labour productivity and retention among workers in Jei River farms in the Central Region of Ghana. Stratified and simple random sampling techniques were used to sample hundred (100) workers from a population of four hundred and forty seven (447) workers. Descriptive statistics and ordered probit regression were used in the analysis. The results indicated that motivators that were important in influencing labour productivity positively were the challenging nature of the job, mostly for administration and technical staffs and the salary level mostly for field staff. Socio economic factors such as education, farm work experience, age and introduction of new technology were also significant in explaining labour productivity. Educational level and the introduction of new technology had positive effects on labour productivity. However, age and farm work experience had negative effects on labour productivity.

Keywords
Farms, motivation, probit, productivity, retention.

JEL Codes
D02, D24, J01, J24.

INTRODUCTION

With the increasing acknowledgement of staff as the firm's best asset there is the need to find ways to increase labour`s contribution while better appreciating the effect of better human resource practices. If a firm can recruit and retain the right labour, develop them through training and skill acquisition, then this knowledge can be used as a competitive advantage to drive firm growth (Guy, 2003).

Every firm needs a source of labour to function. This axiom applies equally whether we rely solely on a basic economic model of the firm, with labour as one of the four factors of production (Bannock *et al.,* 1988), or other research which emphasizes 'labour power' (Lapides, 1998). Alternatively, we can subscribe to more complex models, which place importance on intellectual or 'human' capital and the importance of knowledge management (Harrison, 1999).

Human resource management is a strategic and coherent approach to the management of firm's most valued assets; the people working there who individually and collectively contribute to the achievement of firm objective (Armstrong, 2004). This means that human resource management emphasizes on the strategic management of people (the human capital of the farm) which enable the achievement of the farms objective as well as fulfilling the labour needs. Human resource management emphasizes that labour should be treated as an asset rather than cost and as such should be regarded as a source of competitive advantage and a human capital to be invested in, through the provision of learning and development opportunities.

For labour to be able to achieve the farm's goals they should be motivated adequately. This axiom implies that motivation influences productivity and that supervisor need to understand what motivates labour to reach peak performance. It is not an easy task to increase labour motivation because labour responds in different ways to their jobs and their firm's practices. According to Robin and Decenzo cited in Monese & Thwala (2008) motivation is defined as "the willingness to exert a high level of effort to reach a firm's goals, conditioned by the effort's ability to satisfy some individual need". This

means that motivation is the set of processes that move a person toward a personal goal. Thus, motivated behaviours are voluntary choices controlled by the individual worker.

Motivation is expected to yield enormous returns in businesses. However, this was not found to have materialized (Wilcox *et al.,* 2000). Also, a high labour turnover reduces productivity since the firm will have to hire new labourers who often must spend some time before they adjust and become conversant with their work (Hackett, 1979; Krau, 1981). Aggrieved workers will either quit the employment or embark upon industrial action which will reduce productivity.

To help address some of these unsettled issues associated with motivating workers on the farm so that their productivity can increase, the authors used Jei River Farms as a case study. Jei River Farms was established under the free zones board of Ghana in March 1993. The farm is located at Awutu Senya in the central region of Ghana. The size of the Farm is 500 hectares and it's into the production and export of tropical fruits. The main fruit for export is pineapple and varieties exported are; MD2, sugar loof, smooth cayenne and queens. MD2 forms 70 percent of total production and 95 percent of total export.

Jei River Farms is competitive in the export of tropical fruits and as such it must hire and keep people it needs. The Farm motivates its labourers through the two forms of rewarding employees: total compensation and relational forms. Total compensation is all forms of financial returns and tangible services and benefits which employees receive as part of an employment relationship (Milkovich, 1999). This can either be a direct benefit which includes base pay, bonus or indirect benefits such as allowances and fringe benefits. The other return in exchange for work is the non-financial form which is the relational forms such as getting the needed recognition and status, respect, learning opportunity and challenging work.

Just as machinery is more efficient when used properly workers would produce more if they were better organized and motivated (Taylor, 1911). Motivational strategies being adopted on farms has not been devoid of setbacks especially in the area of labour turnover (Appiah, 2002). This suggests that there could be some peculiar problems affecting the motivation of labour on farms in this country.

Problem Statement

In every firm, there is the need to influence the amount of effort that workers will put into their job for better productivity. Many firms have adopted different motivational elements all with the view of improving productivity. However, the use of motivational elements as a means to improve productivity has had its own setbacks (Wilcox *et al.,* 2000).

The problem of how best to motivate labour so that one can retain them for a very long time has attracted the attention of many researchers. In the past, administrators believed in McGregor's theory X which says that "human beings are inherently lazy, have dislike for work and try to avoid responsibility and only seek security and therefore have to be coerced and controlled to get them to put forth adequate efforts towards the achievement of the firms objectives" (McGregor, 1960). Trends have shown that attempts to treat labour at Jei River Farms like machines will eventually result in voluntary quits. High labour turnover for any firm is dangerous as this will affect the growth of the firm. Researchers believe that a core of experienced labour is very necessary for the growth of a firm. For experience on the job, labour must be stable (Hackettt, 1979).

The issue as to the motivational elements that should be employed to motivate labour at Jei River Farms also needs to be identified. It is believed that people are motivated once their needs are met (Mullins, 1999; Lussier, 2000). However, labour has different needs that influence their motivation at a point in time which could be financial or non-financial. To understand what motivates the individual worker at Jei River Farms, management must be aware of each labour's needs, sentiments, and values so as to identify what will influence labour to contribute efficiently and effectively towards the farm's goal.

Literature has it that, the inability of management to identify any of these two elements that motivate the individual labour so that it can be employed by the firm will have negative consequences on labour ranging from absenteeism, labour quit, to the problem of free-riding (Aluko, 1998).

Equity is the perception of fairness involved in rewards given to a group of people. A fair or equitable situation is one in which people with similar inputs experience similar rewards. Labour at Jei River Farms compares their rewards with the rewards received by others for their efforts. If labourers perceive that an inequity exists, they are likely to withhold some of their contributions, either consciously or unconsciously, to bring a situation into what they perceive to be a better balance. For example, if workers are not getting enough pay (reward) for their work (input), they will try to get that pay increased or reduce the amount of work they are doing. On the other hand, when workers are being paid too much for the work they are doing, they tend to increase the amount of work (Adams, 1963). Not only do workers at Jei River Farms compare their own inputs and outputs, they also compare their input/output ratio with the input/output ratio of other workers. If one work team believes they are doing more work than a similar team for the same pay, their sense of fairness will be violated and they will tend to reduce the amount of work they are doing. It is a normal human inclination to want fairness. The foregoing issues give rise to the following questions:

1. What motivational elements increase labour productivity at Jei River Farms?
2. What motivational elements are causing labour retention at Jei River Farms?

The main objective of this study is, therefore, is to determine the effect of farm motivational elements on labour productivity at Jei River Farms.

METHODOLOGY

Type and Sources of Data

The study was based on both primary and secondary sources of data. The primary data was obtained from staff working at Jei River Farms using questionnaire whiles the secondary data was from journals, newspapers, and previous related research reports.

Sample Size and Sampling Procedure

Stratified and simple random sampling techniques were used to sample hundred (100) workers from a population of four hundred and forty seven (447) workers. Stratified random sampling is used to ensure that key subgroups of the population, especially small minority groups. For any farm, there are structures and Labour belongs to different structures, that is, there are types of labour that are in management and those who are ordinary workers. The distribution of the total workforce was: field workers (222), export workers (89), technical staff (68) and administrators (68). Simple random sampling was used to sample the total sample 22.5 percent from each group. Hence (15) workers were selected from the administration, (50) from field workers, (15) from technical staff and (20) from export workers (20).

The Empirical Model

The ordered probit regression model was used for the analysis. The dependent variable 'labour productivity'(a reporting response from their immediate supervisors) was obtained straight from the survey, as there was a question asking immediate supervisors of the workers to state whether there has been a change in their productivity over the last one year. This is consistent with measuring labour productivity through the value added approach and also consistent with previous research of Bryson *et al*. (2006). Doody (2007) asked management to state whether there has been a change in the productivity of employees over the last one year. The ordered probit model was specified as:

$$Y^*_i = x_i b + e_i, e_i \sim N(0, 1), \text{for all}_i = 1 \ldots N. \quad (1)$$

Where:

Y^*_i = the observed ordinal variable (labour productivity), taking on values 0 through m i.e,

Y_0 = Decreased labour productivity

Y_1 = Average labour productivity

Y_2 = Increased labour productivity

X_i = Independent variables

b = coefficient of the independent variable

Based on literature, socio economic characteristics that influence labour productivity such as age, experience, gender, education, training, technology and motivators being offered by the farm such as compatible work group, promotion, responsibility, recognition, supervision, fringe benefits, salary, job security, challenging job and work environment were regressed together to determine factors that were significant in explaining labour productivity.

Marginal Effects

The rationale for ordinal regression models is that there is an underlying, continuous variable y* that reflects the dependent variable we are interested in. The y* is unobserved, but we observe y, which is basically a collapsed/grouped version of the unobserved y*. Low productivity, constant productivity and high productivity are a collapsed version of a continuous labour productivity variable. As individuals cross thresholds (cut-points) on y*, their value on the observed y changes. According to McCullaph & Nelder (1989), the marginal effect thus is calculated as:

$$y^* = \beta_1' x + e \text{ if } y = 0$$
$$y^* = \beta_2' x + e \text{ if } y = 1$$
$$y^* = \beta_3' x + e \text{ if } y = 2$$

Where:

y = 0 (Low productivity)

y = 1 (Average productivity)

y = 2 (High productivity)

Identification of Factors that is causing Labour Retention at Jei River Farms

Factors that prevent the withdrawal of service by labour were developed based on Maslow's hierarchy of needs and analyzed using their mean scores. Workers were asked to indicate the extent to which factors such as compatible work group, promotion, responsibility, recognition, supervision, fringe benefits, salary, job security, challenging job, achievement, experience, training and development, domestic reasons, flexibility in work, lack of economic opportunities elsewhere, dream place of work and work environment s were keeping them unto the job. A likert scale was used ranging from very low (rated 1) to very high (rated 5). Factors with mean scores of 3 and above were regarded as most important factors causing a continuous stay of the worker on the farm.

The variability in the response to these factors was analyzed using the standard deviation.

The factor with the lowest standard deviation is the response with little variation and the factor with the highest standard deviation is the response that had the greatest variation.

Research Hypotheses

The following hypotheses were set for the study:

1) H_O: Motivational elements do not have any effect on labour productivity on Jei River Farms.

H_I: Motivational elements have an effect on labour productivity on Jei River Farms.

2) H_O: Motivation is not adequate enough at Jei River Farms to cause labour retention

$H_{1:}$ Motivation is adequate enough at Jei River Farms to cause labour retention

RESULTS AND DISCUSSION

The entire population of workers at Jei River Farms was 447 out of which hundred (100) were sampled for this research. The field workers form the majority of workers

(222) on the farm hence half (50 percent) of the respondents were from that department whereas twenty percent (20 percent) were selected from export department, fifteen percent (15 percent) from technical department and fifteen percent (15 percent) from the administration department.

From Table 1, the age distribution of respondents revealed that the ages of workers at Jei River Farms range from 18 to 65 years. The age group with the highest frequency was 36-45 years and this represented 36 percent of the workers. The age group 26-35 years is the next highest frequency in the age distribution. Also, 17 workers representing 17 percent were aged between 18-25 and 9 percent of workers had ages between the ages of 46-60 years. The lowest frequency is workers above 60 years which was only 4 percent of workers interviewed. The results show that majority of the workers interviewed are in their middle age group (36-45) and are capable of working very hard to increase agricultural productivity.

A perusal of Table 1 revealed that the highest educational level attained by the workers at Jei River Farms is first degree representing 12 percent of the workers interviewed. The highest frequency level for the level of education is no formal education representing 27 percent. Twenty percent of the workers interviewed were JSS leavers and 17 percent had completed senior secondary school. Also, 19 percent had ordinary-level and 5 percent had Advanced-level certificate. It was observed that the level of formal education of the majority of the workers (27 percent) interviewed was generally low. This is in line with the findings of Bureau of Labour Statistics (2003) in the United States which argued that agricultural production industry is characterized by a large number of people with low level of educational attainment. More than 30 per cent of the industry's workforce does not have high school diploma. Experience and some formal education are necessary for agricultural managers. A bachelor's degree in business with a concentration in agriculture provides a good background with work experience in the various aspects of farm operations enhances productivity Bureau of Labour Statistics (2003).

In addition, lack of formal education representing 27 percent of the workers undermines productivity, employability leading to poverty and hunger (FAO, 2005).

Furthermore, from Table 1, the highest frequency for the number of years workers interviewed have worked at Jei River Farms is 4-7years representing 48 percent of the workers. This is followed by 0-3 years of experience representing 35 percent of workers, 8-11 years representing 15 percent and 12-15years representing 2 percent of the workers at Jei River Farms. The range of experience shows that workers at Jei River farms have appreciable experience and that if this is accompanied with some form of education for the workers, it will increase their productivity. This is because according to the report by Bureau of Labour Statistics in the United States of America (2003), experience and some formal education are necessary for agricultural workers to increase productivity.

Table 1. Socio economic characteristics of sampled respondents

Variable	Respondents	
	Frequency (N=100)	Percentage (%)
Staff category		
Administration	15	15
Export department	20	20
Field	50	50
Technical staff	15	15
Age		
18-25	17	17
26-35	34	34
36-45	36	36
46-60	9	9
Above 60	4	4
Educational level		
Tertiary (Diploma, Degree, masters, Ph.D.)	12	12
A Level	5	5
O Level	19	19
Senior Secondary School	17	17
Junior Secondary School	20	20
No formal education	27	27
Number of years worked with Jei river farms		
0-3	35	35
4-7	48	48
8-11	15	15
12-15	2	2
Gender		
Male	65	65
Female	35	35
Marital status		
Single	29	29
Married	41	41
Divorced	30	30

Lastly from Table 1, it is evident that the majority of the respondents 65 percent were male while 35 percent were female which is representative of the demographics of the male/female ratio (1.85:1) of workers at Jei River Farms.

Factors Affecting Labour Productivity

Results from the ordered probit model in Table 2 indicate a chi squared value of 29.83 percent which means that 29.83 percent of the changes in the regressand (labour productivity) is explained by its association with the regressors. The likelihood ratio (LR) tests the limitation that the coefficients of the variables in Table 2 are not significantly different from zero (which in this case is the null hypotheses) as against the alternate hypothesis that

the coefficients are significantly different from zero.

The likelihood ratio (LR) statistics was significant at 1 per cent. The z-statistics also test the hypothesis that the coefficient of each of the independent variables is not significantly different from zero. The probability attached to the independent variables determines whether this null hypothesis should be accepted or rejected. The lowest probability level which was used to either reject or accept the null hypothesis was 0.1; hence variables whose probabilities were more than 0.1 were regarded as variables that had no explanatory power on the dependent variable (labour productivity). Hence, the socio-economic factors: education and introduction of new technology were significant at 1 percent and both had a positive effect on labour productivity. This was in agreement with the work of Heizer & Render (1990) who reported that the introduction of a new technology and education has a positive effect on labour productivity. The implication is that Jei River Farms should employ workers that have received some form of formal education and also should often introduce new technologies on the farm (Table 2).

Age and age square were significant at 5 percent and experience was significant at 10 percent. Age and experience had a negative effect on labour productivity. These two variables did not meet the a priori expectation. The reason for this may be that as a worker attains the age of 45 years his productivity begins to reduce because most of the work on the farm involves the use of physical strength. Also, the longer labourers stay and work on the farm, the more experienced and secured they become in their job and such the worker may not put in as much effort as compared to a newly employed worker.

Also, challenging job and salary were significant at 1 percent and 10 percent respectively. This result is in agreement with the work of Darlton and Tudor (1993) who reported that challenging job has a positive effect on labour productivity. The remaining variables: gender, on the job training, compatible work group and responsibility were not significant at 10 percent. We can, therefore, conclude with 90 percent confidence that, gender, training, compatible work group, and responsibility have no explanatory power over labour productivity. These variables did not meet the a priori expectation. The reason for this was that the workers were of the view that those motivational elements had little impact on their productivity.

Table 3. Marginal effects of significant variables for ordered probit model

Variables	Low productive category	Average productive category	High productive category
Experience	0 .0335	-0.0050	-0.0330
Age	0.0225	-0.0003	-0.0222
Salary	-0.0795	0.0012	0.0783
Challenging job	-0.3321	0.0790	0.2530

Marginal effects of the significant variables

The ordered probit model is not estimated by ordinary least squares (OLS). Therefore, its coefficients do not exactly explain the effect of a unit change in a variable on the changes in labour productivity as may be the case of OLS. Thus, to get the effect of a unit change in an independent variable on the changes of labour productivity, marginal effect of all the variables on productivity were estimated. Also since the dependent variable was an ordered response of three categories, the marginal effect was calculated for the three categories for the three categories as presented in Table 3. The categories are; low productive, average productive and high productive categories.

A perusal of Table 3 revealed that with an increase in age by one year increases the probability of labour productivity by 0.022 among the low productive category, decreases the probability of labour productivity by 0.0003 among the average category and decreases the probability of labour productivity by 0.222 among the high productive category. The implication here is that younger workers are more productive than the older workers

Table 2. Ordered probit model results

Variable	Coefficient	Std. Error (S.E)	b/S.E	P (Z)>z	Mean of X
Gender	0.0982	0.2709	0.3630	0.7168	0.6600
Education	0.7861	0.2898	2.7120	0.0067***	0.7400
Experience of labour	0.1012	0.0575	-1.7590	0.0786*	4.7000
Age	-0.0680	0.0336	-2.0250	0.0428**	35.6500
Age Squared	0.0010	0.0005	2.0660	0.0388**	1375.7100
Introduction of new technology	0.6605	0.2719	2.4290	0.0151**	0.6800
Training	0.1284	0.2706	0.4750	0.6351	0.6400
Challenging job	0.9250	0.3203	2.8880	0.0039***	.74000
Compatible work group	-0.0918	0.1627	-0.5650	0.5724	2.4100
Responsibility	0.0667	0.1472	0.4530	0.6506	2.4100
Salary	0.2402	0.1427	1.6840	0.0923*	1.3600
Mu (1)	1.2464	0.1706	7.3060	0.0000	

******, **, and * Significant at 1, 5, and, 10 per cent level.***

Table 4. Factors that are causing labour retention at Jei River Farms

Variables	Total score	Mean	Std. Dev.	Percent
Lack of economic opportunities	304	3.04	0.941	60.8
Domestic reasons	301	3.01	0.979	60.2
Job security	297	2.97	0.979	59.4
Challenging job	287	2.87	0.836	57.4
Experience	278	2.78	0.835	55.6
Achievement	264	2.64	0.870	52.8
Promotion	252	2.52	0.797	50.4
Compatible work group	241	2.41	0.779	48.2
Responsibility	241	2.41	0.975	48.2
Recognition	227	2.27	0.919	45.4
Work environment	223	2.23	0.814	44.6
Training and development	217	2.17	0.853	43.4
Quality of supervision	190	1.90	0.904	38.0
Dream place of work	175	1.75	0.998	35.0
Fringe benefits	149	1.49	0.858	29.8
Flexibility in work	141	1.41	0.842	28.2
Salary	136	1.36	0.915	27.2

especially those between ages 18 and 30.

Further, the number of years worked on the farm was used as a proxy for experience. The results show that an increase in the number of years worked on the farm by one year increases the probability of labour productivity by 0.0335 among the low productive category, decreases by 0.0005 among the average productive category and decreases by 0.0330 among the high productive category. The implication here is that newly employed workers who had been employed on the farm for less than three (3) years were more productive than those that have been employed for more than three (3) years.

The more a worker perceives that his salary influences productivity, decreases the probability of labour productivity by 0.079 among the low productive category, increases by 0.001 among the average productive category and increases by 0.078 among the high productive category. Also the more a worker perceives that challenging job influences productivity decreases the probability of labour productivity by 0.332 among the low productive category, increases by 0.079 among the average category and increases by 0.253 among the high productive category (Table 3).

Factors causing labour retention at Jei River Farms

The workers were asked to indicate the extent to which some motivational elements were preventing them from withdrawing their service. They indicated them according to their perceptions based on Five points Likert Scale which ranged from 1 meaning "Very Low" contributing factor to 5 meaning "Very High" contributing factor. The measure of central tendency used was the analysis of the mean values of the factors. The perusal of Table 4 revealed that only two factors scored an average mark of 3. The highest mean score was lack of opportunities elsewhere (3.04). This suggests that lack of opportunity elsewhere is the most important factor that is preventing labourers from withdrawing their service. This result is in agreement with Bezuidenhout *et al*. (2009) who reported that the second most important reason for leaving an employment is the prospect of a better opportunity elsewhere. The next important factor causing labour retention is domestic reasons (family considerations) with a mean score of 3.01. These two variables were significant in explaining the reason why workers are unwilling to leave Jei River Farms.

The other factors scored below the average mark of 3. Job security was the third most important factor and the challenging job was the fourth most important factor. Udo and Tor-Guimaraes (1997) reported that challenging job is one of the most important factors that cause labour retention.

The least factor causing labour retention was salary which meant that workers are not too happy with the level of remuneration. The implication is that salary is not a significant motivating factor in explaining labour retention at Jei River Farms.

The measure of dispersion used was the standard deviation (SD). The highest standard deviation (SD) of 0.999 "for dream place of work" meant that there was wide variation in the response to this factor. The two lowest standard deviations of 0.779 and 0.797 for "compatible work group" and "promotion" meant that these two factors had the lowest variability in their response to these questions.

Attitude of labourers towards perceived low motivation

The response of labour towards low motivational package at Jei River Farms include lateness to work, absenteeism, delay in the performance of duty, free riding

Table 5. Attitude of labourers towards perceived low motivation

Item	Yes		No	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Lateness to work	32	32.00	68	68.00
Absenteeism	20	20.00	80	80.00
Delay in performing duty	64	64.00	36	36.00
Free ride	58	58.00	42	42.00
Dislike for Management	59	59.00	41	41.00

and the dislike for management.

Lateness to work

The perusal of Table 5 revealed that 32 percent of the workers (majority belonging to the export and technical department) are of the view that they sometimes deliberately come to work late because motivators were generally low whiles the remaining 68 percent who form the majority assert that they always come to work on time even though motivation is low. This is because they are picked to work by company truck, and as such if they miss the truck, they could not walk to the farm because their houses are far from the farm. This implies that majority of the workers are happy with the provision of a vehicle to carry them to work and that the absence of this arrangement will result in lateness to work. However, this finding is in disagreement with the work of Aluko (1998) who reported that low motivation causes lateness to work.

Absenteeism

The perusal of Table 5 shows that 80 percent of the workers were of the view that they did not absent themselves from work due to low motivation whereas the other 20 percent reported they absented themselves from work because of low motivation. The reason for the majority of the respondents not absenting themselves was that they were paid by the number of days they worked and that if they absented themselves from work their wage for that month would reduce. It was observed that majority of the respondents (15 percent) out of the twenty labourers who absented themselves due to low motivation were fixed salary earners mostly belonging to administration and technical categories of staff. This result indicates that payment of workers by the number of days worked encourages workers to come to work regularly.

Delay in the performance of duty

The results presented in Table 5 revealed that 64 percent of the workers (mostly belonging to field department) reported that they sometimes delayed in their performance of duty because of low motivation whereas the other 36 percent (mostly belonging to administration and technical departments) reported they did not see the need to delay in the performance of their duty. Those who reported that they do not delay in performing their duty gave reasons such as; it is their work so why the delay and others also said their religious belief does not permit them to do that because they would not want anyone to do same to them in future when they also start their own farm.

Free riding

The findings presented in Table 5 indicated that majority 58 percent of the respondents (mostly belonging to field department) had recourse to free riding because of low motivation in the form of salary and fringe benefits. This is consistent with the work of Hansen (1997) who reported the problem of free riding in his study. Some of the workers reported that they deliberately converse among themselves to while away the time so that their colleagues who were better motivated in the form of better salary package do the work. The implication of this finding is that workers who work in teams, especially the field workers usually have free ride as compared to workers that do not work in teams. The rest (42 percent) mainly belonging to administration and technical departments reported that they do not have free ride because that would amount to cheating whiles others also reported they did not want to be reported to management for this behaviour.

Dislike for management

The results presented in Table 5 clearly revealed that low motivational package can result in the dislike for those in management. Majority (59 percent) of the respondents (mostly belonging to the field department) reported they dislike management because they thought motivational package, especially salary and fringe benefits, was low on the farm and management was not doing anything about it, whiles the other 41 percent mostly belonging to administration and export departments reported they did not see dislike for management appropriate because of low salaries and fringe benefits. The latter group reported that their religious belief on work ethics was the reason why they would not dislike management due to low motivation.

CONCLUSIONS AND RECOMMENDATIONS

The findings of the study show that workers at Jei River Farms have different socio economic characteristics in age, number of years worked on the farm, gender, marital status, number of children and educational level.

Motivators that were important in influencing labour productivity were the challenging nature of the job, mostly for administration and technical staffs and the salary level mostly for field staff. They both had positive effects on labour productivity. Socio economic factors such as education, farm work experience, age and introduction of new technology were also significant in explaining labour productivity. “Education” and “introduction of new technology” had positive effects on labour productivity. However, “age” and “farm work experience” had negative effects on labour productivity. They both did not meet the a priori expectation. The reason for this may be that as a person gets older his productivity reduces and also the more years worked on the farm suggests job security for the worker and therefore complacency in terms of work effort as compared to the newly employed worker.

The findings further show that workers desire for achievement, experience, promotion, challenging job, job security, domestic reasons and lack of economic opportunities elsewhere were the factors that were identified as factors causing the retention of labourers at Jei River farms. Factors such as compatible work group, responsibility, recognition, training and development, supervision quality, fringe benefits, salary, work environment, flexibility in work and dream place of work were factors identified as factors that contributed least in

labour retention at Jei River farms.

In context of policy recommendation, factors such as compatible work group, responsibility, recognition, training and development, supervision quality, fringe benefits, work environment, and flexibility in work contributed least to the retention of labourers on the farm hence management should engage the workers in discussions as to how best they can satisfy them on these issues. The farm needs to address concerns causing low staff motivation such as inadequate fringe benefits and inadequate training.

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Cropping Pattern, Diversification and Concentration of Crops: Some Evidence from Himachal Pradesh

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ABSTRACT

Diversification of crops is regarded as an appropriate strategy to raise farm income, generate employment, poverty alleviation, conservation of precious soil and water resources, mitigating crop risk etc. In this backdrop, the purpose of the present study is to make detailed analysis of cropping pattern at the state as well as districtlevel with a view to bringing out the areal concentration and diversification of crops in the state of Himachal Pradesh. With the help of various tools like proportion of area under crops, Berry's index, Theil's Entropy Index, Location Quotient (LQ) method, the study reveals that the dominance of food grain crops in terms of acreage allocation has reduced marginally by 3.7 Per cent whereas it has increased in case of high value crops like fruits (dry +fresh), vegetables and other food crops (sugarcane, ginger, garlic, chilies, turmeric, onion etc.) during the study period at the state level. The empirical results shows that crop diversification in the state has been persisting since the beginning of the period of study, however reallocation of land towards high value crops has been taking place continuously at the macro level. Further, it is also clear from the analysis of regional concentration of crops that crops of high value have more concentration in the districts of Shimla, Solan, Sirmaur, Kullu, Lahul & Spiti, and Kinnaur as compared to district Bilaspur, Mandi, Hamirpur and Kangra(having more fertile and plain area). In view of this, the present study has an important policy implications for evolving a suitable cropping pattern to raise the crop income in the state through motivating the farmers to produce high value crops, providing critical infrastructure, policy for stray- cattle, coordinated approach by all departments dealing with agricultural issues, adoption of villages etc.

Keywords
Berry's Index, crop diversification, cropping pattern, Entropy index, location quotient method.

JEL Codes
Q10, Q15, Q18.

INTRODUCTION

The study of cropping pattern, diversification and concentration of crops is of paramount importance for planning rational and balanced programs for land use of crop production. The cropping pattern deals with the nature of crop and percentage of area under each crop at a point of time and it changes in response to change in agro-climatic, economic, technological and institutional factors (Vaidyanathan, 1992). A change in cropping pattern means change in the proportionate area under different crops. Further, Crop diversification generally means a shift from mono crop farming to multiple crop farming, from subsistence farming to commercial farming or from low value food crops to high value food or non-food crops to increase the income of farmers. The crop diversification is very essential in order to minimize the risk and uncertainties associated with yield, market, price, weather, pests, diseases, etc. Moreover, crop diversification is also considered essential to reap scale economies arising out of the complementary and supplementary enterprises. It also generates more employment as the farmers and agricultural workers remain busy in inter-cultural operations of different crops throughout the year. Similarly, the study of crop concentration permits us to understand the multifaceted agricultural background of a region so as to facilitate us to decide the approaches for agricultural development. Crop concentration means the variation in the density of crops in a region at a given point or period of time. The spatial variation in the degree of concentration are largely

determined by the interaction between various factors such as physiographic, climatic, hydrological, socio-economic, techno-organizational, etc.(Ghosh, 2010).

Agriculture has an important place in Himachal Pradesh' economy as about 90 per cent the population of the state resides in rural areas (highest in country in terms of percentages) and nearly 63 per cent of the working population directly or indirectly depends on it to eke out its livelihood. However, the share of agriculture sector in gross state domestic product has declined from 21.1 per cent in 2000-01 to 10.4 per cent in 2014-15, yet the agriculture sector continues to occupy a vital place in the state economy and any fluctuation in the production of food grains/ fruit affects the overall performance of the economy (Economic Survey of Himachal Pradesh: 2015-16, p. 10). Besides, there is a greater scope for the development of this sector comprising of cultivation, horticulture, animal husbandry & fishery, however agriculture is more dependent up on vagaries of monsoon thereby risk of crop loss becomes so high especially due to inadequate source of irrigation. Therefore, farmers grow several crops in a season to get somewhat from their fields in case of extreme weather. Governmental of Himachal Pradesh is leaving no stone unturned to promote the widespread diversification in the field of agricultural production. Over the years, state government has launched a series of programs for the development of agriculture for example, high yielding variety programs, multiple cropping, soil testing programs, kisan credit card scheme, plant protection programs, bringing more are under HYV cultivation, approach to watershed development, demonstration and effective dissemination of improved farm technology, national agricultural technology project, crop insurance scheme, seed certification program, seed village program, agriculture education &training program, computerization of land records etc. in order to increase the food grain production through diversification process thereby boosting the income of farm families(Kumar; 2015). Keeping in view the dominance of agriculture in state's economy and occupation of people of the state, the present study also provides a detailed analysis of cropping pattern, crop diversification and concentration of crops to suggest remedial measures for crop planning in order to boost farm family income. More specifically, the objectives of the present paper were:

i, to explore the nature and trends of cropping pattern in Himachal Pradesh,

ii, to examine if there exists any significant variation in cropping pattern across the districts of the state,

iii, to study whether there is crop specialization taking place across the districts or diversification of crops going on,

iv, to study the major crops which are concentrated at the district level, and

v, To find out the chief determinants of crop specialization/diversification and suggest changes in cropping pattern to raise crop income.

DATA SOURCE AND METHODS

The present study relies on secondary data compiled from various published sources. Data were collected from various issues of Economic Surveys, State Statistical Abstract and District Statistical Abstract published by the Directorate of Economics and Statistics, Himachal Pradesh and Annual Seasons and Crop Report (Various issues) published by Directorate of Land Records, Himachal Pradesh for the period1980-81 to 2012-13. The nature of crop diversification is examined through changes in allocation of land towards the cultivation of different crops grown in different seasons over the years. However, there are various methods available in the literature to study the extent of diversification but for the present empirical examination, Berry's index and Theil's Entropy index have been used. Berry's Index has been defined as:

$$\text{Berry's Index of Diversification} = 1 - \sum_{i=1}^{n} P_{it}^2$$

Where $P_{it} = \frac{A_{it}}{\sum_{i=1}^{n} A_{it}}$ =Proportion of Area under ith crop at time't',

A_{it} = Area under ith crop at time 't'.

$\sum_{i=1}^{n} Ait$ = Gross cropped area under all crops at time't'.

The value of Berry's index varies between zero and one. It is one in case of perfect diversification and zero in case of perfect specialization.

$$\text{The Entropy Index is defined as: } \sum_{i=1}^{n} Pit \log\left(\frac{1}{Pit}\right)$$

The value of Entropy index (E) varies from zero to log n. 'E' takes the value of zero in case of perfect specialization and log n when there is perfect diversification.

Actual degree of diversification to maximum diversification for a given number of crops can be measured through Berry's index as:

$$\text{Degree of diversification} = Berry's\ Index / \left(1 - \frac{1}{n}\right)$$

Where n= Number of crops grown in the area.

Degree of diversification by Entropy Measure

= Entropy Index/logn

In order to identify the relative importance of crops in each district, the Crop Concentration Ratios (CCR) (defined as the ratio of share of area under a crop in a district to share of area under a crop in the state(Deshpande *et al*., 2004)) have been worked out with the help of location Quotient method (LQ). The crops with CCR above 0.40 have been identified as major crops in a particular district. There are many qualitative and quantitative measures available to determine crop concentration, however the most common method is the Location Quotient Method (LQ) or coefficient of

localization for which different methods have been suggested by Florence(1948); Chisholm (1962); Bhatia (1965); Singh(1976). LQ for crop concentration can be computed as:

$$LQ = \frac{\frac{Aij}{Aj}}{\frac{\Sigma^{n}_{i=1} A_{ij}}{\Sigma^{n}_{j} A_{j}}}$$

A_{ij} = Gross cropped area under i^{th} crop in j^{th} district,

A_{ij} = Gross cropped area in j^{th} district

$\sum_{i=1} A_{ij}$ = Gross cropped area under i^{th} crop in the state and

$\Sigma^{n}_{j} A_{j}$ = Gross cropped area of the state.

When the index value is greater than unity, the constituent area unit accounts for a share greater than it would have had if the distribution remained uniform in the entire region and therefore, the areal unit has a concentration of great agricultural significance (Bhatia, 1965). Higher the crop concentration index, higher is the level of interest in the production of that crop in a particular areal unit. It also helps us in making important decisions regarding marketing, storage and trading of the crop produce.

Prominent Research Work in the Field

A general review of the literature of the period shows that the researchers, policy makers and agricultural economists are very much interested to study cropping pattern, crop profitability, crop diversification and concentration of crops over the years at the national as well as state level as it is the agriculture sector which affects the overall performance of our Indian economy. Our 12th Five Year Plan has also set the target of 4.0 per cent growth in agriculture so that overall target of 9.0 per cent can be achieved (12th fyp_vol.1, p. 42). The studies conducted at the national level by Singh (1962); Gupta & Tewari (1985); Vyas (1996), Hazara (2001); Ramasamy (2004); Birthal *et al.* (2006); Ray (2007); Raghvan (2008); Thirunavukkarasu (2009); Ghosh (2010 & c2011); Wani(2011); Pal & Kar (2012); Kumar *et al.* (2012); Velvan & Balaji (2012); Basu & Berma (2014); Dasgupta & Bhaumik (2014); Pattanaik & Shah (2015); Singh *et al.*(2015) and at the state level by Kalia (1983); Thakur *et al.* (1985); Oberai & Raina (1991); Chand (1996), Kumar *et al.* (2002); Singh & Sikka (2004); Sharma (2005 & 2011); Kumar (2011); Kumar *et al.* (2012) Sharma & Chauhan (2013); Kumar (2015) are the main ones in this field. Vyas (1996) conducted a study on agricultural diversification reveals that Indian agriculture is diversifying towards high value commodities such asfruits, vegetables, milk products, meet and fisheries and similar results were obtained by Gulati *et al.* (2004). Mazumdar (2006) pointed out that agricultural diversification is a pre-requisite to attain rural diversification. Ray (2007) highlights the importance of credit availability as an important contributing factor towards changes in cropping pattern. Velvan & Balaji (2012) conducted a study on crop diversification in Tamil Nadu shows that crop diversification is taking place in the state. The study conducted by Kumar *et al.* (2012) in eastern region of the country reveals that crop sector has been diversifying towards high value crops albeit slowly and there are considerable variations in crop diversification across different states of the region. The study highlights the importance of technology, modern implements, education and road connectivity as the important determinants of crop diversification towards high value crops besides agro climatic factors.

Thakur *et al.* (1985) reveals that diversification towards intensive vegetables cultivation can enable farmers to get yields which are ten times higher than cereals crop per unit of land. As the price of vegetables also remains higher than that of cereals, diversification of farming with vegetables production helps even the small farmers can earn sufficient income to make their livelihood. Sharma (2005) has pointed out towards economic viability and ecological unsustainability of the process of crop diversification due to the degrading soil health, erratic water conditions, perceptible changes in weather & climatic conditions, old age of crop bearing apple plants, increasing cost of production, increasing competition from cheaper imports due to WTO, low & stagnant productivity level, excessive use of agro-chemicals especially after post- liberalization, emergence of numerous, insects, pests & diseases, etc. He has suggested for the incorporation of regional specificities mingled with committed state intervention for creating favorable conditions for triggering the process of agricultural transformation through crop diversification. Further, Sharma & Chauhan (2013) advocated for the promotion of agricultural R & D and its effective dissemination especially for the farming of high value crops may enhance economic viability and sustainability of crop farming in the hilly areas of Himachal Pradesh.

Changes in Cropping Pattern

Table 1 portrays that the economy of the state is predominantly agricultural based as about 81 per cent of the area is covered by food grain crops in 2012-13 however, it has come down since 1980-81. Major food crops (maize, paddy, and wheat) predominate the agricultural scenario, which account for about 78 per cent of total cropped area, however the area under rice is showing declining trend whereas in case of maize and wheat, it is more or less constant. The area under pulses mainly gram and other cereals comprising of barley, ragee, millet (mandua, kangani, and cheena), etc. is decreasing whereas, the area under orchards especially of apple and vegetables like tomato, potato, ladyfinger, cauliflower, cabbage, etc. is increasing over the years. Main cereals like maize and wheat has replaced inferior cereals such as barley, ragee, millet, etc. due to technological changes occurred in recent past in the state and changes in taste of farmers due to increase in income and interaction with the rest of the world. The area under

pulses especially of gram has also decreased due to more requirement of labour on account of tedious intercultural operations, frequent weather changes in recent past, violent fluctuation in prices of pulses and traditional variety of pulses has also became susceptible to insects and pests over time. Moreover, with the improvement in infrastructural facilities like road network, increased commercialization and development of trade, crop pattern got adjusted because of advantages of trade in commodities. Earlier, a family used to grow most of the crops it required for its self-use because of trade with other region was so weak. It being so, the area under many of the traditional crops and pulses has declined over the years, for example the area under pulses has come down to 22.62 thousand hectares in 2012-13 from 55.6 thousand hectares in 1980-81 thereby showing a decline of about 59.31 per cent during this period.

There are two nodal agencies to supply the information on area under fruits that is, Department of Horticulture and Land Records. However, there is inconsistency in their record as far as area under fruit is concerned for example the data reported by horticulture Department is almost four time higher than the data provided by Land records.

After a careful examination, it is concluded that the area under fruits supplied by Land Records is more reliable, authentic and useful to study crop pattern because it is based on field to field enumeration done by village revenue officials and also follows standard methodology to apportion area under fruits, trees& other crops when intercropping is done. Again, the area under various crops and uses is tallied with total land area of each village i.e. increase in area under one crop or use must involve decrease elsewhere. Such type of enumeration is absent in the Department of Horticulture and the data furnished by them is mostly depend upon number of nursery plants sold, export of fruits outside the state etc. It is also pertinent to note that a small shift in crop pattern to a suitable crop can lead to tremendous increase in output and income of the farm families. Apple, cherry, citrus and offseason vegetables like tomato, peas, cauliflower, cabbage, potato, etc. are important examples of such success stories due to favorable climatic and topographical conditions of the state. Apple with only 5.0 per cent share in total cropped area, has made the state to be known as Apple State. Fruits and Vegetables (potato having 1.7 per cent in 2012-13) despite of their low share in area as approximately 13 per cent, make significant contribution towards total output because of their manifold higher output value as compared to cereals , pulses and oilseeds. Keeping in view, the peculiar physical and agro climatic conditions of the state, the scope to bring more area under cultivation is severely limited and available land is exhaustively used for raising cereal crops for the purpose of self -subsistence of the rural masses however, the trend of area apportion to fruits and vegetables is quite considerable in some recent years due to the growing awareness of high value crops among the farming communities. Again as far as crop diversification is concerned, there is no change in diversification of crops as suggested by Berry and Entropy measures under the study period.

Table 1. Temporal changes in cropping pattern in Himachal Pradesh, 1980-81 to 2012-13

(000'ha)

Crop and crop groups	1980-81	1990-91	2001-02	2012-13
Rice	93.3	84.93	80.58	74.86
	(9.8)	(8.64)	(8.4)	(7.94)
Maize	285.9	319.11	301.28	296.87
	(30.2)	(32.44)	(31.5)	(31.51)
Wheat	350.8	376.27	366.51	360.67
	(37.0)	(38.26)	(38.3)	(38.28)
barley	36.5	29.29	25.02	21.06
	(3.9)	(2.98)	(2.6)	(2.23)
Other cereals	34.5	21.96	13.98	9.16
	(3.7)	(2.23)	(1.5)	(0.97)
Total cereals	**801.0**	**831.56**	**787.37**	**762.62**
	(84.6)	**(84.55)**	**(82.3)**	**(80.94)**
Total pulses	55.6	39.98	29.56	22.62
	(5.9)	(4.06)	(3.1)	(2.40)
Total food grains	**856.6**	**871.54**	**816.93**	**785.24**
	(90.5)	**(81.61)**	**(85.4)**	**(83.34)**
Total fruits	20.3*	43.71	62.42	83.07
	(2.1)	(4.44)	(6.5)	(8.81)
Total vegetables	16.7**	29.01	36.09	37.70
	(1.8)	(2.95)	(3.8)	(4.00)
Other food crops	6.7	5.49	8.52	11.01
	(0.6)	(0.56)	(0.9)	(1.16)
Total food crops	912.2	949.75	923.96	917.02
	(96.4)	(96.56)	(96.7)	(97.33)
Total non-food crops	34.2	33.84	31.78	25.10
	(3.6)	(3.44)	(3.3)	(2.66)
Total food and non-food crops	**946.4**	**983.59**	**955.74**	**942.12**
	(100.	**(100.0)**	**(100.0)**	**(100.0)**
Berry' index	**0.75**	**0.73**	**0.74**	**0.74**
DD_B (per cent)	**83.33**	**81.11**	**82.22**	**82.22**
Entropy index	**0.74**	**0.72**	**0.72**	**0.72**
DD_E (per cent)	**74**	**72**	**72**	**72**

Source: Computed from Annual Season and Crop Report (Various Issues), Directorate of Land Records, Shimla, Government of Himachal Pradesh.

**** stands for the area under apple crop only, ** denotes area under potatoes only and *** indicates area under fruits & vegetables except apple and potatoes. DD_B & DD_E denotes degree of Diversification through Berry's Measure and Entropy Measure.***

Cropping Pattern at the District Level

Himachal Pradesh being a hilly state enjoys different agro-climatic conditions (depending up on altitude, rainfall , climate & other related factors) and therefore the study of cropping pattern at district level also have greater significance for planning rational and balanced programs

Table 2. Cropping pattern at the district level during 2012-13

(Area ha)

Crop and crop groups	Bilaspur	Chamba	Mandi	Kangra	Hamirpur	Una	Kinnaur	Lahul &	Kullu	Solan	Sirmaur	Shimla
Maize	27409	27580	48630	56790	32294	32157	88	27	16855	23961	20708	10370
	(47.51)	(40.08)	(30.37)	(26.67)	(46.22)	(43.00)	(0.91)	(0.79)	(28.28)	(38.77)	(27.42)	(11.80)
Rice	1274	3355	18760	36622	1957	1587	6.00	-	1516	2094	6442	1246
	(2.21)	(4.88)	(11.72)	(17.20)	(2.80)	(2.12)	(0.06)		(2.54)	(3.39)	(8.53)	(1.42)
Wheat	26963	21589	70605	92537	34452	34836	148	55	19278	24714	26153	9339
	(46.74)	(31.37)	(44.10)	(43.46)	(49.31)	(46.58)	(1.53)	(1.60)	(32.35)	(39.99)	(34.63)	(10.62)
barley	224	3978	3242	2293	82	-	680	490	3130	1659	2360	2924
	(0.39)	(5.78)	(2.02)	(1.08)	(0.12)		(7.03)	(14.29)	(5.25)	(2.68)	(3.12)	(3.33)
Other cereals	14	1190	1267	579	6	-	1056	31	1067	-	553	3400
	(0.02)	(1.73)	(0.79)	(0.27)	(0.01)		(10.92)	(0.90)	(1.79)		(0.73)	(3.87)
Total cereals(1 to 5)	55884	57692	142504	188821	68791	68580	1978	603	41846	52428	56216	27279
	(96.87)	(83.84)	(89.01)	(88.67)	(98.46)	(91.70)	(20.45)	(17.59)	(70.21)	(84.83)	(74.43)	(31.03)
Total pulses	167	3383	3191	3063	28	192	647	1518	3440	1374	1806	3806
	(0.29)	(4.92)	(1.99)	(1.44)	(0.04)	(0.26)	(6.69)	(44.27)	(5.77)	(2.22)	(2.39)	(4.33)
Total food grains	56051	61075	145695	191884	68819	68772	2625	2121	45286	53802	58022	31085
	(97.16)	(88.75)	(91.00)	(90.11)	(98.50)	(91.96)	(27.14)	(61.85)	(75.99)	(87.06)	(76.82)	(35.36)
Total fruits	385*	2378	6259	9685	84	652	5817	39	9787	746	1635	45604
	(0.67)	(3.46)	(3.91)	(4.55)	(0.12)	(0.87)	(60.15)	(1.14)	(16.42)	(1.21)	(2.16)	(51.88)
Total vegetables	304	1976	5075	2411	199	1345	1137	935	2856	4582	6803	10076
	(0.53)	(2.87)	(3.17)	(1.13)	(0.28)	(1.80)	(11.76)	(27.27)	(4.79)	(7.41)	(9.01)	(11.46)
Other food crops	344	265	653	938	214	198	66	320	947	759	5627	685
	(0.60)	(0.39)	(0.41)	(0.44)	(0.31)	(0.26)	(0.68)	(9.33)	(1.59)	(1.23)	(7.45)	(0.78)
Total food crops	57084	65694	157682	204918	69316	70967	9645	3415	58876	59889	72087	87450
	(98.95)	(95.46)	(98.49)	(96.23)	(99.21)	(94.89)	(99.73)	(99.59)	(98.79)	(96.91)	(95.44)	(99.49)
Total non- food crops	606	3122	2418	8025	550	3821	26	14	721	1912	3442	448
	(1.05)	(4.54)	(1.51)	(3.77)	(0.79)	(5.11)	(0.27)	(0.41)	(1.21)	(3.09)	(4.56)	(0.51)
Total food & non food	57690	68816	160100	212943	69866	74788	9671	3429	59597	62001	75529	87498
	(100.00)	(100.00)	(100.00	(100.00)	(100.00)	(100.00)	(100.0)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00

Data in parentheses shows percentages to respective column total.

of the crops in each district. The farmers desire that crop combination for which they can derive maximum possible net revenue at minimum possible risk if there is no dearth of crucial factors of cultivation of these crops. Due to different agro-climatic zones of the state, the atmosphere is very congenial for the production of different crops ranging from staple & low value crops like maize, paddy or wheat to high value crops as apple, dry fruits or medicinal plants. It being so, different areas of the state have varied production potential of different crop combination depending mostly up on law of comparative advantages, agro- climatic conditions and technical & institutional factors. Table 2 explores cropping pattern at the district level for the given years. It can be observed from the table that traditional crops like maize and wheat dominate the agricultural crop area scenario in the districts of low hill zone viz. Bilaspur, Chamba, Mandi, Kangra, Hamirpur, Una, Solan and Sirmaur due to similar agro-climatic conditions.

Even the climate and soil content is congenial for the cultivation of paddy crop yet it is not desirable due to the tedious intercultural operations associated with it in recent years. Lack of availability of hired in labour at the peak hours of cultural operations is also the reason for non -popularity of this crop. Similar conclusion can also be drawn for the area under pulses. In respect of area under fruits is concerned, the districts like Shimla, Kinnaur and Kullu have made significant improvement for the cultivation of different kinds of dry as well as fresh fruits due to the high market value and congenial atmosphere for these crops. Districts like Solan, Sirmaur, Shimla, Kinnaur and Lahul & Spiti are leading in terms of area under vegetables is concerned. District Sirmaur has made its image in the production of ginger, Solan in vegetables, Lahul- Spiti in Potato & peas whereas Kullu has made significant contribution in the production of Garlic. In case of non- food crops, the districts like Sirmaur, Una and Lahul & Spiti have more area as compared to the other districts of the state. In a nutshell, agro-climatic conditions, existing infrastructure, market value of the respective crops etc. have driven people of particular area to cultivate favourable crop for them. Inter district analysis of cropping pattern can also be judged from the Table 3 which is just superimposed on Table 2 and it is self- explanatory.

Crop Diversification at District Level

The Crop diversification is opposite to crop specialization and it largely depends up on the agro-climatic, socio-economic conditions as well as technological improvement in a particular area. It is generally presumed that there is inverse relationship between the level of farm technology and degree of crop diversification. The nature of Crop diversification i.e. cropping pattern can be judged through the proportion of area under different crops and the same has been provided in Table 1, Table 2 and Table 3. As far as the extent of crop

Table 3. Inter district analysis of cropping pattern

(Per cent)

Crop group	Districts
Cereals	
1. A ≥80	Bilaspur,Chamba, Mandi, Kangra, Una, Hamirpur and Solan
2. 60 ≤A ≤80	Sirmaur and Kullu
3. A≤35	Kinnaur, Lahul & Spiti and Shimla
Total Pulses	
1. A ≥40	Lahul & Spiti (44 per cent)
2. 05 ≤A ≤10	Kinnaur & Kullu
3. A≤5	Bilaspur,Chamba, Mandi, Kangra, Una, Hamirpur and Solan,Shimla and Sirmaur
Total Fruits	
1. A ≥50	Shimla and Kinnaur
2. 15 ≤A ≤20	Kullu
3. A≤5	Bilaspur, Chamba, Mandi, Kangra, Una, Hamirpur, Solan ,Lahul & Spiti and Sirmaur
Total Vegetables	
1. A ≥20	Lahul & Spiti
2. 05 ≤A ≤15	Shimla ,Kinnaur, Solan and Sirmaur
3. A≤5	Bilaspur, Chamba, Mandi, Kangra, Una, Hamirpur and Kullu
Non- Food Crops	
1. A ≥05	Una
2. 03 ≤A ≤05	Chamba, Solan, Sirmaur and Kangra
3. A≤03	Mandi, Bilaspur, Kullu, Kinnaur, Lahul & Spiti, Shimla and Hamirpur

A= Gross Cropped Area.

diversification is concerned, Berry's measure and Theil's Entropy Index have been used in the present study.

From the Table 4, it is evident that degree of crop diversification ranges from 60 per cent (Hamirpur) to 87 per cent (Sirmaur) for the latest available data and it can be concluded that each district in the state is highly diversified.

However, district Shimla has about 91 per cent degree of diversification in 2004-05 but the data is not consistent due to lack of information under fruit category in that period. Districts like Shimla, Sirmaur, Solan, Kullu, Lahul and Spiti, Chamba, Mandi, Una, and Kangra having higher degree of diversification (more than 70 per cent) as compared to districts Bilaspur, Hamirpur and Kinnaur on the basis of Berry's index. Subsistence kind of farming in the districts (Bilaspur, Hamirpur, Kangra) of low hill zone, agricultural uncertainties, movement towards high value crops like apple, dry fruits, vegetables etc. in mid and high hill zone's districts (Shimla, Mandi, Sirmaur, Kullu, Lahul & Spiti, Solan, etc.) etc. can be given in support of growing crop diversification in the state. As far as the variation in crop diversification with in the districts over the period is concerned, there is no major change has been noticed for any district regarding crop diversification except district Kangra. In district Kangra, degree of crop diversification through Berry's measure has increased from 73 to 79 per cent during the period 2005-06 to 2012-13.

As Entropy Index is concerned, it also indicate towards more crop diversification for those districts as suggested by Berry's measure for the respective period. Both Berry and Entropy's measures provide the same results however, the degree of diversification may be altogether different in both the indices.

Level of Crop Concentration at District Level

Table 5 portrays the crop concentration index of

Table 4. Agricultural diversification in Himachal Pradesh at district level since 2004-05 to 2012-13

District & year	Berry's index	Degree of diversification (Per cent)	Theil's entropy index	Degree of diversification (Per cent)
Bilaspur				
(2005-06)	0.56	62.22	0.42	42
(2012-13)	0.55	61.11	0.42	42
Chamba (2012-13)	0.73	81.11	0.71	71
Mandi				
(2004-05)	0.71	78.88	0.67	67
(2012-13)	0.70	77.77	0.65	65
Kangra				
(2005-06)	0.66	73.33	0.54	54
(2012-13)	0.71	78.88	0.64	64
Hamirpur				
(2007-08)	0.54	60.0	0.39	39
(2012-13)	0.54	60.0	0.40	40
Una				
(2005-06)	0.57	63.33	0.44	44
(2012-13)	0.59	69.55	0.48	48
Kinnaur				
(2005-06)	0.74	83.25*	0.66*	69.47
(2012-13)	0.60	66.66	0.58	58
Lahul and Spiti				
(2007-08)	0.70	77.78	0.63	63
(2012-13)	0.70	77.78	0.62	62
Kullu (2012-13)	0.78	86.67	0.77	77
Solan				
(2005-06)	0.69	76.67	0.64	64
(2012-13)	0.68	75.55	0.62	62
Sirmaur				
(2005-06)	0.78	86.67	0.79	79
(2012-13)	0.78	86.67	0.78	78
Shimla				
(2004-05)	0.81	91.12*	0.79*	83.15
(2012-13)	0.69	76.67	0.69	69

**** No data under fruits category. n=10 and n=9 without area under fruits.***

Table 5. Crop concentration index of major crops at district level in Himachal Pradesh during 2012-13

District	Maize	Rice	Wheat	Barley	Other cereals	Pulses	Fruits	Vegetables	Other food crops	Non-food crops	Most concentrated crop
Bilaspur	1.47	0.31	1.21	0.11	0	0.10	0.09	0.21	0.39	0.51	Maize
Chamba	1.29	0.62	0.77	2.37	2.34	1.74	0.47	0.81	0.25	1.71	Barley
Mandi	0.95	1.46	1.09	0.91	1.09	1.44	0.47	0.89	0.40	0.49	Paddy
Kangra	0.85	2.11	1.13	0.55	0.01	0.51	0.44	0.37	0.32	1.44	Paddy
Hamirpur	1.46	0.34	1.28	0.02	0	0.01	0.02	0.08	0.16	0.17	Maize
Una	1.29	0.31	1.23	0	0	0.12	0.10	0.40	0.49	2.06	Non-food crops
Kinnaur	0.06	0	0.05	4.83	17.7	2.74	6.62	2.18	0.64	0.07	Other cereals
Lahul & Spiti	0.02	0	0.03	5.07	3.50	18.3	0.11	7.32	6.34	0.30	Pulses
Kullu	0.88	0.30	0.84	2.18	2.40	2.05	1.95	1.55	1.34	0.44	Other cereals
Solan	1.21	0.41	1.04	1.11	0	0.79	0.14	2.40	1.03	1.25	Vegetables
Sirmaur	0.88	0.97	0.91	1.25	0.25	0.86	0.28	2.87	6.67	1.51	Other-food crops
Shimla	0.42	0.21	0.36	1.83	3.33	1.65	6.48	1.28	0.40	0.15	Fruits

major crops grown at district level for the year 2012-13. It can be seen from the table that maize is the highly concentrated crop in the districts of Bilaspur and Hamirpur whereas paddy for the districts Mandi and Kangra. Similarly, Fruits especially apple is the leading crop for the Shimla district, other cereals (Ragee, Mandua, Kangni, and Cheena) for the districts Kullu & Kinnaur, vegetables for Solan, Barley for Chamba and non- food crops for the Una district.

As far as district wise analysis is concerned, maize and wheat are the two highly concentrated crops in district Bilaspur whereas Barley, other cereals, pulses, non- food crops and maize are the more intense crops in district Chamba. Fruits, other cereals, barley, pulses and other food crops (sugarcane, ginger, garlic, chilies, turmeric, onion etc.) are the major concentrated crops for district Shimla. It can also be observed from the table that each district has diverse cropping concentration which is largely determined by traditions, climate, soil content and other socio- economic factors of that unit area. Regional concentration of crops in descending order can also be seen from Table 6 which has been worked out from Table 5.

Table 6. Regional concentration of crops at district level in descending order

Districts	Concentration of Crops in descending order
Bilaspur	Maize and Wheat
Chamba	Barley, other Cereals, Pulses, Non- food crops and Maize
Mandi	Paddy, Pulses and other Cereals
Kangra	Rice, Non- food crops and wheat
Hamirpur	Maize and Wheat
Una	Non- food crops, Maize, and Wheat
Kinnaur	Other cereals, fruits, Barley, Pulses, and Vegetables
Lahul &Spiti	Pulses, vegetables, other food crops, Barley and other cereals
Kullu	Other cereals, Barley, Pulses, and Fruits and vegetables
Solan	Vegetables, Non- food crops, Maize, Barley, Wheat, and other food crops
Sirmaur	Other food crops, vegetables, non- food crops, and Barley
Shimla	Fruits, other Cereals, Barley, Pulses and Vegetables

CONCLUSION AND POLICY IMPLICATIONS

Diversification of crops is regarded as an appropriate strategy to raise farm income, generate employment, poverty alleviation, conservation of precious soil & water resources, mitigating crop risk, etc. The empirical results shows that crop diversification in the state has been persisting since the beginning of the period of study, however reallocation of land towards high value crops has been taking place continuously at macro level. There are large scale inter district variation in the level of crop diversification ranging from 60 to 87 per cent, however each district enjoys a reasonable degree of crop diversification but the question is, in which direction crop diversification is taking place? The districts of mid & High hill zones comprising of Shimla, Solan, Kullu, Sirmaur, Mandi, Kinnaur, Lahul and Spiti, etc. are making a much headway towards high value crops due to pleasant weather conditions whereas district like Bilaspur, Hamirpur, Una and Kangra are lacking due to unfavorable climatic conditions, lack of irrigation facilities, fragmented and scattered holdings, growing marginalization of holdings, menace of stray-cattle, etc. Further, it is also clear from the analysis of regional concentration of crops that crops of high value have more concentration in the districts of Shimla, Solan, Sirmaur, Kullu, Lahul and Spiti, and Kinnaur as compared to district Bilaspur, Mandi, Hamirpur, and Kangra. The chief determinants of crop diversification towards high value

crops may include favorable agro-climatic conditions, remunerative price for the fruits, vegetables, and other crops, awareness among common masses for the cultivation of high value crops. In view of this, the present study has an important policy implications for evolving a suitable cropping pattern to raise the crop income in the state.

- Keeping in view the interest of 63 per cent of the working population of the state in agriculture, the first and foremost thing is to motivate the farmers through adequate incentives especially of low hill zone to cultivate the crops of high market value. Crop farming in low hill zone has become increasingly complex and needs a new set of practices & institutions (Government, NGO's, economic, social, legal etc.) to bring about this structural readjustment. There is no denying the fact that Himachal Pradesh can't compete with its adjoining states in terms of productivity (yield) of food grain crops, it being so, emphasis must be on the cultivation of high value crops suitable to particular area or region with due consideration of agro- climatic conditions. Initially, Government have to identify those regions where staple food grain crops dominate and have congenial climatic conditions as well as potential for the production of chosen high value crops. After that, Government should adopt at least one village for three years of adequate size in terms of area and population in each panchayat to set it as a model village and a committee must be constituted comprised of Village Pradhan, Revenue Officer, Soil Scientist, Agronomist, Technical Worker, Block Development Officer, etc. to motivate the farmers and supervise the progress of crop production. Then, all the villagers must be motivated to cultivate the identified crops through this constituted committee in addition to adequate incentives such as crop insurance, cash compensation in case of crop failure , easy access to institutional credit at subsidized rate etc.
- After motivation and to make them ready to cultivate chosen crops, next thing is to provide critical infrastructure. New farm implements, machines, irrigation facilities, certified seeds, fertilizers, storage and warehousing facilities, etc. must be provided well- in time and at affordable prices to the farmers. It is the responsibility of the committee to monitor the production process in accountable, transparent and responsible manner on regular basis and if obstacles are found at any stage, these must be solved through suitable measures. Further; most importantly, an appropriate strategy must be chalked out to get rid of the menace of stray- cattle and wild animals like swine, monkeys, mice, rabbits, birds etc. as the huge bulk of crops are eaten and destroyed by theses stray- cattle and wild animals. As per the 19th National Livestock Census, 2012, Indian livestock population accounts for more than half- a billion (512 Million) and from all national livestock there are approximately 190 million exotic/crossbreed & indigenous cattle (Cow species), more than anywhere else in the world. From all national livestock, the holy cows(Mother Goddess) suffer the worst fate as the milch cattle(in milk and dry) turns dry between milking cycles, older animals and nearly all the males are no longer used to plough fields in many parts of the country are left to fend for themselves. These stray-cattle are forced on garbage in cities and towns and viewed as pests by rural farmers. Stray- cattle have become a nuisance that is turning into menace. The problem of stray-cattle has turned so acute that farmers now have to spend huge sums to fence their fields. Moreover, farmers had to pay more for expensive veterinary procedure to abort unwanted calves and to keep them with Gosadans which is not cost effective and loss of earning for them. As the problem of stray-cattle does not belong only to one state therefore it calls for the formulation of national stray-cattle policy to mitigate this menace. For this, it is suggested that grazing land/pastures/ meadows/grasslands or cattle feeding areas must be identified at the national level on the analogy of wild life sanctuaries which must be protected, controlled and managed by concerned departments, rural local bodies, NGO's, civil societies, religious institutions, social workers, Industrial houses, veterinary doctors, agronomists, etc.
- In this respect, Himachal Pradesh has formulated its stray-cattle policy in 2014 which reveals that there are 32130 stray-cattle and 75 cow shed/ Gosadan run by NGO's and one managed by government with a capacity of 7451. At present these Gosadans are giving shelter to 6498 animals. Government is assisting many of these Gosadans within its limited resources and also seeking the involvement of Temple Trusts in this endeavor. If all these stray - cattle were to be housed in Gosadans, the estimated financial requirement is ₹80 crore (as one time capital expenditure on sheds) and a recurring annual expenditure of about ₹66 crore (at the rate of ₹56 per animalper day) to feed and maintain the animals in Gosadans. Moreover, there had also been a trend that some people bring truck loads of stray-cattle from adjoining states and dump them in the border areas of the state. The state government is prioritizing this menace and taking a lot of initiatives to rehabilitate but keeping in view the present status of the number of stray cattle and existing infrastructure (cow sheds/Gosadan, daily expenditure to upkeep them that is, estimated to be ₹56/day, etc.), these initiatives are inadequate as well as not cost effective and demanding more generalized, practical, and sustainable solution as suggested above to make crop

farming more profitable. Suitable measures must also be undertaken to provide relief to the farmers from swine, monkeys, mice, birds, etc.

- It is also very important to take into consideration the cost aspect of this proposed strategy of adoption of village in each panchayat. As per latest estimate, there are 3226 panchayats in the state of Himachal Pradesh and the aggregate size of 12th Five Year Plan of the state has been projected at ₹22800 crore. If we take into account the proposed outlay on four heads that is, agriculture and allied activities, rural development, area development, and irrigation and flood control, then it worked out to be ₹6309 crore approximately and further it turns out to be about ₹1262 crore per year. If we make a budget of ₹20 lacs per year for each village to meet out necessary expenditure for chosen crop production process, then it came out to be ₹645 crore which is about 51 per cent of the proposed budget outlay and is found feasible. This type of production process undoubtedly help to improve the well-being of stakeholders and it can be replicated to another regions of the state also.
- Last, but not the least, a coordinated approach must be required on the part of all departments dealing with agricultural issues. However, Government leaving no stone unturned to raise crop income and well-being of farm families but these suggestions also need careful consideration if the state has to forge ahead in agricultural development and as a strong viable and sustainable economy from at least agricultural point of view. The action and will power of the government must be seen in the eyes of common people to earn credibility.

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An Econometric Investigation on Groundnut Market Integration in India

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ABSTRACT

This paper analyzes groundnut market integration in four regional markets located in Tamil Nadu, Karnataka, Andhra Pradesh and Gujarat of India using monthly wholesale prices of Groundnut. Unit root test indicated that the price series in each location are non -stationary at their levels, and stationary at their first differences. Co-integration results showed that the regional markets have price linkages, and thus are spatially integrated. Price transmission analysis revealed that bidirectional relationships exist within domestic markets which indicated the price transmission happening in short run adjustments and the presence of long run equilibrium existed among the groundnut markets in Andhra Pradesh, Tamil Nadu, Gujarat, and Karnataka. In the case of Tamil Nadu Groundnut market, the speed of adjustment towards equilibrium was almost 0.34 per cent and Karnataka market was the key determinant of shocks in the groundnut market of Tamil Nadu.

Keywords
Groundnut, price transmission, spatial market integration, time series.

JEL Codes
C01, C22, E37, M31.

INTRODUCTION

Groundnut also known as peanuts, earthnuts, goobers, pinders and manila nuts is believed to be a native of Brazil before it moved to other parts of the world. In India, it was introduced from one of the Pacific Islands of China somewhere in the first half of the sixteenth century. At present, the crop ranks as the thirteenth most important food crop in the world. Shelled groundnuts are basically used as seed, consumed as raw edible groundnuts or after transformation into "prepared" groundnuts (roasted, salted, flavoured, *etc*.) or into groundnut butter/ paste. The seeds can also be crushed for oil and a by-product, *viz*. groundnut meal (animal feed). Groundnut oil is used as quality cooking oil with a high smoke point (440º F) and neutral flavour and odour. Presently, India along with China accounts for half of the world's groundnut production. Grown in tropical and subtropical areas, groundnut thrives between 25-28ºC and under 500 mm rainfall in a loamy and black soil. India ranks second in the world (after China) in groundnut production. The three southern states of Andhra Pradesh, Tamil Nadu, Karnataka and the western state of Gujarat together account for close to 80 per cent of the annual output in India. About 70-75 per cent of the crop is Kharif, grown during the rainy season (planted during May-July and harvested in September-mid December). In the Rabi (winter) season planting is during mid-September to November and harvesting during March and April. Crop failures occur periodically due to inadequate or excessive rain or unfavorable rainfall distribution. Thus, being largely a Kharif crop, monsoon variation fluctuates, groundnut production in the country.

Major Producers of Groundnut in the World

Globally, groundnut is cultivated in more than 100 countries hence it is referred to as a *universal crop*. It is estimated that around 65 per cent of the crop produced in the world is crushed to extract groundnut oil and the rest is used in making other edible products. The world production of groundnut is 42.24 million tonnes during 2016. The groundnut oil is produced to an extent of around 8 million tonnes. The major producers of groundnut in 2016 along with their area, production and

yield are given in Table 1. The per cent share of major groundnut producing countries in area and production of groundnut during 2016 is given in Figure 1 and Figure 2 respectively.

In the context of the production of groundnut oil, China remains on top with a production of around 15.78 million tonnes followed by India with the production of around 7.15 million tonnes. The maximum area that is used for the production of this oilseed is bagged by India with around 4.76 million hectares that account up to 19.05 per cent share in the total area of the world which is around 23.10 million hectares. The country that gets maximum yield from the groundnut crop is China which has a yield of approximately 3.60 tonnes/ha. The world production has been in the uptrend since last decade and it is rising steadily.

Table 1. Major groundnut producing countries of the world 2015

Country	Area (million ha)	Production (million tonnes)	Yield (tonnes/ha)
China	4.700	15.78	3.60
India	4.760	7.15	1.55
Nigeria	2.230	3.40	1.20
Sudan	1.800	1.77	0.78
Indonesia	0.668	1.13	1.84
Myanmar	0.665	0.87	1.00
USA	0.630	2.36	4.12
World	**23.10**	**42.24**	**1.66**
India's percent share	**19.05**	**12.17**	

Source: USDA (United State Department of foreign Agricultural Services).

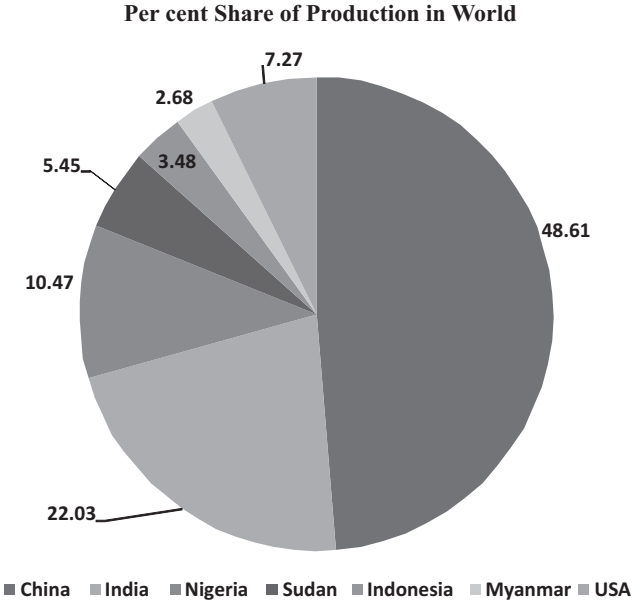

Figure 2. Share of major groundnut production in the major countries of the world (2016)

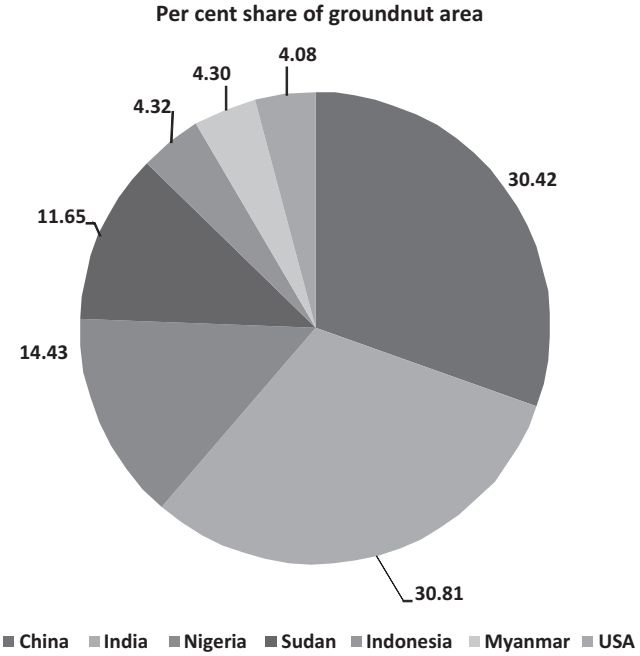

Figure 1. Share of groundnut producing area in the major countries of the world (2016)

REVIEW OF LITERATURE

Granger (1981) studied the econometric methods are not always more accurate than time-series models, they help in understanding causal relationships between variables and can provide evidence of the validity of economic theory. Moreover, all forecasting methods require the use of qualitative judgement. Simple methods based on sound judgement frequently give better forecasts than complex and sophisticated methods. Thus, a point forecast is of limited use and tends to be associated with uncertainty

Engle & Granger (1987) studied the error correction model is generally thought to be isomorphic to integrated data and the modeling of cointegrated processes, and as such, is considered inappropriate for stationary data. Given that many political time series are not integrated, analysts are unable to take advantages of the error correction model's ability to capture both long and short-term dynamics in a single statistical model. We use analytical results to demonstrate that error correction models are appropriate for stationary data.

Goodwin & Schroeder (1991) studied the spatial linkages in regional cattle markets using cointegration tests of regional price series. Several markets were not co-integrated over 1980 through 1987 period. However, significant increases in cointegration of several regional livestock markets are observed through the 1980s. The increased cointegration parallels significant structural changes in the livestock industry. A formal analysis of market characteristics reveals that distances between markets, industry concentration ratios, market volumes, and market types have significant influences on

cointegration relationships between markets.

OBJECTIVES

Keeping the above aspect in view an attempt is made in this paper to analyze the marketing efficiency of groundnuts market at regional levels, with the overall objective the present study was carried out with the following specific objectives:

i. to analyze the spatial and temporal aspects of the area, production, yield and price aspect of groundnut cultivation in India,
ii. to analyses the direction of causality among Groundnut markets, and
iii. to estimate the price transmission within the Domestic Groundnut markets

If the markets are integrated, a given change in the price of Groundnut in one market should reflect in the change in prices of Groundnut in other markets.

MATERIALS AND METHODS

Selection of Markets

The present study was based on secondary data. The time-series data on area, production, productivity and domestic price were collected from published sources of the Indiastat for the period of 65 years (from 1950-51 to 2014-2015). In India Andhra Pradesh, Gujarat, Tamil Nadu, and Karnataka put together contributes more than 80 per cent of the country's total Groundnut production, so markets from Andhra Pradesh, Gujarat, Tamil Nadu, and Karnataka states were selected purposively. Among the various regulated markets, a representative market was selected from each state based on arrivals, a period of existence, the participation of traders, etc. and monthly price data for groundnut were collected from each selected regulated market from January 2005 to August 2016.

An Overview of Groundnut Market

Groundnut is the single largest source of edible oils in India and constitutes roughly about 50 per cent of the total oilseed production. India grows about nine million tonnes of groundnuts (in the shell) currently. Four types of groundnut were grown in India, though marketed under many names; such as Coromandel, Bold, Khandesh (or Peanuts), and Red Natal. The prices of Groundnut and Groundnut products in the country and states are mainly centered on two major Groundnut products viz., Groundnut and Groundnut oil. The price of Groundnut is usually influenced by the price of Groundnut oil prevailing in the wholesale markets. The factors that determine the price of Groundnut and Groundnut products are also associated with the growers, oil industry, and consumers. Variations in quality of matured Groundnut, size of shell, Groundnut content, oil content, marketing cost, marketing methods of fresh Groundnut production are also deciding factors for the price received by the Groundnut farmers. The Groundnut shells produced on farm move through many agencies like farmers or producers, collectors, wholesalers and processors, before reaching the consumer in various forms. The involvement of these agencies and number of agencies involved in the marketing channels are also deciding factors of Groundnut and Groundnut oil prices. The size of Groundnuts matters much in fixing the price of matured nuts, as bigger shells usually yield more Groundnut.

This crop has diverse uses and consumption pattern varies widely from state to state. The size, shape, and maturity of the nuts have more considerations of consumer preference. The bulk of the processed groundnut oil goes to the consumer in filtered form, and only a small portion is refined. The small part of groundnut oil routed through refineries mainly goes through brokers. The channel is refineries-wholesalers-retailers-consumers. The bulk of the oil, which is only filtered, goes through the brokers-wholesalers-retailers-consumers for sale within the state. For outstation sales, the channel is broker-commission agent-wholesaler-retailers-consumers.

Market Integration

The area and production of Groundnut are on the increase in India as confirmed by positive compound annual growth rates during 1950-2015. The growth rates during 2010-11 to 2015-16 are 5.01 for the area and 4.98 for production. To maintain the growth rate, it is essential that a farmer should receive remunerative prices. They should get a better share of consumers' rupee paid for Groundnut oil and Groundnut. This is possible only when marketing efficiency is of a high order. Market integration analysis over space and form are the major tools to verify the marketing efficiency.

If price changes in one market are fully reflected in the alternative market, these markets are said to be spatially integrated (Goodwin & Schroeder, 1991). Prices in spatially integrated markets are determined simultaneously in various locations, and information about any change in price in one market is transmitted to other markets (Gonzalez-Rivera & Helfand, 2001). Markets that are not integrated may convey inaccurate price signal that might distort producers marketing decisions and contribute to inefficient product movement (Goodwin & Schroeder, 1991), and traders may exploit the market and benefit at the cost of producers and consumers.

Price Transmission Analysis

Price transmission analysis measures the effect of prices in one market on prices in another market. This analysis can be used to study the relationship between domestic price and regional prices for Groundnut and prices in four different local markets. The output of price transmission analysis helps to understand the following points - Is there a long-term relationship between the two markets, Do prices in market 'A' influence those in market 'B', the reverse, or do they both influence each other, If the price in one market changes how much will it cause the other price to change in short run and if the price in one market changes how much will it cause the other price to

change in the long run (Rivera, 2007). In the context of two domestic prices, it tells us whether market 'A' is influencing market 'B', or 'B' is influencing 'A', or if both are influencing each other. This causation analysis helps in understanding and describing trends in local prices.

ADF test

Prior to testing for co integration, the price series are first tested for their order of integration, since a necessary condition for co integration is that the series are integrated of the same order. The augmented Dickey- Fuller (ADF) test is used to test for the order of integration. To test unit root, the ADF test is conducted based on the following regression equation:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_i \Sigma ? Y_{t-1} + e_t$$

[t-1: 1 month lagged price and ? : differenced series]

Y_i denoted the price series of markets (Andhra Pradesh, Tamil Nadu, Gujarat, Karnataka Groundnut price series).

If the coefficient δ is not statistically different from zero, it implies that the series has a unit root, and, therefore, the series is non-stationary. To verify that the first differenced price series is indeed stationary, ADF unit root tests are used. The null hypothesis of non-stationary is tested using a t-test. The null hypothesis is rejected if the estimated variable is significantly negative.

Once the variables are checked for stationary and are of the same order, integration between them can be tested.

Market Integration

Testing for market integration is central to the design of any agricultural price policy in many developing countries and has been an area of abiding research interest. This literature can be divided into three broad categories. Until recently two broad approaches had been used to investigate market integration: (i) that devised prior to the use of co integration techniques (ii) those using co integration methods of the Engle-Granger variety, and (iii) those using Johansen maximum-likelihood techniques (Johansen, 1988). To the extent that agricultural prices tested are non-stationary, the latter technique is more appropriate.

Engle-Granger causality

An Autoregressive Distributed Lag (ADL) model for the Granger-causality test was developed following Engle and Granger (1987) specification provided below:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^{j} \beta_j P_{t-j}^1 + \sum_{k=1}^{k} h_k P_{t-k}^2 + \varepsilon_t$$

Where T is the time trend, $_t$ is the error term.

Lags for the ADL model were selected to minimize the Akaike's Information Criterion. Granger causality tests were specified as:

$$P_t^1 = \alpha + \beta_0 T + \sum_{j=1}^{j} \beta_j P_{t-j}^1 + \sum_{k=1}^{k} h_k P_{t-k}^2 + \varepsilon_t$$

$$H_0 : h_1 = h_2 = ... = h_k = 0$$

$$P_t^2 = \delta + \phi_0 T + \sum_{j=1}^{j} \Omega_j P_{t-j}^1 + \sum_{k=1}^{k} \varphi_k P_{t-k}^2 + \upsilon_t$$

$$H_0 : \varphi_1 = \varphi_2 = ... = \varphi_k = 0$$

Co-Integration

Co integration means that despite being individually non-stationary, a linear combination of two or more time series can be stationary. The series that satisfy this requirement are said to be co-integrated.

Following Granger (1981), a time series x_t which has a stationary, invertible, non-deterministic ARMA representation after differencing *d* times is integrated of order *d* and is denoted by x_t *I(d)*. The components of the vector x_t are said to be co integrated of order *d, b*, denoted CI (d,b), if all the components of x_t are I(d); there exists a vector ' x_t is 1(d-b), b>0

The vector is then called a co integrating vector. A necessary condition for co integration is that the data series for each variable involved exhibit similar statistical properties, that is, to be integrated into the same order with evidence of some linear combination of the integrated series.

Johansen (1988) developed a multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. Johansen's approach is also widely used in many bivariate studies as it has some advantages to the single equation approach. First, the multivariate system of equations approach is more efficient than the single equation approach, i.e., it allows estimating the cointegration vector with smaller variance. The second advantage of the multivariate approach is that in the simultaneous estimation it is not necessary to presuppose exogeneity of either of the variables.

Error Correction Model

Although, the price transmission analysis is a useful tool for understanding and predicting price trends, it only tells us about the relationship between two prices over time. It does not tell us why the price transmission is strong or weak, fast or slow (Engle & Granger, 1987). This interpretation can only be done with the local knowledge of transportation routes, seasonal flows in staple foods, trade and agricultural marketing policies, the availability of foreign exchange and credit, the ease of obtaining permits, and the competition for overland freight, among other factors.

RESULTS AND DISCUSSION

The compound annual growth rates (CAGRs) of the area and production of groundnut in India were estimated and presented in Table 2. It may be noted that highest growth in production was registered in the year 2010-2016. The sixties and Seventies are marked by a negative growth in the area and production overall, the growth of area of groundnut is negative and the production of Groundnut is positive in India over the last

sixty years implying that the area was reduced due to uneven rainfall during crop season and other unfavorable conditions.

The details of area and production of Groundnut in different states of India during 2014-15 are furnished in Table 3. It may be noted that Gujarat ranks first in area and production followed by Andhra Pradesh and Tamil Nadu. Andhra Pradesh has higher area comparing Tamil Nadu but the production is more in Tamil Nadu. The data reveal that more than 80 percent of production is contributed by the Southern States alone while the oil products are used throughout India. The production of groundnuts in the State of Andhra Pradesh has been more or less consistent over the years unlike in Gujarat. In fact, Gujarat being one of the major groundnuts producing states, volatility of production has been a major threat to the groundnut industry in the country. On the other hand, two southern States, Tamil Nadu and Karnataka have steadily picked up in the rate of production over the years.

The price movement and the market integration between international and domestic coconut markets such as Andhra Pradesh, Gujarat, Tamil Nadu and Karnataka were studied with time series data collected. The Augmented Dickey Fuller based unit root test was conducted to check whether the price series are stationary. From Table 4, it could be inferred that Augmented Dickey Fuller Test values are below the critical value given by Mackinnon statistical tables at levels implying that the series are non-stationary at their levels indicating the existence of unit root. After taking the first difference, all the series becomes stationary which is obvious from the calculated values for all the markets are more than the critical value and are free from the consequence of unit root.

Johansen co-integration method is the most widely used tool to study market integration. Johansen cointegration test results are given in Table 5. Based on the test the integration between the markets are analyzed using Eviews software which indicated the presence of one cointegration among the markets. Hence groundnuts markets are having long run equilibrium relationship.

Pairwise Granger Causality Test

Having established long run relationship between markets, it is essential to know the influence of each market on other markets in price formation. The pair-wise

Table 2. Growth rates of area and production of groundnut in India

Years	Area	Production
1950-51 to 1959-60	1.04	3.89
1960-61 to 1969-70	0.91	-4.00
1970-71 to 1979-80	-1.38	-0.34
1980-81 to 1989-90	2.32	5.06
1990-91 to 1999-00	-3.76	-0.49
2000-01 to 2009-10	-4.14	-1.93
2010-11 to 2015-16	5.01	4.98
1950-51 to 2015-16	-0.88	0.47

Source: India stat, Ministry of Agriculture, Government of India.

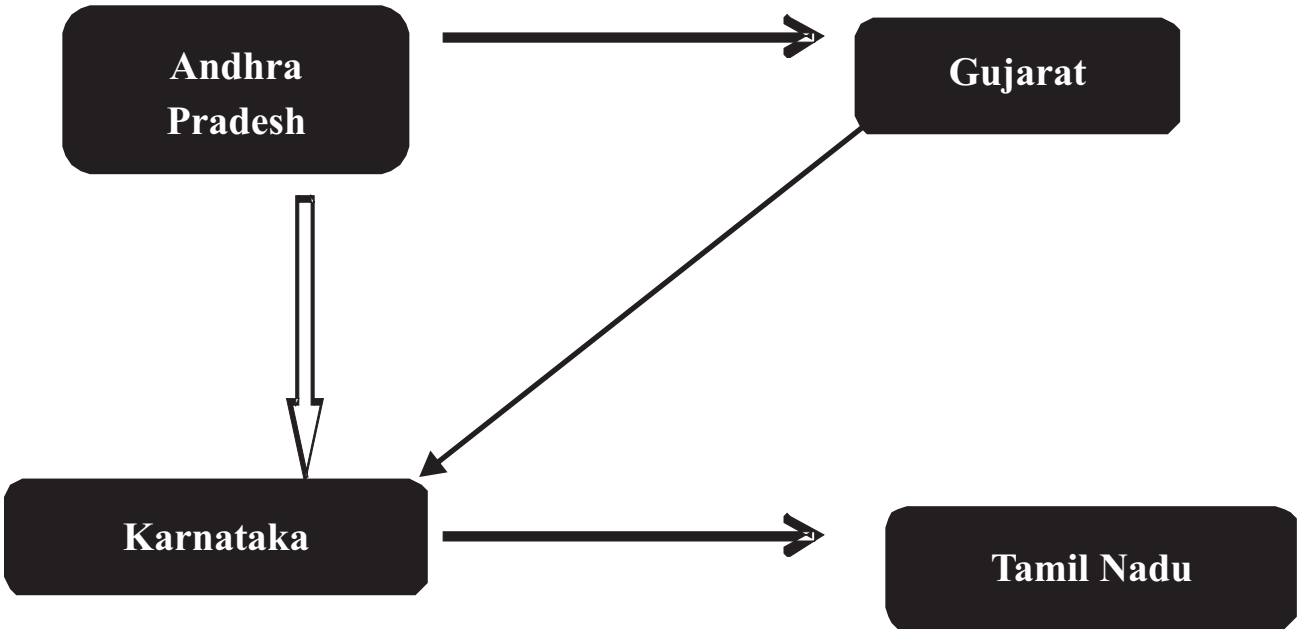

Figure 3. Influence on one market on the other on price formation

Granger causality test was carried out to know the direction of influence of markets on each other. The pair-wise Granger Causality test approaches the question of whether 'X causes Y' was carried out to know how much of the current Y can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation. It is to be noted that the statement 'X granger causes Y' does not imply that Y is the effect or the result of X. that is, it does not indicate causality in the more common use of the term. Y is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently if the lagged X's are statistically significant. If two-way causation is underlying, then X Granger causes Y and Y Granger causes X will hold.

The results of pairwise granger causality tests are furnished in Table 6. Unidirectional influence on Groundnut prices was found to exist among the markets considered.

From the Table 6, it is inferred that there is unidirectional causality found in Andhra Pradesh on Gujarat; Andhra Pradesh on Karnataka; Andhra Pradesh

Table 3. State-wise major area and production of groundnut in India (2014-15)

States	Area (Million ha)	Production (Million tonnes)
Tamil Nadu	1.3	543.9
Karnataka	0.9	221.1
Andhra Pradesh	1.7	487.2
Maharashtra	0.4	167.0
Gujarat	1.8	2205.0
Rajasthan	0.2	899.7
Madhya Pradesh	0.1	380.0
India	**6.40**	**5106.8**

Source: Ministry of Agriculture, Government of India (2014-15).

Table 4. ADF results

Market	Level	First difference	Critical value (per cent)
Andhra Pradesh	-3.14	3.00***	-3.44
Gujarat	-4.02	-3.55***	-3.44
Tamil Nadu	-4.02	-4.05***	-3.44
Karnataka	-4.13	-4.13***	-3.44

*** ***Significant at 1 per cent level.***

Table 5. Co-integration Test Results

Series: Andhra Pradesh, Tamil Nadu, Gujarat and Karnataka

Unrestricted COINTEGRATION Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**
None*	0.183805	50.38891	47.85613	0.0283
At most 1	0.093024	23.17328	29.79707	0.2376
At most 2	0.071889	10.08955	15.49471	0.2739
At most 3	0.000691	0.092628	3.841466	0.7609

Trace test indicates 1 co-integrating equations at the 0.05 level.

*** denotes rejection of the hypothesis at the 0.05 level.***

****MacKinnon-Haug-Michelis (1999) p-values.***

Table 6. Pairwise Granger Causality Test

Null Hypothesis	Observation	F-Statistic	P
Gujarat does not granger cause Andhra Pradesh	137	0.24911	0.7799
Andhra Pradesh does not granger cause Gujarat		4.88759***	0.0090
Karnataka does not granger cause Andhra Pradesh	137	1.09471	0.3377
Andhra Pradesh does not granger cause Karnataka		4.89137***	0.0089
Tamil Nadu does not granger cause Andhra Pradesh	137	0.33981	0.7125
Andhra Pradesh does not granger cause Tamil Nadu		11.1179***	3.E-05
Karnataka does not granger cause Gujarat	137	3.74569**	0.0262
Gujarat does not granger cause Karnataka		1.64359	0.1972
Tamil Nadu does not granger cause Gujarat	137	1.94903	0.1465
Gujarat does not granger cause Tamil Nadu		1.88880	0.1553
Tamil Nadu does not granger cause Karnataka	137	1.06865	0.3464
Karnataka does not granger cause Tamil Nadu		4.13190**	0.0182

****** and ** Significant at 1 and 5 per cent level.***

Table 7. Results of vector error correction model for groundnut markets

State	D			
	Andhra Pradesh	**Karnataka**	**Gujarat**	**Tamil Nadu**
Andhra Pradesh (-1)	-0.251357 (0.18920)[a] [-1.32850][b]	-0.321097 (0.16777)[a] [-1.91396][b]*	0.091626 (0.16523)[a] [0.55456][b]	-0.037128 (0.10116)[a] [-0.36704][b]
Andhra Pradesh (-2)	-0.415126 (0.18613) [-2.23029]**	-0.070815 (0.16504) [-0.42907]	-0.078750 (0.16254) [-0.48449]	-0.104936 (0.09951) [-1.05449]
Karnataka (-1)	0.168124 (0.10065) [1.50731]	-0.297037 (0.09890) [-3.00338]***	-0.009642 (0.09740) [-0.09899]	-0.005748 (0.05963) [-0.09638]
Karnataka (-2)	-0.015466 (0.11137) [-0.13387]	-0.149313 (0.09875) [-1.51205]	-0.016350 (0.09725) [-0.16811]	-0.058596 (0.05954) [-0.98410]
Gujarat (-1)	-0.015031 (0.10272) [-0.14632]	-0.032544 (0.09109) [-0.35729]	-0.166085 (0.08971) [-1.85142]*	-0.041452 (0.05492) [-0.75476]
Gujarat (-2)	-0.172695 (0.10234) [-1.68751]	-0.138604 (0.09074) 1.52746]	-0.162631 (0.08937) [-1.81978]*	-0.061613 (0.10234) [-1.68751]
Tamil Nadu (-1)	0.116509 (0.10477) (1.11207]	0.218678 (0.09290) [2.35399]	0.040053 (0.09149) [0.43779]	0.050621 (0.05601) [0.90373]
Tamil Nadu (-2)	0.277442 0.10065 2.75657**	0.206475 0.08924 2.31361**	0.070755 0.08789 0.80501	-0.056476 0.05381 -1.04953
C	52.08573 39.4776 1.31937	37.41131 35.0046 1.06875	15.35190 34.4749 0.44531	33.61989 21.1065 1.59287
R-Squared	0.920152	0.936210	0.918560	0.936236
Adj. R-squared	0.91624	0.926510	0.923369	0.944263

******, **, and * Significant at 1, 5 and 10 per cent level.***
a = Figures are standard error; b = Figures are t-value.

on Tamil Nadu; Karnataka on Gujarat and Karnataka on Tamil Nadu market.

Vector Error Correction Model

Since the four domestic markets are integrated into the long run, it is important to study the short run and long run association for equilibrium among the markets. Hence, Vector Error Correction Model (VECM) was employed to know the speed of adjustments among the markets for long run equilibrium. It is clearly indicated that from the Table 7, it is implied that Tamil Nadu and Karnataka Groundnut markets came to short run equilibrium as indicated by the level of significance and the speed of adjustment is rapid and further the lagged prices of domestic markets also exerted influence so as to bring the markets in equilibrium under long run.

CONCLUSIONS

Spatial market integration is examined by estimating price linkages among geographically separated four markets. Data used for the analysis are monthly wholesale in domestic markets. For each location, the units root test indicated that the price series are non-stationary at their levels. The results reveal that markets are spatially integrated as indicated by strong spatial price linkages among markets implying that Groundnut farmers throughout India would be benefitted by any change in prices of Groundnut and the increase or decrease would affect Groundnut growers throughout the nation. Among the markets, Andhra Pradesh, Karnataka, and Gujarat came to short run equilibrium at a faster rate than other markets. Thus, the

results of the present study indicated that Groundnut markets in all the states are integrated and leading to efficiency in Groundnut marketing.

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Fish Production in Punjab-An Economic Analysis

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ABSTRACT

Aquaculture in Punjab is purely carp culture and fish farming play a major role in the economic upliftment of the rural masses. However, during last decades, the stagnating farm incomes prompted Punjab's peasantry for undertaking subsidiary occupations such as fish farming. Keeping this in view present study was planned to work out the economics of inland fish production along with marketable surplus of fish in the study area and to investigate the production and marketing constraints in fish farming. Three districts namely Gurdaspur, Bathinda, and Pathankot were selected, which were having maximum concentration of fish farmers and a sample of 100 fish farmers was selected according to their concentration in selected districts by using probability proportional to size sampling technique. Cost-return analysis of fish farming on sample fish farms revealed that labour cost, electricity usage, diesel use in irrigation and aeration cost were the major constituents of variable cost. On private fish farms, total variable cost per hectare was maximum on small fish farms (₹2,26,034) followed by medium (₹2,10,620) and large (₹1,59,178) farms which shows the economies of scale. However, on Panchayati fish farms, total variable cost per hectare was higher on small fish farms (₹1,68,864) followed by large (₹1,61,241) and medium (₹1,59,115) farms. In overall, total variable cost per hectare was ₹2,21,348 on private and ₹1,62,366 on Panchayati fish farms. On the contrary, fixed cost increased with farm size on private fish farms and it was least on medium farms category in case of Panchayati fish farms. Also, fixed cost investment was more on private as compared to Panchayati fish farms. Gross return per hectare on private fish farms were higher (₹3,04,021) than Panchayati fish farms (₹2,75,751), however, there was not much variation in gross returns according to farm categories. Net returns per hectare were higher on Panchayati fish farms (₹93,467) as compared to private fish farms (₹16,638). Benefit-cost ratio (B:C ratio) was 1.06 on private and 1.51 on Panchayati fish farms. On private fish farms B: C ratio was highest on medium and large (1.11) farms followed by small farms (1.04) while on Panchayati fish farms, B:C ratio was maximum on medium farms (1.60) followed by large (1.49) and small farms (1.44). Thus, medium fish farmers were more efficient than their counterparts in terms of judicious utilization of resources. The marketable surplus was nearly 99 per cent of the total fish production on both private and Panchayati fish farms. The major problems in production and marketing of fish farming were; poaching, the incidence of disease, less subsidy and lack of remunerative price, low price etc. Major policy issues brought out were; formation of aqua club by fish farmers, higher subsidization of fish farming, involvement of Govt. agency for the purchase of fish produced at the remunerative price and increasing the demand for fish by advertising about its nutritional importance through print and electronic media.

Keywords
Benefit-cost ratio, constraints, cost-return structure, fishery trends.

JEL Codes
C83, Q22.

INTRODUCTION

Fisheries and aquaculture make crucial contributions to the world's well-being and prosperity. In the last five decades, world fish production has outpaced global population growth and today fish constitutes an important source of nutritious food and animal protein for much of the world's population. In addition, this sector provides livelihoods and income, both directly and indirectly, for a significant share of the world's population. According to Food and Agriculture Organization (FAO) estimates, the human consumption of fish is about 80 per cent of the world's fish production at per capita availability of 17.1 kg, which is expected to rise considerably by the year 2030 (FAO, 2012). Fisheries sector contributes

significantly to the national economy while providing livelihood to approximately 14.49 million people in India. It also occupies a very important place in the socio-economic development of the country. It has been recognized as a powerful income and employment generator as it stimulates the growth of a number of subsidiary industries and is a source of cheap and nutritious food, besides being a foreign exchange earner (Government of Punjab, 2013). Fish is one of nature's best nutritional gifts. In India, the per capita intake of meat and milk is low. Therefore, fish assumes an important place as a protein supplement because it contains an average 15-20 per cent of proteins. So, fishes are one of the best proteins available to a human, both in quality and quantity. It has been noticed that the proteins from plant sources are deficient in one or more essential amino acids needed for sustained human development. Moreover, the most efficient utilization of plant proteins could be obtained if animal protein is included in the human diet. Fish is also a valuable source of vitamin A and B, iodine, and oils containing poly-saturated fatty acid which helps to check the cholesterol level of the blood. Therefore, fish is a good source of food for all ages (Government of Punjab, 2013a).

Global fish production has grown steadily in the last five decades, with food fish supply increasing at an average annual rate of 3.2 per cent, outpacing world population growth at 1.6 per cent. World per capita apparent fish consumption increased from an average of 9.9 kg in the 1960's to 19.2 kg in 2012. This impressive development has been driven by a combination of population growth, rising incomes, and urbanization and facilitated by the strong expansion of fish production and more efficient distribution channels. A sizeable and growing share of fish consumed in developed countries consists of imports, owing to steady demand and declining domestic fishery production. In developing countries, fish consumption tends to be based on locally and seasonally available products, with supply driving the fish chain. However, fuelled by rising domestic income and wealth, consumers in emerging economies are experiencing a diversification of the types of fish available owing to an increase in fishery imports. A portion of 150 gm of fish can provide about 50–60 per cent of an adult's daily protein requirements. In 2010, fish accounted for 16.7 per cent of the global population's intake of animal protein and 6.5 per cent of all protein consumed. Moreover, fish provided more than 2.9 billion people with almost 20 per cent of their intake of animal protein, and 4.3 billion people with about 15 per cent of such protein. Fish proteins can represent a crucial nutritional component in some densely populated countries where total protein intake levels may be low. Global fishery production in marine waters was 82.6 million tonnes in 2011 and 79.7 million tonnes in 2012. In these years, 18 countries (11 in Asia) caught more than an average of one million tonnes fish per year, accounting for more than 76 per cent of global marine catches. World aquaculture production can be categorized into inland aquaculture and mariculture. Inland aquaculture generally uses freshwater, but some production operations use saline water in inland areas (such as in Egypt) and inland saline-alkali water (such as in China). Mariculture includes production operations in the sea and intertidal zones as well as those operated with land-based (onshore) production facilities and structures. Global food fish productions from inland aquaculture and from mariculture were at the same level of 2.35 million tonnes in 1980. However, inland aquaculture growth has since outpaced mariculture growth, with average annual growth rates of 9.2 and 7.6 per cent, respectively. As a result, inland aquaculture steadily increased its contribution to total farmed food fish production from 50 per cent in 1980 to 63 per cent in 2012. Fisheries and aquaculture is a source not just of health but also of wealth. Employment in the sector has grown faster than the world's population. This sector provides jobs to tens of millions and supports the livelihoods of hundreds of millions. Fish continues to be one of the most-traded food commodities worldwide. It is especially important for developing countries, sometimes worth half the total value of their traded commodities (FAO, 2014).

According to a report published by FAO, aquaculture is the world's fastest-growing source of animal protein and currently provides nearly half of the fish consumed globally. The total world fisheries production was 158.0 million tonnes in 2012. Within Asia, China is top most in the marine capture fish producing country with a production of 13.86 million tonnes in 2012. India ranked seventh in the marine capture fish producing country with a production of 3.25 million tonnes. Fish production in India increased from 7.60 million tonnes (2.97 million tonnes for marine and 4.63 million tonnes for inland fisheries) in 2008-09 to 9.01 million tonnes (3.27 million tonnes for marine and 5.74 million tonnes for inland fisheries) in 2012-13 (FAO, 2014). Nearly 58.3 million people were engaged in the primary sector of capture fisheries and aquaculture in 2012. Of these, 37 per cent were engaged full time. In 2012, about 84 per cent of all people employed in the fisheries and aquaculture sector was in Asia, followed by Africa (more than 10 per cent). About 18.9 million were engaged in fish farming (more than 96 per cent in Asia). In the period 2010–2012, at least 21 million people were capture fishers operating in inland waters (more than 84 per cent in Asia). Employment in this sector has grown faster than the world's population. In 2012, it represented 4.4 per cent of the 1.3 billion people economically active in the broad agriculture sector worldwide (2.7 per cent in 1990). Overall, women accounted for more than 15 per cent of all people directly engaged in the fisheries primary sector in 2012. The proportion of women exceeded 20 per cent in inland water fishing and up to 90 per cent in secondary activities (e.g. processing). FAO estimates that, overall, fisheries and

aquaculture assure the livelihoods of 10-12 per cent of the world's population (FAO, 2014a).

Top fish producing states of India are Andhra Pradesh (20.18 lakh tonnes) followed by West Bengal (15.81 lakh tonnes), Gujarat (7.93 lakh tonnes) and Kerala (7.09 lakh tonnes), whereas Punjab ranked 15th (1.04 lakh tonnes) in fish production in 2013-14 (Indiastat, 2011). Aquaculture in Punjab is purely carp culture and district Gurdaspur ranked first with highest fish farmers (317) followed by Bathinda (115), Pathankot (105) in 2013 (Anonymous, 2013). The total number of ponds under fish culture is 8285 and out of which a total number of Panchayati ponds are 6063 and number of private ponds are 2222 (Government of Punjab, 2013b). Against an expenditure of ₹4.68 crores during the 11th Five Year Plan, an outlay of ₹41.26 crores has been provided in 12th Five Year Plan for the growth of fisheries in Punjab. An outlay of ₹10.55 crores was provided in the Annual Plan 2012-13. In Punjab, the area under fish farming has increased from 343 hectares in 1980-81 to 11,687 hectares in 2012-13 with about 8000 fish farmers engaged in the same (Government of Punjab, 2013). Thus, fish farming can play a major role in the economic upliftment of the rural masses. As almost every village has a pond, which serves no useful purpose except as a water reservoir for the cattle and breeding place for mosquitoes. The village ponds and other low lying waterlogged areas can easily give employment to the farmers on their farms. This, in turn, will help to remove disguised unemployment and will raise the marginal value productivity of labour. Besides, farmers can take up fish farming as a subsidiary occupation of farming. The study on fish farming in Punjab was conducted with the following specific objectives:

i. to work-out the economics of fish production in Punjab,
ii. to examine the production and marketable surplus of fish in the study area,
iii. to study the problems and constraints faced in production and marketing of fish produced, and
iv. to suggest policy measures to strengthen fish farming in the state.

METHODOLOGY

To work out the returns from fish farming, a field survey was undertaken. Firstly, a list of fish farmers was obtained from the State Fisheries Department, Punjab. From this list, three districts namely Gurdaspur, Bathinda, and Pathankot were selected, which were having a maximum concentration of fish farmers. From the selected districts, 100 fish farmers were selected according to their concentration in a particular district by using probability proportional to size sampling technique. Thus, out of total fish farmers, 59 were from Gurdaspur, 21 from Bathinda and 20 belonged to Pathankot district.

For primary data collection, a well structured schedule was prepared for the fish farmers. The respondent farmers were interviewed personally for data collection. The relevant information pertaining to inputs used in fish production such as feed, fertilizers, seed, disease control measures, electricity bill/expenses, labour and machine use pattern and output obtained and marketable surplus of fish farms were collected relating to the year 2013-14. The present value of inventory used in fish farming was also estimated. Special emphasis was laid to record data on various production and marketing constraints faced by fish farmers.

Analysis of Data

The selected respondents were classified into three categories on the basis of area under fish farming using cumulative cube root frequency method.

Table 1 shows the category-wise classification of the respondent farmers. There were 44 small, 32 medium and 24 large category respondents after segregating them on the basis of area under fish farming using cumulative cube root frequency method.

Table 2 shows the category-wise distribution of sample fish farmers. Thus, in private fish farmer's category, there were 27 small, 6 medium and one large fish farmer and the total private fish farmers were 34. In Panchayati fish farmers category, there were 17 small, 26 medium and 23 large fish farmers and thus, the total Panchayati fish farmers were 66.

Table 1. Classification of the selected respondents according to area under fish farming in Punjab, 2013-14

Category	No. of respondents
Small (< 3.34 hectares)	44
Medium (3.34-6.47 hectares)	32
Large (>6.47 hectares)	24
Total	100

Table 2. Category-wise distribution of sample fish farmers, Punjab, 2013-14

(Number)

Farm category	Private fish farmers	Panchayati fish farmers
Small	27	17
Medium	6	26
Large	1	23
Total	34	66

RESULTS AND DISCUSSION

Area under Fish Farming

Average area under fish farming on the sample farms has been depicted in Table 3. In the case of private fish farms, the average operational holding was found to be highest on the large farms which was11.33 hectares as compared to 4.57 hectares on medium and 1.64 hectares on small farms. On an average, the leased-in land was 10.12 hectares on large farms but there was no leased-in land in medium and small farms category in case of private fish farms. Panchayati fish farms have been

leased-out to the farmers and the average size of holding was 13.15 hectares on large farms followed by 5.09 hectares on medium and 2.09 hectares on small farms. In the overall situation, operational holding size was 2.44 hectares with 2.14 hectares as owned land and 0.30 hectares as leased-in land in private fish farms while operational holding size was 7.13 hectares which were taken on lease by the farmers from panchayats.

Economics of Fish Production in Punjab

An in depth analysis of various economic parameters of the fish farming such as human labour use, physical input use and benefit cost analysis constituted this part.

Capital investment

The present value of the capital investment incurred in fish farming on sample fish farms has been depicted in Table 4. The perusal of the Table reveals the investment in fish farming involves the expenses incurred on the cost of digging, pipe, generator, aerator, fish catching net and other equipment. In private farms, the maximum present value of capital investment per hectare on small farms worked out to be 34.57 per cent on pipe followed by cost of digging (19.60 per cent), aerator (16.57 per cent) and generator (14.06 per cent) while the minimum present value worked out to be 0.38 per cent on fish catching net. Also, the maximum present value of capital investment per hectare on medium farms was found to be 42.17 per cent on pipe followed by the cost of digging (26.35 per cent), aerator (12.28 per cent), generator (8.93 per cent) and the minimum present value worked out to be 0.21 per cent on fish catching net. Similarly, on large farms, highest investment per hectare worked out to be 52.58 per cent on pipe followed by the cost of digging (26.96 per cent), generator (6.21 per cent), and aerator (6.19 per cent) while lowest value worked out to be 0.18 per cent on fish catching net. In the overall scenario, the maximum investment has been estimated to be ₹27661 on pipes followed by the cost of digging (20.75 per cent), aerator (15.72 per cent), generator (13.14 per cent), etc. In Panchayati farms, the maximum present value of capital investment per hectare among small farmers worked out to be 44.56 per cent on aerator followed by the generator (34.33 per cent) and diesel engine (18.08 per cent). On

Table 3. Average area under fish farming on sample fish farms in Punjab, 2013-14

(Ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Area owned (a)	1.64	4.57	1.21	2.14	-	-	-	-
Area leased-in (b)	-	-	10.12	0.30	2.09	5.09	13.15	7.13
Total operational area under fish farming (a+b)	1.64	4.57	11.33	2.44	2.09	5.09	13.15	7.13

Table 4. Present value of the capital investment incurred in fish farming on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Cost of digging	15736 (19.60)	16867 (26.35)	14828 (26.96)	15909 (20.75)	540 (2.76)	-	238 (3.69)	222 (1.97)
Pipe cost	27763 (34.57)	26996 (42.17)	28914 (52.58)	27661 (36.07)	-	-	-	-
Generator	11292 (14.06)	5718 (8.93)	3416 (6.21)	10077 (13.14)	6718 (34.33)	3322 (32.78)	2722 (42.25)	3988 (35.36)
Aerator	13306 (16.57)	7859 (12.28)	3405 (6.19)	12054 (15.72)	8722 (44.56)	3968 (39.16)	2057 (31.92)	4526 (40.13)
Fish catching nets	304 (0.38)	131 (0.21)	102 (0.18)	268 (0.35)	54 (0.27)	129 (1.27)	148 (2.30)	116 (1.03)
Electric motor	7301 (9.09)	4150 (6.48)	2383 (4.33)	6601 (8.61)	-	-	-	-
Diesel engine	4600 (5.73)	2298 (3.59)	1942 (3.53)	4116 (5.37)	3538 (18.08)	2714 (26.79)	1279 (19.84)	2426 (21.51)
Total	80302 (100.00)	64020 (100.00)	54990 (100.00)	76685 (100.00)	19572 (100.00)	10133 (100.00)	6443 (100.00)	11278 (100.00)

Figures in parentheses are the percentages of the total.

medium farms also the proportion of investment was maximum on aerator (39.16 per cent) followed by the generator (32.78 per cent) while least (0.27 per cent) was on fish catching net. Similar was the scenario on large fish farms. The overall scenario of capital investment revealed that an estimated ₹4526 was the present value of aerator followed by ₹3988 on generator out of total ₹11278 of the value of the investment made. On Panchayati fish farms, the present value of pipe and electric motor was not there due to the fact that these belonged to panchayats. So, no present value was accounted for these assets.

Fixed cost incurred on sample fish farms

The fixed cost constituted the interest on capital investment, per annum depreciation on the pipe, generator, aerator, fish catching net, electric motor/submersible pump, and diesel engine. Rental value of leased-in land and imputed value of owned land for fish farmers were also components of fixed cost. It can be seen from the table that depreciation of the various assets and interest on capital investment made were the important constituents of fixed costs incurred in fish farming. On the private fish farms, the proportion of interest on capital investment per hectare in total fixed cost worked out to be 10.45 per cent, while it was 11.43 per cent on small, 8.65 per cent on medium and 3.59 per cent on large fish farm categories. The share of depreciation of pipe in total fixed cost was found to be 2.20 per cent on small, 2.03 per cent on medium and 1.05 per cent on large fish farm categories.

In overall, the proportion of depreciation of pipes in fixed cost was estimated to be 2.09 per cent. Rest among all the equipment's, the relative share of depreciation of aerator was maximum which accounted for 1.05 per cent on small, 0.59 per cent on medium and 0.12 per cent on large farms while the minimum share in depreciation was of fish catching net which was 0.10 per cent on small, 0.04 per cent on medium and 0.01 per cent on large farms. The rental value of leased-in land accounted for 51.20 per cent of the total fixed cost while the imputed value of owned land was 43.75 per cent on large farms category. The imputed value of owned land was found to be 87.78 per cent on medium and 83.40 per cent on small farms. In the overall scenario, the rental value of leased-in land and owned land constituted 3.14 and 81.74 per cent of the fixed cost.

On Panchayati farms, the proportion of interest on capital investment per hectare was calculated as 3.42 per cent, while it was 9.44 per cent on small, 5.79 per cent on medium and 2.27 per cent on large farm categories. Among all the equipment's, highest depreciation accounted for aerator and it was found to be 2.34 per cent on small, 1.26 per cent on medium and 0.40 per cent on large farms while minimum depreciation was found in the case of a diesel engine which was 0.95 per cent on small, 0.86 per cent on medium and 0.25 per cent on large farms. The rental value of land accounted for 96.43 per cent on large, 90.87 per cent on medium and 85.43 per cent on small farm categories. In the overall scenario, the rental

Table 5. Fixed cost incurred on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Interest on the capital investment @ 9 per cent	7227 (11.43)	5762 (8.65)	4949 (3.59)	6902 (10.45)	1761 (9.44)	912 (5.79)	580 (2.27)	1015 (5.10)
Depreciation on pipe@ 5 per cent	1388 (2.20)	1350 (2.03)	1446 (1.05)	1383 (2.09)	-	-	-	-
Depreciation on generator @5 per cent	565 (0.89)	286 (0.43)	171 (0.12)	504 (0.76)	336 (1.80)	166 (1.05)	136 (0.53)	199 (1.00)
Depreciation on aerator @ 5 per cent	665 (1.05)	393 (0.59)	170 (0.12)	603 (0.91)	436 (2.34)	198 (1.26)	103 (0.40)	226 (1.14)
Depreciation on fish catching nets @ 20 per cent	61 (0.10)	26 (0.04)	20 (0.01)	54 (0.08)	11 (0.06)	26 (0.16)	30 (0.12)	23 (0.12)
Depreciation on electric motor/ submersible pump @ 5 per cent	365 (0.58)	207 (0.31)	119 (0.09)	330 (0.50)	-	-	-	-
Depreciation on diesel engine @ 5 per cent	230 (0.36)	115 (0.17)	97 (0.07)	206 (0.31)	177 (0.95)	136 (0.86)	64 (0.25)	121 (0.61)
Rental value of leased-in land	-	-	70609 (51.20)	2077 (3.14)	15948 (85.43)	14307 (90.87)	24646 (96.43)	18333 (92.04)
Imputed value of owned land	52748 (83.40)	58454 (87.78)	60331 (43.75)	53978 (81.74)	-	-	-	-
Total	63249 (100.00)	66593 (100.00)	137912 (100.00)	66035 (100.00)	18669 (100.00)	15745 (100.00)	25559 (100.00)	19918 (100.00)

Figures in parentheses are the percentages of the total.

value of leased-in land constituted 92.04 per cent of the fixed cost. Thus, in fixed cost rental value of land had a major share. On Panchayati farms, farmers did not have own land for fish farming, therefore, they have taken Panchayati ponds on rent.

Human labour in fish farming

Human labour is the basic input required to produce any farm commodity. The operation-wise per hectare use of human labour for fish farming has been given in Table 6. On private farms, the per cent share of the cost incurred on family labour use in fish farming has been estimated as 24.99, 23.94, and 23.89 per cent, respectively on small, large and medium farms. The proportion of permanent labour use in total labour cost has been estimated at 70.25, 69.52, and 68.87 per cent, respectively on medium, large and small farms. The per cent share of hired/seasonal labour use in total labour cost was lower as compared to family labour and permanent labour. The relative share of hired labour use has been estimated as 6.54, 6.14, and 5.86 per cent, respectively on large, small and medium farms. The medium fish farmers used less hired labour than their smaller counterparts because medium fish farmers had more permanent labour. In overall, per cent share of the cost incurred on family labour, permanent labour, and hired labour has been estimated as 24.77, 69.12 and 6.11 per cent, respectively. On Panchayati fish farms, the per cent share of the cost incurred on family labour use in fish farming has been estimated as 25.35, 24.89 and 24.23 per cent, respectively on medium, small and large farms. The relative share of permanent labour use has been estimated as 69.30, 68.88 and 68.79 per cent, respectively on small, large and medium farms. Similarly, the hired labour use share has been estimated as 6.89, 5.86 and 5.81 per cent respectively on large, medium and small farms. The overall per cent share in total labour cost in family labour, permanent labour, and hired labour has been estimated as 24.85, 68.95 and 6.20 per cent, respectively. Thus, expenses on labour per hectare were higher on small farms as compared to medium and large farms on both private and Panchayati farms which shows the economics of scale.

Marketing cost incurred on sample fish farms

Marketing costs incurred in fish farming on sample fish farms have been depicted in Table 7. A perusal of the table reveals that transportation was the major constituent of the marketing costs. On private fish farms, the proportionate share of transportation cost was 40.90 and 38.21 per cent of total marketing cost on small and medium farms while this was followed by harvesting and marketing costs. Large farmers sold their produce on the

Table 6. Labour cost incurred in fish farming on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Family labour	10542 (24.99)	9493 (23.89)	8970 (23.94)	10239 (24.77)	9584 (24.89)	9335 (25.35)	8753 (24.23)	9196 (24.85)
Permanent labour	28807 (68.87)	27912 (70.25)	26051 (69.52)	28568 (69.12)	26688 (69.30)	25325 (68.79)	24881 (68.88)	25521 (68.95)
Hired/seasonal labour	2570 (6.14)	2328 (5.86)	2451 (6.54)	2523 (6.11)	2239 (5.81)	2158 (5.86)	2489 (6.89)	2294 (6.20)
Total cost	41829 (100.00)	39734 (100.00)	37472 (100.00)	41331 (100.00)	38511 (100.00)	36818 (100.00)	36123 (100.00)	37012 (100.00)

Figures in parentheses are the percentages of the total.

Table 7. Marketing cost incurred in fish farming on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Harvesting	7580 (31.72)	5756 (31.99)	-	7036 (31.75)	-	-	2748 (32.97)	958 (32.97)
Transportation	9775 (40.90)	6875 (38.21)	-	8976 (40.51)	-	-	3501 (42.01)	1220 (42.01)
Marketing	6546 (27.39)	5362 (29.80)	-	6144 (27.73)	-	-	2085 (25.01)	726 (25.02)
Total	23901 (100.00)	17993 (100.00)	-	22156 (100.00)	-	-	8333 (100.00)	2904 (100.00)

Figures in parentheses are the percentages of the total.

farm and hence there were no marketing expenses incurred. In overall, highest expenses on marketing costs were on transportation (40.51 per cent) followed by harvesting (31.75 per cent) and marketing (27.73 per cent). On Panchayati farms, only large farmers sold their produce and thus incurred higher proportionate expenses on transportation (42.01 per cent) followed by harvesting (32.97 per cent) and marketing charges (25.01 per cent). On Panchayati farms, small and medium farmers didn't sell fish produced themselves and hence did not incur any expenses.

Other major costs incurred on sample fish farms

Table 8 reveals the miscellaneous costs incurred on sample fish farms. On the private fish farms, among the small, medium and large farms, the maximum proportion of cost was incurred on electricity bill which was estimated as 35.01 per cent of the total cost on large farms, 33.15 per cent on medium farms and 32.42 per cent on small farms. In the overall scenario, the proportion of electricity bill was 32.61 per cent of other major costs. On the other side, the minimum proportion of cost was incurred on renovation work on small and medium farms but on large farms, the proportion of cost incurred on repair and maintenance of irrigation structure was least among farm categories. The cost of renovation has been estimated at 7.07 and 6.72 per cent on small and medium farms, respectively. In overall, the renovation cost has been estimated at 6.99 per cent and the cost incurred on repair and maintenance of irrigation structure has been estimated as 4.99 per cent of major costs on large farms. In overall, the proportion of repair and maintenance of irrigation structure has been found to be 7.46 per cent. Similarly, in case of the Panchayati fish farms, among small, medium and large farms, the maximum proportion of cost was incurred on electricity usage bill which was estimated as 40.13 per cent on large farms, 37.95 per cent on medium farms and 36.32 per cent on small farms. In overall, the proportion of electricity bill cost was 38.17 per cent. On the other hand, the minimum proportion of cost was incurred on renovation on small, medium and large farms. Other major costs on both the farms were the use of diesel for filling the fish pond with water using diesel engine/generator and cost of aeration.

Total variable cost per ha incurred on sample fish farm

Table 9 depicts the total variable cost incurred on both private and Panchayati fish farms on per hectare basis. A perusal of the table reveals that on the private farms, among the small fish farms, the major component of variable cost was expenses on other major costs(diesel engine-diesel used, electricity bill, generator-diesel used, aeration, renovation, repair & maintenance of irrigation structure) which were 47.52 per cent and second major constituent of variable expenditure was labour used in various fish farming operations which were 18.51 per cent and the minimum expenses incurred on fertilizer and predator control which was 0.31 and 2.09 per cent, respectively. Similarly, in medium and large fish farm categories, the major component of variable cost was expenses on other major costs which were 46.53 per cent and 55.53 per cent, respectively. On medium fish farms category, the lowest expenses incurred on fertilizer and predator control which were 0.31 and 1.93 per cent of the total variable cost while on large fish farms category the minimum expenses incurred on fertilizer and predator control measures which were 0.09 and 0.25 per cent of the total variable cost. The interest on variable cost for half period was estimated to be 4.32 per cent. In the overall scenario, the major component of total variable cost was other major costs (47.52 per cent) followed by labour

Table 8. Other major costs incurred in fish farming on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Diesel engine (diesel used)	13467 (12.54)	11687 (11.92)	10782 (12.20)	13074 (12.43)	11252 (11.21)	9705 (10.97)	8649 (10.70)	9735 (10.96)
Electricity bill	34823 (32.42)	32495 (33.15)	30943 (35.01)	34298 (32.61)	36455 (36.32)	33562 (37.95)	32423 (40.13)	33910 (38.17)
Generator (diesel used)	18677 (17.39)	17443 (17.80)	15912 (18.00)	18378 (17.47)	19867 (19.79)	17420 (19.70)	15082 (18.67)	17236 (19.40)
Aeration cost	24588 (22.89)	23207 (23.68)	21094 (23.87)	24242 (23.05)	20265 (20.19)	18779 (21.23)	17907 (22.16)	18858 (21.22)
Renovation	7596 (7.07)	6582 (6.72)	5240 (5.93)	7348 (6.99)	5160 (5.14)	3771 (4.26)	2855 (3.53)	3810 (4.29)
Repair & maintenance of irrigation structure	8256 (7.69)	6598 (6.73)	4413 (4.99)	7851 (7.46)	7369 (7.34)	5204 (5.88)	3878 (4.80)	5300 (5.96)
Total	107408 (100.00)	98012 (100.00)	88385 (100.00)	105190 (100.00)	100367 (100.00)	88440 (100.00)	80795 (100.00)	88848 (100.00)

Figures in parentheses are the percentages of the total.

Table 9. Total variable cost incurred in fish farming on the sample fish farm, Punjab, 2013-14

(₹per ha)

Particular	Private fish farms								Panchayati fish farms							
	Small		Medium		Large		Overall		Small		Medium		Large		Overall	
	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)	Quantity (Kg)	Value (₹)
Seed	-	20323 (8.99)	-	24765 (11.76)	-	15323 (9.63)	-	20960 (9.47)	-	18118 (10.73)	-	20181 (12.68)	-	23003 (14.27)	-	20633 (12.71)
Feed	10264.98	7385 (3.27)	11000.55	7147 (3.39)	10261.88	8381 (5.27)	10395.18	7373 (3.33)	619.73	542 (0.32)	30.18	461 (0.29)	468.66	525 (0.33)	334.42	504 (0.31)
Fertilizer	42.73	693 (0.31)	42.77	649 (0.31)	24.71	138 (0.09)	42.22	669 (0.30)	28.90	477 (0.28)	33.04	547 (0.34)	34.43	563 (0.35)	32.45	534 (0.33)
Disease control	186.43	10021 (4.43)	191.91	9152 (4.35)	164.22	2193 (1.38)	186.75	9637 (4.35)	80.85	530 (0.31)	101.43	3158 (1.98)	105.32	2363 (1.47)	97.49	2204 (1.36)
Predator control	-	4716 (2.09)	-	4070 (1.93)	-	397 (0.25)	-	4475 (2.02)	-	3031 (1.79)	-	2640 (1.66)	-	2573 (1.60)	-	2717 (1.67)
Labour charges	-	41829 (18.51)	-	39734 (18.87)	-	37472 (23.54)	-	41331 (18.67)	-	38511 (22.81)	-	36818 (23.14)	-	36123 (22.40)	-	37012 (22.80)
Marketing charges	-	23901 (10.57)	-	17993 (8.54)	-	-	-	22156 (10.01)	-	-	-	-	-	8333 (5.17)	-	2904 (1.79)
Other major costs	-	107408 (47.52)	-	98012 (46.53)	-	88385 (55.53)	-	105190 (47.52)	-	100367 (59.44)	-	88440 (55.58)	-	80795 (50.11)	-	88848 (54.72)
Interest on variable cost @ 9 per cent for half period	-	9758 (4.32)	-	9098 (4.32)	-	6889 (4.32)	-	9557 (4.32)	-	7288 (4.32)	-	6870 (4.32)	-	6963 (4.32)	-	7010 (4.32)
Total		226034 (100.00)		210620 (100.00)		159178 (100.00)		221348 (100.00)		168864 (100.00)		159115 (100.00)		161241 (100.00)		162366 (100.00)

Figures in parentheses are the percentages of the total.

charges (18.67 per cent) marketing charges (10.01 per cent) and seed cost (9.47 per cent). In aggregate total variable cost per hectare was found to be highest on small fish farms (₹2,26,034) followed by medium (₹2,10,620) and large fish farms (₹159178) which shows the economies of scale. The total variable cost on large farms category was less than small and medium farms because large farmers stored the inputs in bulk and had their own assets that's why they did not have to rent the assets. In overall total variable cost was ₹221348 per hectare on sample fish farms. The analysis of the table reveals that on Panchayati fish farms, among the small farmers, the major component of variable costs was expenses on other major costs which were 59.44 per cent of the total variable cost and second major constituent of variable expenditure were labour used in various fish farming operations which were 22.81 per cent and the minimum expenses incurred on feed and disease control measures which were 0.32 and 0.31 per cent of the total variable cost. Similarly, on medium and large farms category, the major component of variable cost was expensed on other major costs which were 55.58 and 50.11 per cent, respectively. On medium and large farm categories, the minimum expenses incurred on feed that is 0.29 and 0.33 per cent, respectively. The interest on variable cost for half period was calculated to be 4.32 per cent of the total variable cost. In the overall scenario, on Panchayati fish farms, a major constituent of total variable costs were other major costs (54.72 per cent) followed by labour charges (22.80 per cent) and expenses on seed (12.71 per cent). The total variable cost was estimated to be ₹1,59,115 on medium fish farms followed by large (₹1,61,241) and small fish farms (₹1,68,864) while in overall total variable cost was estimated to be ₹1,62,366 per hectare.

Gross and net returns from fish farming

The returns from fish farming on per hectare basis have been presented in Table 10. A perusal of the table reveals that on private fish farms, gross returns from fish farming came out to be ₹301879, 308674 and 331107 per hectare on small, medium and large fish farms, respectively, while it worked out to be ₹304021 in an overall situation. Returns to fixed farm resources (RFFR) were calculated after deducting the variable cost from gross returns. Returns to fixed farm resources (RFFR) per hectare worked out to be ₹75845 on small, ₹98054 on medium and ₹171929 on large farms, while it came out to be ₹82673 to an overall situation in the study area. The total fixed cost on large farms was more than small and medium farm category because large farmers include both the rental value of leased-in land and owned land. The benefit-cost ratio (variable cost) was worked out after dividing the gross returns by Returns to fixed farm resources (RFFR). The benefit-cost ratio (variable cost) was estimated to be 1.34, 1.47 and 2.08 for small, medium and large fish farms, respectively and in overall B:C ratio was 1.37. Net returns from fish farming were calculated by deducting total cost from gross returns. Net returns per hectare were estimated to be ₹12596, 31461 and 34017 on small, medium and large fish farms, respectively, while in an overall scenario, it was ₹16638 per hectare. The benefit-cost ratio (total cost) was found to be in direct relationship with the fish farm size. This showed that a small fish farmer earned ₹1.04 by investing rupee one on fish farming, while by investing the same amount, medium and large farmers earned ₹1.11 each. This indicated that there was a net return of ₹0.04, 0.11 and 0.11 on small, medium and large farms, respectively for an investment of rupee one on fish farms.

A perusal of the table reveals that on Panchayati fish farms, gross returns from fish farming came out to be ₹270830, 279798 and 278293 on small, medium and large farms respectively, while it worked out to be ₹275751 in an overall situation. Returns to fixed farm resources (RFFR) worked out to be ₹101966 on small, 120683 on medium and 117052 on large fish farms, while it came out to be ₹113385 in an overall situation on the sample farms.

Table 10. Gross and net returns from fish farming on sample fish farms, Punjab, 2013-14

(₹per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Total fish production (kg)	3870.24	3674.69	4300.09	3848.37	3428.23	3541.75	3478.66	3490.52
Average price received (₹/ kg)	78.00	84.00	77.00	79.00	79.00	79.00	80.00	79.00
Gross returns (1×2)	301879	308674	331107	304021	270830	279798	278293	275751
Variable cost	226034	210620	159178	221348	168864	159115	161241	162366
RFFR (3-4)	75845	98054	171929	82673	101966	120683	117052	113385
Benefit-cost ratio (3/4) (Variable cost)	1.34	1.47	2.08	1.37	1.60	1.76	1.73	1.70
Fixed cost	63249	66593	137912	66035	18669	15745	25559	19918
Total cost (4+7)	289283	277213	297090	287383	187533	174860	186800	182284
Net returns (3-8)	12596	31461	34017	16638	83297	104938	91493	93467
Benefit-cost ratio (3/8) (Total cost)	1.04	1.11	1.11	1.06	1.44	1.60	1.49	1.51

Figures in parentheses are the percentages of the total.

The benefit-cost ratio (variable cost) was estimated to be 1.60, 1.73 and 1.76 for small, medium and large farms, respectively and in overall B:C ratio was 1.70. Net returns per hectare were estimated to be ₹83297, 104938 and 91493 on small, medium and large farms, respectively, while in an overall scenario it was ₹93467 per hectare. The Benefit-cost ratio (total cost) were worked out to be 1.44, 1.60 and 1.49 for small, medium and large farms while in overall B:C ratio was 1.51. This showed that a small fish farmer earned ₹1.44 by investing rupee one on fish farming while by investing the same amount, large and medium farmers earned ₹1.60 and 1.49, respectively while on overall it was ₹1.51. This indicated that there was a net return of ₹0.44, 0.60 and 0.49 on small, large and medium farms respectively for an investment of rupee one on fish production. This highlights that on both private and Panchayati fish farms, the medium farmers were more efficient in utilizing the resources judiciously as compared their other counterparts.

Marketable Surplus of Fish Farming

Table 11 contains the information on the marketable surplus of fish on different farm size categories of fish farmers in the study area. On private fish farms, on an average, only 0.21 per cent of total production of fish was consumed at home while 0.35 per cent was given to relatives as a gift and 0.42 per cent was given to labour as kind wages. The overall marketable surplus i.e. 99.02 per cent of the total produce was sold on the farm or off the farm. On Panchayati fish farms, on an average, only 0.20 per cent of total production of fish was consumed at home while 0.32 per cent was given to relatives as a gift and 0.40 per cent was given to labour as kind wages. In overall, the marketable surplus was 99.08 per cent of the produce and was sold on the farm or off the farm. The pattern of distribution of fish production was similar on all the fish farm categories except on large fish farms in case of private fish farms. However, the proportionate share of home consumption and given to relatives and kind wages to labour was inversely related to the fish farm size.

Constraints Faced in Production and Marketing of Fish Produced

There is no doubt that the fish farming is an enterprise which requires less effort and more profits. This is the reason that the fish farming activity is catching up rapidly in Punjab. The selected fish farmers highlighted various difficulties faced by them both in production and marketing of fish which are summarized in Table 12 and 13.

Contraints in production

Poaching or theft

It is perhaps the most serious problem being faced in the pond fish culture. High price and ready market for carps attract the thieves easily. It was reported that all the selected fish farmers were affected by this problem. The detail of production constraint depicted in Table 12.

Incidence of disease

Generally, fishes have a great resistance to diseases. Heavy stocking density, non-maintenance of a clean environment, over manuring, accumulation of organic matter in the pond etc. cause many hazards to fish health.

Table 12. Constraints faced by fish farmers in fish production, Punjab, 2013-14

(Multiple responses)

Problems	Small	Medium	Large	Total
Poaching	44 (100.00)	32 (100.00)	24 (100.00)	100 (100.00)
Incidence of disease	44 (100.00)	32 (100.00)	24 (100.00)	100 (100.00)
Insect pest attack	40 (90.91)	24 (75.00)	18 (75.00)	82 (82.00)
Weeds	18 (40.91)	12 (37.50)	16 (66.67)	46 (46.00)
Less subsidy	44 (100.00)	32 (100.00)	24 (100.00)	100 (100.00)
Others (flooding, reptiles, etc.)	24 (54.55)	18 (56.25)	18 (75.00)	60 (60.00)

Figures in parentheses are the percentages of the total.

Table 11. Marketable surplus realized on the sample fish farms, Punjab, 2013-14

(Kg per ha)

Particulars	Private fish farms				Panchayati fish farms			
	Small	Medium	Large	Overall	Small	Medium	Large	Overall
Production	3870.24 (100.00)	3674.69 (100.00)	4300.09 (100.00)	3848.37 (100.00)	3428.23 (100.00)	3541.75 (100.00)	3478.66 (100.00)	3490.52 (100.00)
Family consumption	9.27 (0.24)	4.02 (0.11)	1.92 (0.04)	8.13 (0.21)	6.99 (0.20)	3.33 (0.09)	1.47 (0.04)	3.62 (0.20)
Quantity given to relative	15.59 (0.40)	6.32 (0.17)	2.90 (0.07)	13.58 (0.35)	11.09 (0.32)	5.26 (0.15)	2.35 (0.07)	5.75 (0.32)
Kind wages to labour	18.46 (0.48)	7.56 (0.21)	3.59 (0.08)	16.10 (0.42)	13.61 (0.40)	6.34 (0.18)	2.79 (0.08)	6.98 (0.40)
Marketable surplus	3826.92 (98.88)	3656.79 (99.51)	4291.68 (99.80)	3810.57 (99.02)	3396.54 (99.08)	3526.81 (99.58)	3472.05 (99.81)	3474.17 (99.08)

Figures in parentheses are the percentages of the total.

Table 13. Constraints faced by fish farmers in fish marketing, Punjab, 2013-14

(Multiple responses)

Problems	Small	Medium	Large	Total
Irregular payments	22 (50.00)	20 (62.50)	14 (58.33)	56 (56.00)
Low price	38 (86.36)	26 (81.25)	22 (91.67)	86 (86.00)
High transportation cost	14 (31.82)	8 (25.00)	5 (20.83)	27 (27.00)
Lack of remunerative price	44 (100.00)	32 (100.00)	24 (100.00)	100 (100.00)
Lack of clientele	12 (27.27)	3 (9.38)	5 (20.83)	20 (20.00)

Figures in parentheses are the percentages of the total.

These hazards include retarded growth, injuries, diseases and parasitic infections which adversely affects the production. This problem was reported by all the selected fish farmers (Table 12).

Insect-pest attack

During the course of fish culture operations, few insect and pests are encountered which sometimes cause heavy fish mortality. These insects and pests include aquatic insects, predatory and frogs, etc. which reduce the fish production directly or indirectly. This problem was reported by 82 per cent of the fish farmers in the study area (Table 12).

Weeds

One of the major problems in fish ponds is to control the excessive growth of aquatic weeds. Though the presence of some plants to a limited extent is desirable, yet their excessive growth affects fish production. This problem was reported by 46 per cent of the selected fish farmers (Table 12).

Less subsidy

It is another constraint which was reported by fish farmers in the production process. There is a less subsidy on the construction of the pond, feed, aerator, etc. This constraint was reported by all the fish farmers in the selected sample (Table 12).

Others (flooding, damaging by reptiles, etc.)

Being an outdoor enterprise, it is prone to various natural hazards such as damage by animals like snakes and flooding during the rainy season which discourages the farmers in the adoption of this enterprise. This problem was reported by 60 per cent of the selected farmers (Table 12).

The above discussion clearly brings out that fish production faced few constraints/problems which can affect the production level adversely. Among these problems, the poaching, insect-pest attack, and flooding during rainy season were found to be a serious one.

Constraints faced in the Marketing of Fish

The constraints in the marketing of fish have been shown in Table 13 which was highlighted by the fish farmers as well as the intermediaries during the course of the investigation.

Irregular payments

About 56 per cent of the fish farmers faced the problem of delayed payment after selling of fish. The time lag between the delivery of fish and the payment for it was reported to be up to two months. Moreover, the delay in payment is not compensated by way of paying any interest on the amount due.

Low price

Although inland fish farming is a profitable enterprise, the fish farmers faced problems due to the lack of steady marketing outlets. Fish is a highly perishable commodity, the producers thus forced to sell their produce at lower prices than what they could possibly get for the same produce if it were sold outside the state. This problem was reported by 86 per cent of the fish farmers on the sample farms.

High transportation cost

It was seen that due to fish markets being at a long distance, the cost of transportation was higher. This problem was reported by the fish farmers who transported their produce to wholesale markets. This problem was faced by 27 per cent of the respondents. This problem discouraged the farmers to send the produce to the distant fish markets.

Lack of remunerative price

There is no control over the fish market by any government agency/institution and no public agency regulates the fish price. It results in fetching low prices to the producers during the bumper harvest. This problem was faced by all the farmers on the sample farms.

Lack of clientele

It was reported by 20 per cent of the selected fish farmers that consumers play an important role in the production of fish. They informed that the fish was generally consumed by the migrant labour. They also pointed out that the main hindrance in the sale of fish is its peculiar odour. Such unfounded impression affected the demand for fish among the consumers (Table 13).

CONCLUSIONS

The above discussion on the component-wise analysis of costs-return structure and constraints analysis of fish farming culminate to following conclusions.

- The present value of the capital investment incurred in fish farming on private fish farms was highest (₹80302/ha) on small farms followed by medium (₹64020/ha) and large farms (₹54990/ha). In overall, the present value of the capital investment was ₹76685 per hectare with nearly 57 per cent of total investment on the cost of pipes and cost of digging the fish ponds.
- On Panchayati fish farms, the present value of investment incurred was ₹19572 per hectare on small

farms followed by ₹10133 per hectare on medium, ₹6443 per hectare on large and ₹11278 per hectare in the overall situation. Nearly 75 per cent of the total capital investment was made on aerator and generator on the sample fish farms.

- The fixed cost incurred on private fish farms was higher on large farms (₹1,37,912/ha) due to the rental value of the land taken on lease followed by medium (₹66593/ha) and small (₹63249/ha) fish farms. On Panchayati fish farms also, fixed cost per hectare was highest on large farms (₹25559/ha) followed by small (₹18669/ha) and medium (₹15745/ha) farms. Variability in fixed cost was mainly due to the rental value of Panchayati fish ponds with respect to the location and cleanliness of the pond along with surroundings.
- The relative share of permanent labour in total expenses incurred on labour on fish farms was nearly 69 per cent followed by family labour (nearly 25 per cent) and seasonal labour (nearly 6 per cent).
- Major marketing cost incurred on the sample fish farms, as found during the course of the investigation, was expensed on transportation of fish produced (40-42 per cent) followed by harvesting/catching of fish and expenses on marketing.
- Other major expenses in fish farming include the electricity bill usage, diesel used for running diesel engine/generator, aeration cost, renovation of fish farms and repair and maintenance of irrigation structure.
- On private fish farms, the total variable cost was highest on small fish farms (₹2,26,034/ha) followed by medium (₹2,10,620) and large (₹1,59,178) fish farms. Expenses were lower on large fish farms due to no marketing cost incurred and due to economies of scale.
- On Panchayati fish farms, the total variable cost incurred was maximum on small fish farms (1,68,884/ha) followed by large (₹1,61,241) and medium (1,59,115) fish farms. Thus, medium fish farmers were more efficient as compared to their counterparts.
- Net return in fish farming on private fish farms were highest on large fish farms (₹34017/ha) followed by medium (₹31461/ha) and small (₹12596/ha) fish farms. On Panchayati fish farms, net returns were maximum on medium fish farms (₹1,04,938/ha) followed by large (₹91493) and small (₹83297/ha) fish farms.
- In marketing costs, the cost of transportation was highest on both private and Panchayati fish farms.
- As far as the selling of fish produced is concerned, 99.02 per cent of the produce was sold on the farm or off the farm by private fish farms and 99.08 per cent by Panchayati fish farms.
- The total marketable surplus was more on private fish farms (38.10 q/ha) as compared to Panchayati fish farms (34.74 q/ha).
- The major problems in production and marketing of fish were; poaching, the incidence of disease, less subsidy and lack of remunerative price, low price etc.

Policy Measures

For improvement in the production, productivity and profitability from fish farming, as well as the overall economic welfare of the fish farmers, the following policy measures are put forward:

- Fish farmers may be encouraged to establish an aqua club that may facilitate developing awareness about different fishery activities like; control of predatory, poaching, control of weeds, the incidence of disease etc.
- The Government should provide more subsidies to fish farmers so that they can improve their production/profitability and thus decrease the cost of production.
- There should be control over the fish market by any government agency/institution presently operating in the state which should ensure remunerative price to the fish farmers.
- Markets should be nearby located in order to reduce the transportation cost.
- Regular payments should be ensured to the farmers from contractors to encourage fish farming.
- For increasing the demand for fish in the market, people should be made aware of the nutritional importance of fishes by electronic and print media through advertisements.

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Developing a Consumer Well-Being Matrix with reference to Materialism and Money Attitude

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ABSTRACT

The study of the concept of consumer well-being has become imperative for developing societies that are being influenced by consumerism. India is one of the nations where consumption has amajor contribution in its development. Materialism and money attitude have been considered as two determining factors of consumer's well-being. The taxonomy of materialism and money attitude has been prepared and the level of consumer well-being has been determined across the taxonomies. It has been found that extremely materialistic people with an indifferent attitude towards money have lowest consumer well-being and minimally materialistic people with the preferential attitude towards money have the highest consumer well-being. Based on taxonomy, the paper further develops the consumer well-being matrix that highlights the demographic characteristics of people lying in different quadrants of the consumer well-being matrix. It was found that people with highest consumer well-being are males of age 25 years or below working in private sectors. People with lowest consumer well-being are males of 25 to 30 years of age who are self-employed businessmen.

Keywords
Anxiety, consumer well-being, distrust, materialism, money attitude, power-prestige, quality, retention-time.

JEL Codes
M11, M31, M37.

INTRODUCTION

In India, the economic development has been linked to the level of consumption (Zimring & Rathje, 2012) with increasing level of income and purchasing power of people. Due to globalization, there is a huge impact of consumer culture on Indian society (Gupta, 2011), which put forth the relevance of the study of consumer well-being in the Indian context. The basic postulation of consumer comportment is that consumer always strives to maximize his satisfaction. Consumption and spending bring happiness and satisfaction (Larsen *et al*., 1999). Increase in satisfactionfrom consumption and spending intensifies the level of one's overall well-being (Ryan & Deci, 2002). Consumer well-being has been concomitant to an objective measure of overall well-being (Ahuvia *et al*., 2010). The objective of increasing the overall well-being can be advanced by increasing the level of satisfaction one gets from consumption and spending. The consumption decision depends on one's desire for material goods and willingness to spend that is, consumption decision depends on the degree of interaction between money attitudes and materialistic values, which ultimately brings contentment or discontentment. Buying decisions depend on one's materialistic tendencies and one's inclination towards spending. This is where the materialism and attitude towards money are influencing consumer's well-being. Thus, this study is an attempt to analyze this interaction of materialism and money disposition as a stimulus for increasing consumer's well-being.

LITERATURE REVIEW

Materialism is giving importance to material goods (Belk, 1984; Richins & Dawson, 1992; Hudders & Pandelaere, 2012). A person is said to be materialistic

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when material goods are used to maintain social status and reflect identity (Ward & Wackman, 1971; Wong *et al.,* 2011; Shrum *et al*., 2013; Dittmar *et al*., 2014). Materialism person believes that material goods bring satisfaction (Easterlin & Crimmins, 1991; Chan & Prendergast, 2007).

Money Attitude is a multi-dimensional concept. People use money as a tool to show off status, power, identity, etc. (Yamauchi & Templer, 1982; Lindgren, 1980). It reflects achievements and accomplishment of life (Murray, 1938; Tang, 1988 &1992)

Consumer well-being is the satisfaction one gets from various consumer life domains (Lee *et al*., 2002; Sirgy & Lee, 2006) like possession (Day, 1978 & 1987; Leelakulthanit *et al.,* 1991; Nakano *et al*., 1995); ownership (Nakano *et al*., 1995), acquisition (Day, 1978 & 1987; Meadow, 1983; Leelakulthanit *et al*., 1991); consumption (Sirgy *et al*., 2007) of consumer goods.

Materialistic people have perceptual compression to purchase goods that they can exhibit to society. This paints a disconsolate picture of consumption behaviour of a materialist. (Hirschman, 1991; Baumeister *et al*., 1998; Shiv & Fedorikhin, 1999) and against one's subjective and collective well-being. This demonstrates a negative association between materialism with consumer well-being (Richins & Dawson, 1992; Eastman *et al*., 1997; Hudders & Pandelaere, 2012; Podoshen & Andrzejewski, 2012; Roberts *et al*., 2015; Ferrandi *et al*., 2015). For consumption assessment, materialism plays an important role as a stimulant (Rindfleisch *et al*., 1997). Material values influence consumption decisions. Materialistic people have a propensity to continuously search for some superior as well as sumptuous goods for possession. There is a strong relationship between money attitude and consumption behaviour. The power/prestige money attitude of an individual becomes stronger, the consumer advances towards the materialistic purchase behaviour (Wong, 2004) that goes against the consumer's well-being. But following the same pattern of money attitude and consumption behaviour, as consumer's distrust and time retention money attitude become prominent; his purchase becomes less materialistic and limited. This shows that people with different money attitude depict different purchase decision depending on the level of materialistic values they possess. Individual's behaviour and lifestyle affect the purchase decisions (Liou, 2009).

RESEARCH METHODOLOGY

The study is descriptive in nature. The existing standardized and established scales of materialism, money attitude, and consumer well-being were adapted, to suit the objective of the current study, to collect the primary data on three variables under study i.e. materialism, money attitude and consumer well-being. A self-administered questionnaire survey was done in Delhi and National Capital Region. To check the level of consumer well-being at different levels of materialism and money attitude, a taxonomy was prepared on the basis of quartile scores. The effect of the interaction of different levels of materialism and money attitude on consumer well-being was checked.

DEVELOPMENT OF SCHEDULE

The list of different scales of materialism, money attitude and consumer well-being that were reviewed to draft a data collection instrument is presented in Annexure I. The final schedule was developed in various steps. The preliminary draft of measures was put to experience survey, where nine experts from the relevant field were asked to rate the statements included in measures. The resulting measures were put in the pilot survey. The reliability and internal consistency were checked and the measures were factor analyzed. The results of factor analysis were incorporated to get the final data collection instrument. In addition to three measures, several demographic questions were also added in final questionnaire. Six points Likert scale anchored from strongly disagree to strongly agree was used on variable measuring instruments. The final version of the schedule used for data collection is presented in Annexure II.

DATA

The study required the collection of primary data twice. The first time it was collected for pilot study. After developing the context-specific questionnaire, the primary data was again collected to conduct the final study.

SAMPLING

Primary data, for both pilot and final survey, was collected from Delhi and National Capital Region (NCR), which includes New Delhi, Noida/Greater Noida, Gurgaon, Faridabad, and Ghaziabad. The sample size planned for the pilot survey was 220 out of which 212 responses were found suitable for analysis. The sample size planned for the final survey was 700 out of which data from 688 were found suitable for final study.

DATA ANALYSIS AND FINDINGS

The quartiles were calculated and used to prepare taxonomy of three variables under study i.e. materialism, money attitude and consumer well-being, to study the consumer well-being at different levels and combinations of materialism and money attitude. These variables were split up into three categories, on the basis of quartile scores, in order to study the different levels of consumer's well-being at the interaction of different intensities of materialism and money attitude. Table 1 below shows the quartile scores of materialism, money attitude, and consumer well-being.

The quartile scores divided the data into four parts for each scale. The first quartile covered the sample of people who have achieved minimum mean score and in every subsequent quartile, the presence of variable under study increased. The fourth quartile included the sample group who have attained maximum mean score. This way there were four different groups showing different intensities of representative variables. The quartiles of all the three scales were given nomenclature to reflect their strength

Table 1. Quartile scores

Quartiles	Q_1	Q_2	Q_3
Materialism	2.6	3.3	4.0
Money attitude	3.1	3.6	4.0
Consumer well-being	3.8	4.3	4.9

and scope. In perusal of Table 2 below the details of taxonomy and the nomenclature given to three variables under study.

For a taxonomy of materialism scale, all those who scored less than or equal to the first quartile (2.60) were labelled as minimally materialistic. Those who scored above 2.60 and below or equal to 4.00 were labelled as reasonably materialistic and all who scored above 4.00 were named as extremely materialistic. Both second and third quartiles were combined to reflect the transitional tendency. With this we had three categories of materialistic people based on their scores, that is, minimally materialistic, reasonable materialistic and extremely materialistic.

Table 2. Taxonomy and nomenclature of materialism, money attitude, and consumer well-being

Range of value	Variable nomenclature
Materialism	
2.60 or below	Minimally materialistic
Between 2.61 to 4.00	Reasonably materialistic
Above 4.00	Extremely materialistic
Money attitude	
3.12 or Below	Indifferent attitude towards money
Between 3.121 to 4.00	Casual attitude towards money
Above 4.00	Preferential attitude towards
Consumer well-being	
3.75 or below	Low consumer well-being
Between 3.751 to 4.85	Moderate consumer well-being
Above 4.851	High consumer well-being

On the same lines for money attitude scale, the classification was done on the basis of quartile score on money attitude scale. All those who scored less than or equal to 3.12 were classified as people having an indifferent attitude towards money, all those who scored above 3.12 but below or equal to 4.00 were classified as people having a casual attitude towards money and all those who scored above 4.00 classified as people were people having a preferential attitude towards money.

The scores in five sub-dimensions of money attitude reflect the amount of importance one gives to money. High score in power-prestige sub-dimension reflects the importance one gives to money for showing one's status. On the other hand, people scoring low on power-prestige would reflect that money is insignificant for them. High score of retention-time sub-dimensions reflects the importance one gives to money in terms of keeping money reserve for future uncertainties. Whereas low score on retention-time sub-dimension means that the individual is not giving importance to money for securing his future. A high score on distrust sub-dimension reflects the importance one gives to money in terms of not trusting anyone or even himself when it comes to making decisions involving money. A low score on distrust sub-dimension reflect the ease of spending money and the individual is not thinking much before spending. Money is not an important object in their life. A high score on quality sub-dimension reflects the purposefulness of money in terms of its ability to make the spender buy quality products. Money is significant for people who score high on quality as for them with money they can get superior goods. A low score on quality reveals that a person is not interested in spending for quality products. A high score on anxiety dimension would reflect the importance of money in one's life in terms of an object that makes one apprehensive. A low score on anxiety reflects that money does not make one feel concerned, that is, it is not important for them.

The idea was to make inter variable comparison between the first quartile and the fourth quartile based on descriptive data for each category. Consumer well-being was tested for a different combination of different levels of materialism and money attitude. Combination of different levels of materialism and money attitude was used to develop a consumer well-being matrix, on the basis of taxonomy done based on quartiles.

Similarly, with consumer well-being frame the classification was done on the basis of quartile scores. The four sub-dimensions of consumer well-being scale reflect the level of satisfaction one gets from different consumer life domains that is, purchase, acquisition, possession, consumption, and maintenance. People scoring high on these sub-dimensions would enhance the overall consumer well-being. People who scored less than or equal to 3.75 on consumer well-being scale were deduced to have low consumer well-being. People who scored above 3.75 and below or equal to 4.85 were regarded as having moderate consumer well-being and people scoring above 4.85 were construed to have high consumer well-being.

A high score on purchase satisfaction reflects the pleasure one gets from experiencing purchase of durable goods. A low score reflects that person has not pleased from the purchase activity. A high score on acquisition satisfaction shows that person feels contented by acquiring the consumer durable goods and the low score reflects his discontentment from acquiring the commodity. A high score on deployment satisfaction, which encompasses satisfaction from possession and consumption, reflects that an individual is happy to have and use the product. A low score on the deployment satisfaction shows unfulfilling feeling from the ownership of the product and reflects that the product is of less utility to them. A high score on maintenance satisfaction reflects that a person is happy with the quality and expenses of after sales services of the product. A low

score reflects the person is unhappy from the maintenance and after sale services.

After the taxonomy and nomenclature, descriptive statistics (mean and standard deviation), of materialism, money attitude and consumer well-being, were worked out for people falling in different reference groups.

The major findings for materialism scale were that people falling in the minimally materialistic category, which is 26.02 percent of the sample, showed the highest score on consumer well-being (Table 3). People falling in the extremely materialistic category, which is 25.73 percent of the sample, scored lowest on consumer well-being. A minimally materialistic individual has a high level of consumer well-being and extremely materialistic individuals have a low level of consumer well-being. As we moved from minimum to extreme category of materialism, there was arise in significance of money in one's life i.e. the mean value of money attitude was rising as we move from minimally materialistic to reasonably materialistic and to extremely materialistic.

For money attitude scale, it was found that as the importance of money increases, materialism also goes up. For people having an indifferent attitude towards money, materialism was low. People having a casual attitude towards money had a relatively high score. People having a preferential attitude towards money scored highest on materialism.

For consumer well-being scale, for people with low consumer well-being, which is 25 percent of the sample, materialism was high and for people having high consumer well-being, which is 25.73 percent of the sample, materialism was low. The significance of money was found to be rising with an increase in the level of consumer well-being, that is, the mean value of money attitude was rising as we move from low consumer well-being to moderate consumer well-being and to high consumer well-being.

The mean value of consumer well-being was also analyzed by combining different categories of materialism and money attitude and results presented in Table 4. Analysing the different combination of extremes of materialism and money attitude, it was found that respondents with indifferent money attitude and minimal materialism had lowest mean value for materialism and respondents with preferential money attitude combined with extreme materialism had highest mean value for materialism.

It was also found in the present research that money plays an important role in the formation of materialistic tendencies. The mean value of materialism was lower when combined minimally materialistic with indifferent money attitude as compared to mean value of minimally materialistic alone. The mean value of materialism was higher when combined extremely materialistic with preferential money attitude as compared to mean value of extremely materialistic alone.

Consumer well-being was analyzed for people reflecting different combinations of materialism and money attitude. The interaction of these variables shows that 4.36 per cent of respondents who were minimally materialistic with the preferential attitude towards money had highest consumer well-being and 1.6 percent respondents who were extremely materialistic with an indifferent attitude towards money scored lowest on consumer well-being.

The importance of money attitude was also reflected

Table 3. Descriptive statistics of materialism, money attitude and consumer well-being based on taxonomy

Variables		**Materialism**	**Money attitude**	**Consumer well-being**
Different levels of variables	**N (Per cent)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Minimally materialistic	26.02	1.98 (0.41)	3.30 (0.70)	4.87 (0.74)
Reasonable materialistic	48.26	3.34 (0.37)	3.54 (0.59)	4.19 (0.62)
Extremely materialistic	25.73	4.48 (0.40)	3.97 (0.61)	3.83 (0.98)
Indifferent money attitude	26.02	2.67 (0.83)	2.76 (0.29)	4.42 (0.78)
Casual money attitude	46.8	3.39 (0.87)	3.56 (0.23)	4.14 (0.82)
Preferential money attitude	25.73	3.7 (1.03)	4.45 (0.35)	4.37 (0.92)
Low consumer well-being	25.00	3.86 (0.81)	3.55 (0.59)	3.19 (0.56)
Moderate consumer well-being	49.27	3.33 (0.81)	3.56 (0.61)	4.28 (0.28)
High consumer well-being	25.73	2.62 (1.03)	3.67 (0.83)	5.32 (0.32)

by the strength of consumer well-being when money attitude was combined with materialism. The mean value of consumer well-being was higher when minimally materialistic was combined preferential attitude towards money as compared to mean value of consumer well-being of minimally materialistic people alone. The mean value of consumer well-being was lower when extremely materialistic was combined with indifferent money attitude as compared to mean value of extremely materialistic alone.

Thus it was found that the respondents in the minimally materialistic category showed a high level of consumer well-being and respondents in the extremely materialistic category showed a low level of consumer well-being. The mean value of consumer well-being increases as we move from less severe category to more severe category of materialism (from minimally to extremely).

Respondents who were minimally materialistic and had indifferent money attitude were found to have lowest mean value for materialism and the respondents who were extremely materialistic and had preferential money attitude were found to have highest mean value for materialism. The mean value of materialism was lower when combined with indifferent money attitude as compared to mean value of minimally materialistic alone and the mean value of materialism was higher when combined with preferential money attitude as compared to mean value of extremely materialistic alone. This shows that money plays an important role in the formation of materialistic tendencies. One's attitude towards money does affect the level of materialism (Christopher *et al*., 2004; Troisi *et al.*, 2006; Lemrová *et al*., 2014).

Considering the third objective of our study, to study the influence of materialism and money attitude, we have studied consumer well-being at different combinations of levels of materialism and money attitude. The results show that an individual is at the highest level of consumer well-being when he is minimally materialistic and has a preferential attitude towards money and individual is at the lowest level of consumer well-being when he is extremely materialistic and has an indifferent attitude towards money. This confirms the previous findings of Miriam Tatzel that individuals who are least materialistic and are loose with money have the highest level of well-being and individuals who are highly materialistic and tight with money have low well-being (Tatzel, 2002 & 2003).

CONSUMER WELL-BEING MATRIX

After analyzing the consumer well-being at different levels of materialism, money attitude and their combinations, the demographic description was also analyzed through different demographics. A four-quadrant matrix was developed with four different combinations formed out of the interaction of extremes of materialism and money attitude that is, minimally materialistic and indifferent money attitude, minimally materialistic and preferential money attitude, extremely materialistic and indifferent money attitude and extremely materialistic and preferential money attitude. Table 5 below shows the consumer well-being matrix with four quadrants.

Table 4. Descriptive statistics of at different combinations of different levels of materialism and money attitude

Variables		**Materialism**	**Money attitude**	**Consumer well-being**
Combinations of different level of variables	**N (Per cent)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Minimally materialistic +Indifferent money attitude	12.35	1.94 (0.41)	2.71 (0.29)	4.79 (0.78)
Minimally materialistic +Casual money attitude	9.30	2.06 (0.43)	3.52 (0.24)	4.77 (0.72)
Minimally materialistic +Preferential money attitude	4.36	1.95 (0.33)	4.47 (0.26)	5.32 (0.42)
Reasonably materialistic +Indifferent money attitude	12.06	3.19 (0.34)	2.83 (0.26)	4.14 (0.57)
Reasonably materialistic +Casual money attitude	26.89	3.38 (0.36)	3.56 (0.23)	4.15 (0.62)
Reasonably materialistic +Preferential money attitude	9.30	3.41 (0.39)	4.4 (0.38)	4.36 (0.66)
Extremely materialistic +Indifferent money attitude	1.60	4.32 (0.28)	2.7 (0.41)	3.65 (0.85)
Extremely materialistic +Casual money attitude	12.06	4.23 (0.36)	3.62 (0.23)	3.66 (0.95)
Extremely materialistic +Preferential money attitude	12.06	4.55 (0.44)	4.49 (0.35)	4.04 (0.98)

Table 5. Consumer well-being matrix

	Minimally materialistic	**Extremely materialistic**
Indifferent attitude towards money	**CWB=4.79 (0.78)**	**CWB=3.66 (0.85)**
	Age = Above 40 years (30 per cent)	Age = 25-30 years (55 per cent)
	Education= Post graduate (45 per cent)	Education= Under graduate (37 per cent)
	Occupation=Private sector (36 per cent)	Occupation=Self-employment business (46 per cent)
	Income= Up-to ₹4, 00, 000 (35 per cent)	Income= Up to ₹4, 00, 000 (37 per cent)
	Gender= Females (55 per cent)	Gender= Males (64 per cent)
	Location= Delhi (29 per cent)	Location= Noida/Gr Noida (45 per cent)
Preferential attitude towards money	**CWB=5.32 (0.42)**	**CWB=4.04 (0.98)**
	Age = Upto 25 years (30 per cent)	**Age** = Upto 25 years (32 per cent)
	Education= Post graduate (54 per cent)	Education= Graduate (41 per cent)
	Occupation=Private sector (47 per cent)	Occupation=Private sector (30 per cent)
	Income= ₹4,00,001 to₹7,00,000 (37 per cent)	Income= ₹10,00,001 to ₹5,00,000 (28 per cent)
	Gender= Males (74 per cent)	Gender=Females (57 per cent)
	Location= Gurgaon (34 per cent)	Location= Delhi (25 per cent)

The perusal of Table 5 shows that the level of consumer well-being was found to be highest in the second quadrant of minimally materialistic with the preferential attitude towards money and the level of consumer well-being was found to be lowest in the third quadrant of extremely materialistic with an indifferent attitude towards money**.**

In the first quadrant (N=85), which was a combination of minimally materialistic and indifferent money attitude, the mean value of consumer well-being was 4.79 (0.78). The kind of people falling in this category (Table 5) was examined and it was found that a maximum number of people falling in this category were females of above 40 years of age, were postgraduates, working in private sector, with income upto ₹4, 00, 000 and residing in Delhi.

In the second quadrant (N=85), which was the combination of minimally materialistic and preferential money attitude, the mean value of consumer well-being was 5.32 (0.42), which was maximum of all. The kind of people falling in this category (referring Table 5) was examined and it was found that a maximum number of people falling in this category were males of up-to 25 years of age, were postgraduates, working in private sector, with income between ₹4,00,001 to ₹7,00,000 and residing in Gurgaon.

In the third quadrant (N=11), which was a combination of extremely materialistic and indifferent money attitude, the mean value of consumer well-being was 3.65 (0.85), which was a minimum of all. The kind of people falling in this category (referring Table 5) were examined and it was found that maximum number of people falling in this category were males of 25-30 years of age, were undergraduates, were self-employed businessmen, with income upto ₹4, 00, 000 and residing in Noida/Greater Noida.

In the fourth quadrant (N=83), which is the combination of extremely materialistic and indifferent money attitude, the mean value of consumer well-being was 4.04 (0.98), which was a minimum of all. The kind of people falling in this category (referring Table 5) was examined and it was found that a maximum number of people falling in this category were graduate females of up to 25 years of age, were working in private sector, with inc**ome** ₹10, 00,001 to ₹5,00,000 and residing in Delhi.

CONCLUSIONS

The dynamism of economic and social environment has put forth various indeterminate issues before marketers in terms of factors shaping buying and spending decisions of consumers. The negative relationship between materialism and consumer well-being gets reflected in the findings of the study. The findings of current study throw light on the demographic characteristics in terms of age, gender, education, occupation, income and location of people falling in different categories of materialism and money attitude. Minimally materialistic people with indifferent money attitude were found to have highest consumer well-being and extremely materialistic people with preferential money attitude were found to have lowest consumer well-being. In view of findings of the analysis, the purposeful strategic alternatives should focus on increasing the consumer well-being of individual consumers in specific and society and economy in general, which will inevitably bring economic and financial well-being.

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Annexure I. Existing materialism measures

Author(s)	Sub-dimensions
Moschis & Churchill (1978)	Materialistic attitude scale
Inglehart (1981)	Materialism and post-materialism scale
Tashchian *et al.* (1984)	Belief in material growth scale (BIMG)
Belk (1984;1985)	Possessiveness, Non-generosity, Envy
Ger& Belk (1996)	Possessiveness, Non-generosity, Envy, Preservation
Richins (1987; 1992)	Personal materialism factor, general materialism factor
Richins & Dawson (1992)	Acquisition Centrality, Acquisition as a pursuit of Happiness, Possession defined success
Atay & Sirgy (2008)	Happiness, Success, Distinctiveness
Trinh & Phau (2012)	Material Success, Material happiness, Material essentiality, Material distinctiveness
Sirgy *et al.* (2013)	Happiness, Social recognition, Uniqueness

Annexure II. Existing money attitude measures

Author(s)	Sub-dimensions
Wernimont & Fitzpatrick (1972)	Shameful failure, social acceptability, pooh-pooh attitude, moral evil, comfortable security, social unacceptability and conservative business values
Goldberg & Lewis (1978)	Status, respect from others, freedom of choice, luxury of time
Yamauchi & Templer (1982)	Power-prestige, retention time, distrust, quality and Anxiety
Furnham (1984)	Obsession, power, retention, security, inadequacy and effort/ability.
Forman (1987)	Spendthrift, miser, gambler, bargain hunter and tycoon.
Tang (1988, 1992)	Good, evil, achievement, respect, budget, and freedom
Furnham (1999)	Attitudes toward saving, spending, indifference, and banking
Mitchell *et al.* (1998)	Value importance of money, personal involvement with money, time spent thinking about financial affairs, knowledge of financial affairs, comfort in taking financial risks, skill in handling money, money as a source of power & status
Beutler *et al.* (2012)	Entitlement and conscientiousness Money-attitude scales

Annexure III. Existing consumer well-being measures

Author (s)	Sub-dimensions
Day (1978 &1987), Day & Walters (1991)	Product acquisition and possession
Meadow, 1983 (Overall Consumer Satisfaction–Composite)	This approach focused on measuring overall acquisition or shopping satisfaction.
The University of Michigan's American Consumer Satisfaction Index (1994)	Perceived value, perceived quality, consumer's loyalty and customer expectations
Nakano *et al*. (1995)	Material possessions and standard of living
Total Consumption Expenditure Index (TCEI) of the United Nations	Composite of consumption of cars, paper products, telephone connections, electricity, total energy, meat, fish, and cereals.
Sirgy *et al*. (2000); Sirgy & Cornwell (2001)	Satisfaction or dissatisfaction with a variety of consumer goods and services available in the local area
Lee *et al*. (2002)	Acquisition, possession, consumption, maintenance and disposal
Consumer Union (2005) (www.consumerreports.org)	Product reliability, durability, and safety.
Sirgy *et al*. (2007)	Perceived QOL impact model

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An Economic Analysis and Resource Use Efficiency of *Bt*-Cotton in Middle Gujarat

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ABSTRACT

The present investigation has analyzed the costs and returns and resource use efficiency of Bt-cotton in Middle Gujarat during 2015-16. The results indicated that average cost of cultivation of Bt-cotton was ₹69372per ha. Out of total cost, human labour cost was ranked first followed by fertilizer cost, manure and cakes. The average yield of Bt-cotton per ha was observed 23.39 quintals on sample farms. The net profit over Cost C_2 was ₹29858per ha. The production function analysis revealed that human and bullock labour, plant protection and irrigation exerted significant influence on the yield of Bt-cotton. About 35.9 per cent of total variation in the gross income from the Bt-cotton cultivation was explained by the explanatory variables included in the function. The sum of regression co-efficient (Σbi's) was noted 0.509 indicating decreasing returns to scale, in other words sample farmers were observed operating in second zone of production. The study has brought to the fore that there is an ample potentiality of the raising Bt-cotton production on the sample farms through adoption of improved and new technologies along with optimum utilization of resources like human labour, seeds, chemical fertilizers, and irrigation with better management practices.

Keywords
Cost of cultivation, marginal value product, net income, resource use efficiency, returns to scale.

JEL Codes
A11, D24, E23, Q18.

INTRODUCTION

The economy of Gujarat is one of the fastest growing economies among all states of India. It also has the distinction of achieving higher agricultural growth compared to the national average. The geographical location of Gujarat has endowed it with longest coastal line among all states in India, facilitating easier access to international trade. In spite of industrialization, majority of population in Gujarat is dependent on agriculture for its livelihood. There is much variability in agricultural production due to many seasonal factors. This uncertainty in agricultural production has led to exclusion of rural population from receiving benefits of economic liberalization and high growth of GDP in India. In such a scenario it becomes imperative to take steps to increase production, improve value added production in agricultural sector for improving income levels of population dependent on it. Promoting exports from agriculture sector will lead to improvement in incomes of the rural population, allowing them to share gains and benefits from economic development.

The plant biotechnology has become a source of agricultural innovation, providing new solutions to age-old problems of low yield and quality constraints. However, the impact of biotechnology is one of the most vigorously contested issues in the recent history of impact of technologies on human society (Loganathan *et al*., 2009).

[#]***This research article has been drawn from the M.Sc. Thesis of the first author***

Cotton *(Gossypium spp.)* is an important fiber crop of global significance, which is, cultivated in tropical and sub tropical regions of more than seventy countries across the world. India is one among the important cotton growers on a global scale. Cotton, the *White Gold* of India, the *King of Fibers*, is a multipurpose crop grown under various agro-climatic conditions. It is cultivated mainly for its lint which is the most sought after textile fiber due to its inherent eco-friendly and comfort characters. Cotton is major supplier of raw material to textile industry.

Cotton provides livelihood to over 60 million people through its cultivation, trade and industry. Cotton and textiles contribute nearly one third of India's annual export, thus bring valuable foreign exchange to the country (Manjunath *et al*., 2013). Cotton is a leading commercial and major cash crop of India. It is grown under rain fed as well as irrigated conditions and the major cotton producing states include Maharashtra, Gujarat, Andhra Pradesh, Punjab, Karnataka, and Madhya Pradesh. The productivity of cotton in India is, however, very low. The pest problem in cotton is worst among all crops. The main pest is boll worms and the largest quantity of pesticides among all crops is applied to control pests in cotton- often with little success. Cotton cultivation had recently become uneconomic in many parts of the country due to the high cost of pesticides and the low yield (Gandhi& Namboodiri, 2006).

In India, the introduction of *Bt*-cotton for commercial cultivation is a major technological landmark after the advent of *Green Revolution* in the late-1960s. Since, its introduction, the technology has transgressed sizes and agro-ecologies resulting in significant economic gains and has transformed the landscape of India's cotton economy. The direct benefits of *Bt*-cotton include reduced insecticide-usage, lower farming risks and production costs, higher yields and profits, expanded opportunities to grow cotton, and a brighter economic outlook for the cotton industry. These benefits have provided increased returns to labour and household income, thereby a reduction in rural poverty (Ramasundaram *et al.*, 2014).

In 2014-15, India achieved a historic milestone by producing more cotton than China and became highest cotton producing country in the World. For the first time in the history of agriculture, India dethroned China to earn the crown of the white gold-as cotton is known among smallholder farmers in the rural parts of India and China. In 2006, India displaced USA to third position by harvesting 28 million bales-a million more than USA to become the second largest cotton producing country. Over the subsequent eight years, 2007-2014, India sustained the growth of cotton primarily due to the introduction and rapid adoption of dual gene *Bt*-cotton technology coupled with a large scale hybridization of cotton area, supply of good quality seeds by private sector and untiring efforts by approximately 8 million cotton farmers in the country (Choudhary & Gaur, 2015).

India continues to benefit enormously from *Bt*-cotton. India has the world's largest hectarage of cotton, and accounts for 46 per cent of the total biotech cotton area planted globally. During a period of 13 years from 2002 to 2014, India has tripled cotton production from 13 million bales to 40 million bales. In 2014, *Bt*-cotton was planted in 11.6 Mha in India, accounted for 95 per cent of the total 12.25 Mha in the country. Commercialization of *Bt*-cotton increased 230-fold at 11.6 Mha in 2014 from 50,000 ha in 2002. India doubled its market share of global cotton production from 12 per cent in 2002 to 25 per cent in 2014, representing a quarter of the total global cotton production. India was estimated to have enhanced farm income from *Bt*-cotton by US$16.7 billion in the 12-year period 2002 to 2013 and US$2.1 billion in 2013 alone (Clive, 2014). An attempt has been made in the present paper to assess the effect of Bt-cotton technology on cotton output in Middle Gujarat. The specific objectives of the present study were:

1. to study the cost of cultivation and returns per ha of *Bt*-cotton crop, and
2. to study the resource use efficiency of *Bt*-cotton crop

SAMPLING AND METHODOLOGY

Ahmedabad and Vadodara districts were selected purposively, as they collectively covered about 83.42 per cent area of cotton in triennium average of the years 2010-11, 2011-12, and 2012-13 in Middle Gujarat Zone. Two talukas were selected from each district on the basis of concentration of area. Further, three villages were selected randomly from the each selected talukas. Thus, total 12 villages were selected for the study. Then, randomly 12 *Bt*-cotton growing respondents from each of the selected villages were chosen for the study. Thus, in all 144 growers (43 marginal, 34 small, 31 medium and 36 large) were selected for the study. The costs concepts of A, B, C_1 and C_2 were employed to achieve the stipulated objectives. In order to determine the efficiency of resources used in the production of Bt-cotton, Cobb-Douglas form of production function was used considering gross income per hectare as dependent variable and other variables as independent variables. The variables included and functional form of the function is as given below:

$$Y = ax_1^{b_1}x_2^{b_2}x_3^{b_3}x_4^{b_4}x_5^{b_5}x_6^{b_6}e^{u} \text{.....(1)}$$

The original equation (1) was converted into log linear form and the parameters were estimated by using the ordinary least squares method.

$$\ln Y = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + b_6 \ln x_6 + U$$

Where,

Y = Gross income of *Bt*-cotton (₹per ha),

a = Intercept

X_1 = Cost of labour (human and bullock in ₹per ha)

X_2 = Tractor charges (₹per ha)

X_3 = Cost of seeds (₹per ha)

X_4 = Cost of fertilizers (₹per ha)

X_5 = Cost of plant protection chemicals (₹per ha),

X_6 = Irrigation charges (₹per ha),

$b_1, b_2 \ldots b_6$ = Regression co-efficients (output elasticity of respective inputs (X_i's))

$\sum_{i=1}^{n} bi$ = Returns to scale, and

e^u = Error term with usual assumptions.

The regression co-efficients of inputs obtained were used to calculate MVP at their geometric mean.

$$MVPxi = bi \frac{\bar{Y}}{\bar{X}}$$

Where,

$\bar{Y}$ = Geometric mean of output (Y),

$\bar{X}$ = Geometric mean of respective inputs (x_i) and

b_i = Regression co-efficient associated with the x_i input.

RESULTS AND DISCUSSION

Cost Structure

The details about component-wise costs for Bt-cotton cultivation on different size of farms per ha are studied and presented in Table 1. The results indicate that the average total cost of cultivation on *Bt*-cotton farms *i.e.* Cost C_2 was ₹69372 per ha. It was found that the highest cost was on large farms (₹73687) followed by medium farms (₹72376), small farms (₹67427) and marginal farms (₹65131). This was mainly on account of more investment made by large farmers on human labour, bullock labour, tractor charges, manures, plant protection chemicals, irrigation charges and also on depreciation, interest on working capital, and interest on fixed capital. On an overall basis among the different items of cash expenditure, the cost of human labour ranked first with 15.52 per cent of the total cost as *Bt*-cotton requires more number of labours for sowing of seeds, application of fertilizers and plant protection chemicals and weeding. Highest expenditure on other inputs was observed on chemical fertilizers (12.31 per cent) followed by irrigation charges (7.22 per cent), bullock labour (6.04 per cent), cost of seeds (5.37 per cent), tractor charges (5.09 per cent), plant protection chemicals (2.70 per cent), manures (2.19 per cent), depreciation (2.15 per cent), picking costs (0.93 per cent), and miscellaneous costs (0.38 per cent). The highest not payable but accounted expenditure was rental value of owned land (20.50 per cent) followed by managerial costs (9.09 per cent), interest on fixed capital (6.12 per cent) and interest on working capital (4.40 per cent). These findings are in consonance with the results obtained by Gandhi and Namboodiri (2006); Visawadia *et al.* (2006); Kotwal and Leua (2014); Haque *et al.* (2015).

Estimates of Different Costs

It could be inferred from Table 2 that overall Cost A was ₹41226per ha. The highest Cost A was ₹42053 per ha on large farms and the lowest ₹39877 on marginal farms.

Further, the study showed that Cost B and Cost C_1 accounted for about 86.05 and 90.91 per cent of Cost C_2. Overall, Cost C_2 was observed to be ₹69372 per ha which was highest on large farms (₹73687) and lowest on marginal farms (₹65131). Higher costs on large farms were associated with intensive use of human labour, bullock labour, inter cultivation, manures, plant protection chemicals, irrigation and also on depreciation, interest on working capital and interest on fixed capital. A positive association was observed between farm size and total cost (Cost C_2) due to cost of production, increase in mechanization and cost of labour charges. This is in conformity with the results obtained by Patel (2015).

Yield, Price and Gross Income and Net Gains

A perusal of Table 3 reveals that the average yield of *Bt*-cotton was 23.39 quintals per ha. It ranged from 21.90 quintals per ha on marginal farms to 27.65 quintals per ha on large farms. Higher yield level on large farms could be attributed to the optimum level of inputs utilized by them along with timely weeding operations and proper selection of varieties of *Bt*-cotton seeds, which affected the output to a greater extent, as compared to other farms. The variation in the yield was due to the lack of knowledge about recommended package of practices or timely technical guidance.

As can also be seen from Table 3 that per quintal average farm harvest price received by the *Bt*-cotton growers was ₹4242. The large size growers realized higher price per quintal (₹4320) followed by medium (₹4236), marginal (₹4224) and small category of farms (₹4187). Generally, medium and large farmers were observed selling their produce at higher prices compared to marginal and small farms, which was mainly due to time of sale and agencies to which the produce was sold.

The overall average gross returns on *Bt*-cotton farms amounted to ₹99230 and it varied from ₹92509 on marginal farms to ₹119471 per ha on large farms. Thus gross income increased with an increase in size of the farms, except in case of small farms.

An analysis of per ha net return as given in Table 4 shows that net returns over operational cost (Cost A) was the highest (₹77417) on large farms and the lowest (₹52632) on marginal farms with an average of ₹58003 on sample farms. Net returns from *Bt*-cotton farms on the basis of Cost B, Cost C_1 and Cost C_2 were₹39537, ₹36165 and ₹29858 per ha, respectively. It is apparent from the analysis that per ha net returns on *Bt*-cotton farms over Cost C_2 ranged from ₹27378 on marginal farms to ₹45783 on large farms with an average of ₹29858. Net income over different costs on *Bt*-cotton farms increased with increase in the size of farms except on marginal farms.

The overall farm business income, family labour income and farm investment income as given in Table 5 were found to be ₹58003, ₹39537 and ₹48324 per ha, respectively. The net profit (over Cost C_2) was ₹29858 per ha for all farms. The analysis also brought to the fore that farm business income, family labour income and farm

investment as well as net profit increased as the category of farm changed from marginal to large except small farms.

Cost per quintal

The estimated cost of production per quintal of *Bt*-cotton is given in Table 6. The overall paid out cost (Cost A) was ₹1762 per quintal, which was 59.43 per cent of the total cost. The overall Cost B was worked out to be ₹2552 per quintal which was 86.05 per cent of total cost. The overall total cost of production (Cost C_2) per quintal of *Bt*-

Table 1. Break-up of the total cost of cultivation for *Bt*-cotton

(₹ha^{-1})

	Category of Farm				
	Marginal	**Small**	**Medium**	**Large**	**Overall**
Human labour	9747	10282	11863	11488	10764
	(14.97)	(15.25)	(16.39)	(15.59)	(15.52)
(a) Family	3066	3154	3673	3686	3372
	(4.71)	(4.68)	(5.08)	(5.00)	(4.86)
(b) Hired	6680	7127	8190	7802	7391
	(10.26)	(10.57)	(11.32)	(10.59)	(10.65)
Bullock labour	4229	4246	3465	4707	4188
	(6.49)	(6.30)	(4.79)	(6.39)	(6.04)
Tractor charges	3375	3505	3578	3704	3532
	(5.18)	(5.20)	(4.94)	(5.03)	(5.09)
Seeds	3935	3741	3625	3548	3726
	(6.04)	(5.55)	(5.01)	(4.82)	(5.37)
Manures	1264	1428	2009	1491	1520
	(1.94)	(2.12)	(2.78)	(2.02)	(2.19)
Chemical fertilizers	8606	9522	8058	7936	8537
	(13.21)	(14.12)	(11.13)	(10.77)	(12.31)
Plant protection chemicals	1931	1637	1822	2064	1872
	(2.97)	(2.43)	(2.52)	(2.80)	(2.70)
Irrigation charges	5085	4890	4992	5038	5007
	(7.81)	(7.25)	(6.90)	(6.84)	(7.22)
Picking costs (₹q^{-1})	648	642	672	628	647
	(1.00)	(0.95)	(0.93)	(0.85)	(0.93)
Miscellaneous	259	261	262	261	261
	(0.40)	(0.39)	(0.36)	(0.35)	(0.38)
Depreciation	906	1382	2102	1755	1488
	(1.39)	(2.65)	(2.90)	(2.38)	(2.15)
Interest on working capital	2953	3071	3102	3115	3053
	(4.54)	(4.55)	(4.29)	(4.23)	(4.40)
Interest on fixed capital	1813	3261	7085	5634	4245
	(2.79)	(4.84)	(9.79)	(7.65)	(6.12)
Rental value of owned land	14452	13420	13155	15613	14220
	(22.19)	(19.90)	(18.18)	(21.19)	(20.50)
Managerial cost	5921	6129	6579	6698	6306
	(9.09)	(9.09)	(9.09)	(9.09)	(9.09)
Total	65131	67427	72376	73687	69372
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Figures in the parentheses indicate the percentages to total.

cotton was ₹2965. It was highest on small farms (₹3206), followed by farms (₹3132), farms (₹2974) and large category of farms (₹2664).

Table 2. Estimation of different costs

(₹ ha^{-1})

Category of farm	Different Costs			
	Cost A	Cost B	Cost C_1	Cost C_2
Marginal	39877 (61.23)	56143 (86.20)	59210 (90.91)	65131 (100.00)
Small	41460 (61.49)	58142 (86.23)	61297 (90.91)	67427 (100.00)
Medium	41882 (57.87)	62123 (85.83)	65796 (90.91)	72376 (100.00)
Large	42053 (57.07)	63302 (85.91)	66988 (90.91)	73687 (100.00)
Overall	41226 (59.43)	59692 (86.05)	63065 (90.91)	69372 (100.00)

Figures in the parentheses indicate the percentages to Cost C_2.

Table 3. Yield level, farm harvest price and gross income per hectare

Category of farm	Yield (qha^{-1})	Average farm harvest price (₹q^{-1})	Value of gross output (₹ha^{-1})
Marginal	21.90	4224	92509
Small	21.03	4187	88063
Medium	23.10	4236	97874
Large	27.65	4320	119471
Overall	23.39	4242	99230

Table 4. Net gains over different costs per hectare

(₹ha^{-1})

Category of farm	Different Costs			
	Cost A	Cost B	Cost C_1	Cost C_2
Marginal	52632	36365	33299	27378
Small	46602	29920	26765	20635
Medium	55991	35750	32077	25497
Large	77417	56169	52482	45783
Overall	58003	39537	36165	29858

Production Function Analysis

To achieve the objective of resource use efficiency on the Bt-cotton farms, Cobb-Douglas production function was used. Gross profit considered as dependent variable and the independent variables were the human and bullock labour, cost of machinery, seeds, chemical fertilizers, plant protection chemicals, and irrigation. The elasticities of production with its standard errors are presented in Table 7. It can be seen from the table that the Co-efficient of Multiple Determinations (R^2) was 0.35 which showed that 35 per cent of the variation in the yield was accounted for by the explanatory variables included in the function.

The conspicuous observation from the Table 7 is that the costs of labour and chemical fertilizers were significant at 5 per cent level of significance. The elasticity of seeds was negative. The elasticity of plant protection chemicals was highly significant but negative and the elasticity of irrigation was positive and highly significant at 1 per cent level of significance.

The value of sum of regression coefficients (Σ bi's) was observed to be 0.509 for *Bt*-cotton indicating decreasing returns to scale or in other words, sample farmers were observed operating in second zone of production.

Ratios of Marginal Value Product to Marginal Factor Cost in *Bt*-cotton Production

The marginal value product (MVP) of a particular

Table 6. Cost of production per quintal on the basis of different cost concepts

(₹q^{-1})

Category of farm	Different costs			
	Cost A	Cost B	Cost C_1	Cost C_2
Marginal	1821 (61.23)	2564 (86.20)	2704 (90.91)	2974 (100.00)
Small	1971 (61.49)	2764 (86.23)	2914 (90.91)	3206 (100.00)
Medium	1812 (57.87)	2689 (85.83)	2848 (90.91)	3132 (100.00)
Large	1520 (57.07)	2289 (85.91)	2422 (90.91)	2664 (100.00)
Overall	1762 (59.43)	2552 (86.05)	2696 (90.91)	2965 (100.00)

Figures in the parentheses indicate the percentages to Cost C_2.

Table 5. Farm business income, family labour income, farm investment income, and net profit over Cost C_2

(₹ha^{-1})

Particulars	Category of farm				
	Marginal	Small	Medium	Large	Overall
Farm business income	52632	46602	55991	77417	58003
Family labour income	36365	29920	35750	56169	39537
Farm investment income	43644	37318	45738	67032	48324
Net profit	27378	20635	25497	45783	29858

Table 7. Production elasticity of *Bt*-cotton crop as estimated from Cobb-Douglas production function

Variables	Production elasticity (bi)
X_1 = Cost of labour (human and bullock) (₹ha^{-1})	0.217** (0.100)
X_2 = Tractor charges (₹ha^{-1})	0.155 (0.098)
X_3 = Cost of seeds (₹ha^{-1})	-0.179 (0.107)
X_4 = Cost of fertilizers (₹ha^{-1})	0.193** (0.097)
X_5 = Cost of plant protection chemicals (₹ha^{-1})	-0.190*** (0.064)
X_6 = Irrigation charges (₹ha^{-1})	0.313*** (0.092)
a = Intercept	2.909
R^2	0.359
Σ bi's = Returns to scale	0.509
n = Number of farms	100

Figures in the parentheses indicate standard error of corresponding elasticity.
****** and ** Significant at 1 and 5 per cent level.***

resource represents the expected addition to the gross income caused by an addition of one unit of that resource, while other inputs are held constant. The estimated marginal value products (MVP), factor costs and their ratio for *Bt*-cotton cultivation were computed and the results are shown in Table 8.

The results furnished in Table 8 revealed that the MVP/MFC ratio was the highest in the case of irrigation (7.30), followed by tractor charges (4.40), chemical fertilizers (3.01) and labour costs (1.42) on *Bt*-cotton farms. This implied that an addition of one rupee in irrigation, tractor charges, chemical fertilizers and labour costs would yield return of 7.30, 4.40, 3.01 and ₹1.42, respectively on *Bt*-cotton farms. As such gross returns from *Bt*-cotton cultivation can be increased by using more of these inputs.

An important factor that is not being considered is that the water requirement increases significantly in the case of the transgenic crops. The production of *Bt*-cotton can be increased by providing water to crop at desired level. The results of resource use efficiency indicated that *Bt*-cotton growers were underutilizing water resource because ratio of MVP to MFC greater than unity (7.30) showed that there is potential for *Bt*-cotton growers to increase their profit by increasing the use of water in *Bt*-cotton crop.

Fertilizer is very important input in cotton production. Most of the soils are nitrogen deficient. There

Table 8. Ratio of MVP to MFC in *Bt*-cotton farms

Resources	MVP/ MFC ratio	Resource use efficiency
Labour costs (human and bullock)	1.42	Under utilization
Tractor charges	4.40	Under utilization
Seeds	-4.96	Over utilization
Chemical fertilizers	3.01	Under utilization
Plant protection chemicals	-11.40	Over utilization
Irrigation	7.30	Under utilization

is always need to add fertilizers in soil to fulfill nutrients deficiency to get maximum production. A balanced used of fertilizer with desired level of nutrients is very much necessary if one wants to get maximum production. *Bt*-cotton growers were observed under utilizing the fertilizer resource because ratio of MVP to MFC for *Bt*-cotton growers was greater than unity (3.01) for fertilizer. Therefore, farmers have an opportunity to increase their profit by using more fertilizer in their fields.

Labour is vital resource in cotton production. The results of resource use efficiency showed that ratio of MVP to MFC for *Bt*-cotton growers was 1.42 showing that the resource was being underutilized and there was need to use more labour in different farm activities to increase profit by equating MVP to MFC. Similar results were reported by Muhammad *et al.,* (2011).

MVP/MFC ratio was found negative (-4.96) for seeds and for plant protection chemicals (-11.40) indicating the reduced return by every additional rupee.

CONCLUSIONS

The average total cost of cultivation of *Bt*-cotton was observed to be₹69372per ha. Break-up of total cost on sample farms indicated that per ha expenditure on the cost of human labour ranked first with 15.52 per cent of the total cost as *Bt*-cotton requires more number of labours for sowing of seeds, application of fertilizers and plant protection chemicals and weeding. The average yield of *Bt*-cotton was 23.39 quintals per ha. The average farm harvest price received by the *Bt*-cotton growers was ₹4242 per quintal. The overall average gross returns on *Bt*-cotton farms amounted to ₹99230 per ha.

On an average, net return from *Bt*-cotton farms ₹29858per ha. The overall farm business income, family labour income and farm investment income were found to be 58003, 39537, and ₹48324 per ha, respectively. The average cost of production was found ₹2965 per quintal.

The production function analysis indicated that the costs of labour, chemical fertilizers and irrigation had significant influence on yield. One per cent increase in the use of these inputs led an increase of 0.217, 0.193 and 0.313 per cent in the gross revenue of crop respectively. The value of co-efficient of multiple determinations showed that 35.9 per cent variation in the gross revenue

was accounted for by the explanatory variables included in the function. The sum of regression co-efficient was 0.509 indicating decreasing returns to scale and in other words, sample farmers were observed operating in second zone of production. The ratio of MVP to MFC of labour, tractor charges, chemical fertilizers and irrigation were found greater than unity indicating that farmers have an opportunity to increase their profit by using more of these inputs in their fields. To sum up, it could be concluded that, there is an ample potentiality of raising *Bt*-cotton production on sample farms through adoption of improved and new technologies along with optimum utilization of resources like human labour, seeds, chemical fertilizers, and irrigation with better management practices.

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Farm Power Scenario in India with Special Reference to Punjab

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ABSTRACT

The present study based on secondary data was conducted to have an overview of farm power scenario of India with particular reference to Punjab. In India the farm power increased seven times from 40.1 million kW in 1960-61 to 282.73 million kW by 2013-14, as against an increase from 1.39 million kW in 1960-61to 18.24 kW by 2012-13 observed in case of Punjab. The density of tractors, the major source of farm power, increased from just two tractors per thousand hectares in 1960-61 to as high as 115 tractors per thousand by 2012-13, the corresponding figures for India being 35 (even less than one third). The study has conclusively established a massive shift towards mechanized farming which has been instrumental in making country food secure.

Key words
Biological power, farm power, mechanical power, tractors.

JEL Codes
O13, Q01, Q16, Q40.

INTRODUCTION

The inception of the green revolution in mid 60s and the consequent improvements on the food security front were made possible by bringing additional area under the plough, mechanizing the agriculture, extending the irrigation facilities and following better crop management techniques. There is no denial to the fact that mechanization of agriculture holds the key to development as it has the capacity to increase the production as well as productivity by maintaining the timeliness of farm operations, reducing the farm losses, economising the cost of production with better management of inputs and making the efficient use of natural resources besides making the farm operations drudgery free. The role of mechanization has been well recognized in boosting the agricultural production coupled with irrigation, biological and chemical inputs, high yielding varieties of seed, fertilizers and pesticides. All these developments over the years have brought about changes in the availability as well as utilization pattern of farm power in Indian Agriculture.

The role of mechanisation in productivity enhancement has also been increasingly recognized and the achievement of quantum jumps in land productivity in the Haryana, Punjab and parts of Uttar Pradesh would not have been a reality but for the availability of mechanical power and improved equipment. Singh *et al.* (2014) also confirmed that mechanization of cultivation of various crops and power availability has been instrumental in bringing about the improvement in farm productivity.

In the context of increasing commercialization of agriculture, mechanization has assumed greater importance. With increasing market orientation, Punjab agriculture has gone through a transformation from subsistence farming, dependent entirely on draught power, to a demand driven mechanized farming using less of biological and more of mechanical power sources like tractors, tillers and harvesters and is now deemed as the most mechanized state of the country. Over time the farm machinery in the state has grown exponentially and the mass scale mechanization of agriculture in conjunction with the use of other complementary inputs and sound crop management practices have completely transformed the face of Punjab. The state has the highest irrigated area and cropping intensity among all the states in the country. With large scale farm mechanization which ensured the variety of the operations to be performed at optimum time, the cropping intensity in state which was only

125.95 per cent in the year 1960- 61 increased to 161.37 per cent in 1981-82 and to as high as 189.64 per cent during 2012-13, with much of the zonal variations.

The present study was therefore envisaged to have an overview of farm power scenario of India with particular reference to Punjab.

DATA AND METHODOLOGY

The formulation of the study, that is, to have an overview of farm power scenario of India with particular reference to Punjab, secondary data were used. The data on pertinent variables, for the time frame of 1960-61 to 2013-14, were culled from various web and published sources and verified from certain research papers, wherever deemed necessary.

The data sources tapped for the present study are:

a) www.Indiastat.com
b) www.agricoop.nic.in
c) Statistical Abstract of Punjab and India, various issues
d) Economic Survey, various issues
e) Agricultural Statistics at a Glance, various issues

RESULTS AND DISCUSSION

The farm power scenario of India has undergone myriad changes over the years. The present study was envisaged to have an overview of farm power scenario of India with particular reference to the state of Punjab, popularly known as the bread basket of India.

Changes in Farm Power Scenario of India

The information pertaining to this aspect has been presented in Table 1. The overtime changes in the availability of farm power sources in India can help one gain better understanding of the dynamism that has brought the country out of the situation of scarcity into the state of self-sufficiency. The quantum of farm power sources in India has been portrayed for the period 1960-61 to 2013-14. The farm power sources peculiar to Indian agriculture are agricultural workers. It can be easily observed that the number of agricultural workers has increased from 131.10 million to 272 million during the period of 1960-61 to 2013-14, registering a CAGR of 1.39 per cent. The highest increase (to the tune of 2.37 per cent per annum) in the number of agricultural workers has been observed in the decade of 90's. The number of draught animals has decreased from 80 million to 52 million during the entire study period, which may well be attributed to the increase in the mechanical power over the period. The number of other mechanical farm power sources have increased during the above said, although the rate of increase has been observed to be the highest in the case of tractor.

It can also be observed from the table that the number of tractors has increased tremendously between the years 1990-91 to 2010-11 and the largest increase in the number of power tillers was also found in the same time period. Considering the entire study period of 53 years, the tractors recorded the highest growth rate of 9.63 per cent per annum, followed by power tillers (9.20 per cent), electric motors (8.74 per cent) and diesel engines (7.04 per cent).

The density of farm power sources, per thousand hectare of net sown area in India has been presented in the Table 2, which shows that the density of human labour per thousand hectares of net sown area was the highest in all these years, while the density of draught animals stood second during the period 1960-61 to 2012-13. The density of power tillers was negligible in the beginning of the

Table 1. Farm power sources in India: Changes over time

(No. in million)

Year	Agricultural workers	Draught animals	Tractors	Power tillers	Diesel engines	Electric motors
1960-61	131.10	80.40	0.04	0.00	0.23	0.20
1970-71	125.70	82.60	0.17	0.01	1.70	1.60
1980-81	148.00	73.40	0.53	0.02	2.88	3.35
1990-91	185.30	70.90	1.19	0.03	4.80	8.07
2000-01	234.10	60.30	2.53	0.11	5.90	13.25
2010-11	263.00	53.50	4.21	0.32	8.20	16.50
2011-12	266.08	53.00	4.55	0.36	8.30	16.70
2012-13	269.20	52.80	4.86	0.40	8.35	16.80
2013-14	272.00	52.00	5.24	0.44	8.45	17.00
CAGR (per cent)**						
1960-61 to 1970-71	-0.42	0.27	15.57	-	22.14	23.11
1970-71 to 1980-81	1.65	-1.17	12.04	7.18	5.41	7.67
1980-81 to 1990-91	2.27	-0.35	8.42	4.14	5.24	9.19
1990-91 to 2000-01	2.37	-1.61	7.83	13.87	2.08	5.08
2000-01 to 2013-14	1.16	-1.13	5.76	11.25	2.80	1.94
1960-61 to 2013-14	1.39	-0.82	9.63	9.20*	7.04	8.74

Source: Singh et al. (2015).

**** over 1970-71; ** Author's computations.***

study period and rose up to three per thousand hectare of net sown area by 2012-13, which was conspicuously less in comparison to other power sources. The density of the rest of power sources like tractors, diesel engines and electric motors was also negligible in the year 1960-61, which continuously increased in the following decades and it was quite remarkable during the later part of the study period. The density of human labour and draught animals was very high as compared to that of the other power sources but the power availability from these sources was very less because these sources provide very less amount of power as compared to other sources. As per the 2012-13 figures, there were 35 tractors, 120 electric motors, 60 diesel engines and 3 power tillers to be manned by 1924 agricultural labourers per one thousand hectares of net sown area in India.

The farm power sources available in the country were converted into the energy units by using the conversion factors. The overtime farm power availability from different categories of power sources in India, along with their corresponding share (in per cent terms) has been presented in Table 3. It can be observed that the farm power increased seven times from 40.10 million kW in 1960-61 to 282.73 million kW by 2013-14. It was found that the biological power has decreased during the given time period, while the mechanical power has shown an upward trend. The percentage of farm power available from the biological sources was more in relation to that from mechanical power sources up to the year 1970-71, there after the per cent share of mechanical farm power has been more than that from the biological sources. The rapid decrease in the per cent share of biological power sources was not due to the decrease in the number of animate power sources only, but was primarily due to the rapid increase in the number of mechanical farm power sources. As of now, the mechanical power sources account for as high as 88 per cent of the farm power.

In order to make an assessment of the farm power availability per hectare of net sown and gross cropped area in India, the requisite analysis was carried out and the results are presented in Table 4. It can be seen from the table that there has not been much increase in net sown area which was 133.2 million hectares in 1960-61 and increased to 139.9 million hectares by 2012-13, but the farm power availability did increase noticeably well to the extent of nearly seven times during the same period. Further, the gross cropped area increased from 152.8 to 194.4 million hectares, but the farm power availability increased by five times during the above said period. The cropping intensity increased from 114.7 to 138.9 per cent during the above said period.

Table 2. Density of farm power sources per thousand hectare of net sown area in India

(Number/ '000 ha)

Year	Agricultural workers	Draft animals	Tractors	Power tillers	Diesel engines	Electric motors
1960-61	984.23	603.60	0.28	0.00	1.73	1.50
1970-71	892.38	586.40	1.19	0.07	12.07	11.36
1980-81	1054.96	523.20	3.79	0.12	20.53	23.88
1990-91	1295.80	495.80	8.34	0.23	33.57	56.43
2000-01	1656.29	426.63	17.91	0.81	41.74	93.75
2010-11	1857.87	377.93	29.72	2.27	57.93	116.56
2011-12	1887.49	375.97	32.30	2.57	58.88	118.46
2012-13	1923.82	377.33	34.72	2.87	59.67	120.06

Table 3. Category wise farm power availability in India

Year	Total farm power,	Farm power			
		Biological		Mechanical	
		Million kW	Percent of total	Million kW	Percent of total
1960-61	40.10	37.11	92.5	2.99	7.5
1970-71	57.55	37.67	65.5	19.88	34.5
1980-81	77.76	35.29	45.4	42.47	54.6
1990-91	124.24	36.21	29.1	88.03	70.9
2000-01	183.39	34.62	18.9	148.77	81.1
2010-11	252.05	33.48	13.3	218.57	86.7
2011-12	262.58	33.44	12.7	229.13	87.3
2012-13	271.49	33.52	12.3	237.97	87.7
2013-14	282.73	33.36	11.8	249.37	88.2

1Tractor = 26.1 kW, 1 Electric Motor = 3.7 kW, 1 Power Tiller = 5.6 kW, 1 Diesel Engine = 5.6 kW, 1 Human = 0.05 kW, 1 Draught animal = 0.38 kW

Changes in Farm Power Scenario of Punjab

This section is devoted to the discussion on farm power scenario of Punjab, the state which has bagged the tittle of most hi-tech state.

It can be observed from Table 5 that the number of agricultural workers in Punjab increased from 19.4 lakh in 1960-61 to 30.4 lakh in 2012-13 registering a compound growth rate of 0.87 per cent per annum. During the same period, the number of draught animals decreased from 26.8 lakh to 3.8 lakh, the rate of fall being 3.68 per cent per annum. The number of tractors has increased from 7900 to 4.77 lakh during the period 1960-61 to 2012-13 registering a growth rate of 8.20 per cent per annum. The number of diesel engines has increased from 7000 in 1960-61 to 1.94 lakh by 2012-13, the rate of growth being recorded at 6.60 per cent. The electric motors increased at the rate of 10.4 per cent per annum to reach close to 12 lakh by 2012-13.

The density of farm power sources per thousand hectare of net sown area in Punjab has been presented in Table 6. It indicates that the density of agricultural workers has increased during the time period 1960-61 to 2010-11. The density of draught animals per hectare of net sown area has continuously decreased during the period 1960-61 to 2012-13. This decrease in the density of the draught animals was found to be commensurate with the rapid increase in the density of tractors, which increased from just two tractors per thousand hectares in 1960-61 to as high as 115 tractors per thousand hectares by 2012-13. The tractors as well as other mechanical and electrical sources almost completely replaced the draught animals on the farms of Punjab. The density of diesel engines and electric motors per thousand hectares of net sown area have also increased many folds over the study period, but the density of electric motors (287/1000 ha) was higher as compared to that of diesel engines (47/1000 ha) on Punjab farms.

The farm power availability scenario in Punjab has been presented in Table 7, which showed an increasing trend throughout the period of 1960-61 to 2012-13, but the share of biological and mechanical power showed an opposite trend. During the year 1960-61, the biological sources were the major sources of farm power, while by the year 2012-13, the mechanical power sources provided

Table 4. Farm power availability per hectare of net and gross cropped area in India and cropping intensity

Year	Area, million ha		Power available, Kw/ha		Cropping intensity
	Net sown	Gross cropped	Net sown area	Gross cropped area	
1960-61	133.2	152.8	0.30	0.26	114.7
1970-71	140.9	165.8	0.41	0.35	117.7
1980-81	140.3	172.6	0.55	0.45	123.1
1990-91	143.0	185.8	0.87	0.67	129.9
2000-01	141.3	185.3	1.30	0.99	131.1
2010-11	141.6	197.6	1.78	1.28	139.6
2011-12	141.0	195.6	1.86	1.34	138.8
2012-13	139.9	194.4	1.94	1.40	138.9

Table 5. Farm power sources in Punjab: Changes over time

(No. in '000)

Year	Agricultural workers	Draught animals	Tractors	Diesel engines	Electric motors
1960-61	1937	2685	7.9	7	7
1970-71	2452	1636	22.3	101	102
1980-81	2859	1649	118.8	320	280
1990-91	3370	1585	213.5	182	600
2000-01	3555	436	407.1	288	845
2010-11	3555	382	443.3	226	1157
2012-13	3039	382	476.8	194	1191
CAGR, per cent*					
1960-61 to 1970-71	2.39	-4.83	10.93	30.59	30.72
1970-71 to 1980-81	1.55	0.08	18.21	12.22	10.63
1980-81 to 1990-91	1.66	-0.40	6.04	-5.49	7.92
1990-91 to 2000-01	0.54	-12.11	6.67	4.70	3.48
2000-01 to 2012-13	-1.30	-1.10	1.33	-3.24	2.90
1960-61 to 2012-13	0.87	-3.68	8.20	6.60	10.38

Source: Lohan et al. (2015).
**** Author's computations.***

the major part of farm power in Punjab. In the year 1960-61, power available from the biological sources was 80.4 per cent, and the mechanical sources accounted for 19.5 per cent. In the case of Punjab, the power available from biological sources was higher up to the sixties and there after the mechanical sources overtook the biological sources in the race of providing farm power. In the year 2012-13, the power available from the mechanical sources was as high as 98.4 per cent and from the biological sources it was only 1.6 per cent.

The power available per thousand hectare of net sown and gross cropped area in Punjab during the last few decades has been presented in the Table 8. This table shows that with the passage of time, the power availability on net sown and gross cropped area basis has increased at a faster pace in comparison to the change observed in case of net sown and gross cropped area. Whatever increase is there in case of gross cropped area, could well be attributed to rapid increase in the farm power availability, which enable the farmer maintain the timeliness. The power available in Punjab per hectare of net sown area in the year 1960-61 was 0.37 kW, which increased by the year 2012-13 to 4.39 kW, the corresponding figure on gross cropped area being 2.32 kW by the year 2012-13.

A comparison farm power availability in India and Punjab

The farm power availability scenario of Punjab with reference to India has been presented in Table 9. The farm power availability per unit of land area has always been higher in Punjab as compared to the country at large. The power available in India per thousand hectare of net sown area was 301.1 kW and that on gross cropped area basis was 262.6 kW in the year 1960-61. Whereas in the case of Punjab, the power available per thousand hectare of net sown area and gross cropped area was recorded at 370 and 293 kW respectively. But by the year 2012-13, there was a stark difference between the power availability in case of Punjab and the country level figure, indicating the fast paced mechanisation that brought about a turnaround in Punjab agriculture. In the year 2012-13 power availability per thousand hectare of net sown and gross cropped area in India was 1940 kW and 1397 kW respectively, whereas that in case of Punjab it was 4394 kW per thousand hectare of net sown and 2317 kW on gross cropped area basis. The share of Punjab in the case of India's net sown area, gross cropped area, biological power and mechanical power has been worked out and presented in Table 10.

The table shows that the state of Punjab, with only 2.8 per cent of the country's net sown area accounted for an equal share in biological power and proportionately higher share (9 per cent) in country's mechanical power pool. The per cent share of Punjab in biological farm power available in India has decreased consistently with the passage of time, whereas that in the case mechanical power has increased till early eighties and declined thereafter, which was due to increase in mechanisation in rest of the Indian states. Still Punjab corners 7.5 per cent share in mechanical farm power to flourish 3 per cent of the country's net cropped area.

Table 6. Density of farm power sources per thousand hectare of net sown area in Punjab

Year	Agricultural workers	Draught animals	Tractors	Diesel engines	Electric motors
1960-61	515.57	714.67	2.10	1.86	1.86
1970-71	604.98	403.65	5.50	24.92	25.17
1980-81	682.18	393.46	28.35	76.35	66.81
1990-91	798.96	375.77	50.62	43.15	142.25
2000-01	836.47	102.59	95.79	67.76	198.82
2010-11	854.98	91.87	106.61	54.35	278.26
2012-13	732.29	92.05	114.89	46.75	286.99

Table 7. Category wise farm power availability in Punjab

Year	Total farm power	Farm power			
		Biological		Mechanical	
		Thousand kW	Percent of total	Thousand kW	Percent of total
1960-61	1388.44	1117.15	80.4	271.29	19.5
1970-71	2269.31	744.28	32.8	1525.03	67.2
1980-81	6698.25	769.57	11.5	5928.68	88.5
1990-91	9582.35	770.8	8.0	8811.55	92.0
2000-01	15708.04	343.43	2.2	15364.61	97.8
2010-11	17439.54	322.91	1.9	17116.63	98.1
2012-13	18234.69	297.11	1.6	17937.58	98.4

Table 8. Farm power availability per hectare of net and gross cropped area in Punjab in relation to cropping intensity

Year	Area, '000 ha		Power available, Kw/ha		Cropping intensity
	Net sown	Gross cropped	Net sown area	Gross cropped area	
1960-61	3757	4732	0.37	0.29	126.0
1970-71	4053	5678	0.56	0.40	140.1
1980-81	4191	6763	1.60	0.99	161.4
1990-91	4218	7502	2.27	1.28	177.9
2000-01	4250	7941	3.70	1.98	186.8
2010-11	4158	7902	4.19	2.21	190.0
2012-13	4150	7870	4.39	2.32	189.6

Table 9. Power available per hectare of net sown and gross cropped area in India and Punjab

Year	Total power available (in million kW)		Power available, kW per thousand hectare			
			Net sown area basis		Gross cropped area basis	
	India	Punjab	India	Punjab	India	Punjab
1960-61	40.10	1.39	301.1	369.6	262.6	293.4
1970-71	57.55	2.27	408.6	559.9	347.1	399.7
1980-81	77.76	6.70	554.3	1598.2	450.5	990.4
1990-91	124.24	9.58	868.8	2271.8	668.9	1277.3
2000-01	183.39	15.71	1297.5	3696.0	989.5	1978.1
2010-11	252.05	17.44	1780.5	4194.2	1275.8	2207.0
2012-13	271.49	18.23	1940.2	4393.9	1396.6	2317.0

Table 10. Percent share of net sown area, gross cropped area and power availability of Punjab in India

Year	Net sown area	Gross cropped area	Power available	
			Biological	Mechanical
1960-61	2.8	3.1	3.0	9.1
1970-71	2.9	3.4	2.0	7.7
1980-81	3.0	3.9	2.2	14.0
1990-91	2.9	4.0	2.1	10.0
2000-01	3.0	4.3	1.0	10.3
2010-11	2.9	4.0	1.0	7.8
2012-13	3.0	4.0	0.9	7.5

CONCLUSIONS

It can be easily observed that the number of agricultural workers in India has increased from 131.10 million to 272 million during the period of 1960-61 to 2013-14, registering a CAGR of 1.39 per cent. Considering the entire study period of 53 years, the tractors recorded the highest growth rate of 9.63 per cent per annum, followed by power tillers (9.20 per cent), electric motors (8.74 per cent) and diesel engines (7.04 per cent). It was found that the biological power has decreased during the given time period, while the mechanical power has shown an upward trend. The farm power availability in India at large increased to the extent of nearly seven times from 1960-61 to 2012-13. The farm power availability scenario in Punjab showed an increasing trend throughout the period of 1960-61 to 2012-13, but the share of biological and mechanical power showed an opposite trend. The density of draught animals per hectare of net sown area has continuously decreased during the period 1960-61 to 2012-13 whereas tractors increased from just two tractors per thousand hectares in 1960-61 to as high as 115 tractors per thousand hectares by 2012-13. The tractors as well as other mechanical and electrical sources almost completely replaced the draught animals on the farms of Punjab. The power available in India per thousand hectare of net sown area was 301.1 kW and that on gross cropped area basis was 262.6 kW in the year 1960-61. Whereas in the case of Punjab, the power available per thousand hectare of net sown area and gross cropped area was recorded at 370 and 293 kW respectively. The farm power availability per unit of land area has always been higher in Punjab as compared to the country at large and that has been reflecting in Punjab's contribution in making India food secure.

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An Empirical Analysis of Distribution Pattern of Household Assets among MGNREGS Beneficiary Households in Punjab

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ABSTRACT

The study has been undertaken to analyse the distribution pattern of household assets among MGNREGS beneficiary sampled households in the rural areas of Punjab. A sample of 440 MGNREGS beneficiary households (106 from Fatehgarh Sahib, 229 from Fazilka and 105 from Hoshiarpur district) have been selected with multi-stage random sampling. The reference period of the study is 2014-15. The analysis of ownership of assets clearly pointed out that majority of MGNREGS beneficiary sampled households are landless and they are mainly dependent upon wage work for their livelihood. The average value of total household assets among MGNREGS beneficiary sampled households is only ₹3,66,827.45, ₹2,99,407.53, and ₹3,40,851.48 in Fatehgarh Sahib, Fazilka, and Hoshiarpur district. As a whole, the total value of assets is ₹3,25,539.64 among all the sampled beneficiary sampled households taken together in the rural areas of Punjab. The results highlighted that the share of productive assets (land, livestock and transport vehicle) to the total value of assets is only 18.55 per cent and due to that reason they are compelled to engage in low-paid jobs and also dependent upon mercy of the medium and large farmers for earning their livelihood in the rural areas of Punjab. The distribution of household assets is uneven among the MGNREGS beneficiary sampled households.

Keywords
Employment, inequality, land, MGNREGS.

JEL Codes
C82, D63, E24, I38, Q15.

INTRODUCTION

Assets are the resource endowments and capabilities that people have to sustain their livelihoods and to enhance their welfare. In the absence of realistic prospects of formal sector employment, the vast majority of poor people rely on the meager assets with which they are endowed, as well as those they can accumulate through the informal economy. Despite the impressive gains in overall economic growth by developing countries in recent decades, vast numbers of people continue to be left behind to face structural disadvantages that have proved resistant to conventional social policy. This uneven growth gives rise to social tensions that are fuelled by deprivation and perceptions of inequality (Moser & Dani, 2008).

Unequal distribution of assets and income is a general phenomenon in developing countries. These differences cut across gender, ethnicity, age, location and income sources. It is widely acknowledged among social scientists that caste is a persistent determinant of power, economic inequality, and poverty in India. Indian society historically had a rigid, occupation-based, hierarchical caste system in which the relative place of a caste in the social hierarchy was determined largely by its traditional occupation. The caste system of social stratification in India has been the basis of continued social discrimination of the weaker sections through the practice of untouchability and other severe forms of deprivation and inequality with respect to education, health, and access to different kinds of jobs (Thorat & Newman, 2007; Thorat & Attewell, 2007; Singh, 2009).

Secure access to productive assets mainly land is critical to the millions of poor people living in rural areas and depending on agriculture, livestock or forests for their livelihood. It reduces their vulnerability to hunger and poverty; influences their capacity to invest in their productive activities and in the sustainable management of their resources; enhances their prospects for better

livelihoods; and helps them develop more equitable relations with the rest of their society, thus contributing to justice, peace and sustainable development (IFAD; 2008). The social distribution of land in a village economy determines the economic position and power relations between different social groups in the village. The limited access to agricultural land and capital assets is both due to the historical legacy associated with restrictions imposed by the caste system and the ongoing discrimination in land market and capital market and other related economic spheres (Thorat, 2002).

In addition, unequal power relations often reinforce economic and social inequities and perpetuate categories and institutional behaviours that reinforce inequalities. This keeps the poor trapped within adverse "terms of recognition" that they themselves often internalise unless social movements and development opportunities give them the "capacity to aspire" to a better future (Moser & Dani, 2008).

MGNREGS is a direct response to the right to work as a goal of socio-economic development that guarantees wage employment at an unprecedented scale and directly touches lives of the poor. The Act aims at enhancing livelihood security of households in the rural areas of the country by providing at least one hundred days of guaranteed wage employment in a financial year to every household whose adult members volunteer to do unskilled manual work (Ministry of Rural Development, 2013). When NREGA was conceptualised, it was supposed to fulfill the long-standing right to work, which though inherent in the right to life guaranteed under the constitution, was never deemed to be a legally enforceable right (Dreze & Christian, 2009).

Some studies highlighted that MGNREGS is playing a key role in improving the socio-economic conditions of rural beneficiaries both directly as well as indirectly. A large number of SC/ST families benefited under this scheme. MGNREGS has an ability to lead the economy towards a labour intensive growth path, especially in the light of low and declining growth rate of productive employment (ILO and Government of Bihar, 2009; Reddy & Upendranadh, 2010; Gupta, 2010; Shobha & Gopal, 2012; Liu & Barrett, 2012).

Due to lack of assets, poor or weaker sections of the society particularly those are unskilled and working on low wage rate, are largely dependent upon public works. This scheme provided them an opportunity for employment and direct participation in economic as well as in political decisions which would result in an increment in the social status of these vulnerable sections. It has a positive impact on rural poor particularly because scheduled caste and scheduled tribe have gained directly as well as indirect benefits from this scheme. These studies analysed that NREGA had a great role in reducing social and economic disparities among weaker sections of the society and ensure social justice by helping marginalised sections of the society. These studies also highlighted that NREGA had become livelihood source for landless and marginal farmers during the off-season (Jha *et al.,* 2008; Mehrotra, 2008; Bhagwan, 2009; ILO & Government of Bihar, 2009; Biswas, 2011).

It is important to mention here that no doubt Punjab is an agrarian rich state but there is an unequal distribution of land which is a major productive assets in the rural areas of Punjab. Majority of weaker sections mainly scheduled caste and backward caste households are landless. Thus, this scheme can play important role in generating employment opportunities in the rural areas of Punjab if implemented properly. This scheme has failed in generating 100 days of assured employment and delayed in payments of wages is a major problem faced by the beneficiaries.

Need and Importance

A large number of studies have been conducted by scholars, government, as well as non-government institutions on implementation and impact of MGNREGS at national and state levels but very few studies, cover some aspects of the distribution pattern of household assets of the beneficiary households. It is important to mention here that no such type of comprehensive study has been conducted in the state of Punjab. In general, various studies have been conducted on the levels, pattern, and distribution of household assets, ownership of assets among farmers and other rural households. Therefore, the present study has been undertaken to study the levels, pattern, and distribution of household assets among the selected MGNREGS beneficiary sampled households in the rural areas of Punjab.

Objectives

The objective of the present study is to analyse the levels, pattern, and distribution of household assets among MGNREGS beneficiary households in the rural areas of Punjab.

RESEARCH METHODOLOGY

The present study is based on the primary as well as secondary data. The primary data has been collected through a well-structured schedule /questionnaire. The selected MGNREGS beneficiary households have provided the first-hand information about the scheme in the rural areas of Punjab. In the present study, a sample of 440 MGNREGS beneficiary households has been selected with the help of multi-stage random sampling method at the district, development block and village level. On the basis of average person days generated in 2013-14, all districts have been categorised into three categories, that is, high participation districts, moderate participation districts and low participation districts. At the first stage, three districts, viz., Fatehgarh Sahib (high participation district), Fazilka (moderate participation district) and Hoshiarpur (low participation district) have been selected purposively. At the second stage**,** nine developmental blocks, three from each district have been selected. At the third stage**,** three villages from each selected block have been selected. Thus, a total of 27

villages have been selected. Finally, a sample of 440 MGNREGS beneficiary households consisting of 106 from Fatehgarh Sahib, 229 from Fazilka and 105 from Hoshiarpur district has been selected. The reference period of the study is 2014-15.

Statistical Tools and Techniques used for Data Analysis

The statistical tools and techniques such as mean values, percentages, and Gini co-efficient have been used for analysing the data and for supporting the findings of the present study.

RESULTS AND DISCUSSIONS

This section deals with the distribution pattern of per household and per capita value of household assets among MGNREGS beneficiary sampled households in the rural areas of Punjab.

Distribution Pattern of Household Assets among MGNREGS Beneficiary Sampled Households

This section deals with the distribution pattern of household assets such as productive and non-productive assets among MGNREGS beneficiary sampled households in the rural areas of Punjab. The distribution pattern of livestock of MGNREGS beneficiary sampled households in the rural areas of Punjab has been presented in Table 1. The table shows that among the total value of livestock, buffaloes has the highest share (68.24 per cent) followed by cows (25.12 per cent), young stock (2.77 per cent), bullock (1.91 per cent), sheep and goats (1.17 per cent) and others (0.80 per cent) in the rural areas of Punjab.

The mechanisation of agricultural activities has changed the mode of production in the rural areas of Punjab which has reduced the demand of bullocks. The percentage share of bullocks to the total value of the livestock is only 0.94, 2.22, and 1.40 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas, as a whole for all the sampled households taken together, the share of bullocks is 1.91. In Punjab, buffaloes and cows constitute a major share of total livestock because buffaloes and cows are the main milch animals. The percentage share of buffaloes is worked out 85.06, 69.40, and 53.11in Fatehgarh Sahib, Fazilka and Hoshiarpur districts and the share of cows is 7.99, 24.33, and 39.10 respectively. Among all the sampled households taken together, the share of buffaloes and cows has worked out 68.24 and 25.12 per cent respectively. The total value of the livestock is the highest in Fazilka (₹26,146.07) followed by Hoshiarpur (₹15,638.10) and lowest (₹10,037.74) in Fatehgarh Sahib District. Among all the sampled households taken together, the average value of the livestock is ₹19757.84 in the rural areas of Punjab. Majority of the people in Fazilka district are engaged in agriculture and allied agricultural activities whereas, in Hoshiarpur and Fatehgarh sahib, people are working in the non-farm sector.

The results of the study also show that only 48.87 per cent of the total sampled households are having livestock mainly buffaloes and cows. The various reason such as low level of income, increasing prices of cattles, increasing caring cost and lack of ownership of land have reduced the access of weaker sections in having a good quality of animals and they have only the inferior or unproductive quality of livestock.

The distribution pattern of transport vehicles of MGNREGS beneficiary sampled households in the rural areas of Punjab has been presented in Table 2. Majority of the beneficiary sampled households have a bicycle as the main vehicle in rural Punjab. The percentage share of sampled households having bicycle is 88.68, 77.29 and 91.43 in Fatehgarh Sahib, Fazilka, and Hoshiarpur

Table 1. Distribution pattern of livestock of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Livestock	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Bullock	94.34	580.79	219.05	377.27
	(0.94)	(2.22)	(1.40)	(1.91)
Buffaloes	8537.74	18144.10	8304.76	13481.82
	(85.06)	(69.40)	(53.11)	(68.24)
Cows	801.89	6362.45	6114.29	4963.64
	(7.99)	(24.33)	(39.10)	(25.12)
Sheep/	245.28	185.59	314.29	230.68
Goats	(2.44)	(0.71)	(2.01)	(1.17)
Young	311.32	659.39	542.86	547.73
Stock	(3.10)	(2.52)	(3.47)	(2.77)
Others*	47.17	213.76	142.86	156.70
	(0.47)	(0.82)	(0.91)	(0.80)
Total	10037.74	26146.07	15638.10	19757.84
	(100.00)	(100.00)	(100.00)	(100.00)

Source: Field Survey, 2014-15.
Figures in parentheses indicate percentages.
**** Poultry, horse, etc.***

Table 2. Distribution pattern of transport vehicles of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Transport vehicles	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Bicycle	1280.19	1030.57	1254.29	1144.09
	(12.95)	(23.34)	(20.85)	(18.71)
Scooter	245.28	56.77	542.86	218.18
	(2.48)	(1.29)	(9.02)	(3.57)
Motor	8075.47	3327.51	4219.05	4684.09
cycle	(81.70)	(75.37)	(70.13)	(76.61)
Moped/	283.02	0.00	0.00	68.18
scooty	(2.86)	(0.00)	(0.00)	(1.12)
Total	9883.96	4414.85	6016.19	6114.55
	(100.00)	(100.00)	(100.00)	(100.00)

Source: Field Survey, 2014-15.
Figures in parentheses indicate percentages.

districts respectively whereas, as a whole for all the sampled households taken together, the share of sampled households having bicycle is 83.41 per cent. The table shows that the percentage share of the bicycle to the total value of transport vehicles is 12.95, 23.34 and 20.85 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas, as a whole for all the sampled households taken together, the share of bicycle is 18.71 per cent. The share of motor-cycle is 81.70, 75.37 and 70.13 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively and for all the sampled households taken together, it is 76.61 per cent. The field survey highlights that fact that majority of households are having a bicycle as a mean of transportation in the rural areas of Punjab.

The data regarding accessibility to transport vehicles reveals that not even a single household is having four-wheeler. Among all the sampled households taken together, the share of sampled households are having motor-cycles is only 20.23 per cent in the rural areas of Punjab. It has been observed from field survey that due to the low level of income majority of the sampled households have second hand/old transport vehicles. The per household average value of transport vehicles is the highest in Fatehgarh Sahib (₹9,883.96) followed by Hoshiarpur (₹6,016.19) and Fazilka (₹4,414.85) district whereas among all the sampled households taken together this is ₹6114.55.

The distribution pattern of household durables such as furnishing articles, electrical appliances, utensils and beddings of MGNREGS beneficiary sampled households in the rural areas of Punjab is shown in Table 3. The share of furnishing articles comes out 33.74, 36.91 and 35.62 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas as a whole, this percentage is 35.61 among all the sampled households taken together. The share of electrical appliances is 36.81, 28.95 and 31.37 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively. Among all the sampled households taken together, this has been worked out 31.99 per cent. In absolute terms, the per household average value of furnishing articles is the highest (₹12,141.51) in Fatehgarh Sahib followed by Hoshiarpur (₹10,609.41) and the lowest (₹8,732.18) in Fazilka district. The results regarding access to furnishing articles show that less than 50 per cent sampled households have a bed in their homes.

The per household average value of electrical appliances is also the highest in Fatehgarh Sahib and the lowest in Fazilka district. The per household average value of electrical appliances is ₹13,246.23, ₹6,848.56 and ₹9,343.95 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively. As a whole, among sampled households, the average value of furnishing articles and electrical appliances is worked out ₹10,001.41 and ₹8,985.31 respectively. It has been observed from the field survey that these poor households are unable to afford a washing machine, cooler etc. The results of the study reveal that less than 10 per cent sampled households are having washing machines.

Table 3. Distribution pattern of durables of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Durables	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Furnishing articles	12141.51 (33.74)	8732.18 (36.91)	10609.05 (35.62)	10001.41 (35.61)
Electrical appliances	13246.23 (36.81)	6848.56 (28.95)	9343.95 (31.37)	8985.31 (31.99)
Utensils	3386.79 (9.41)	2883.41 (12.19)	3069.52 (10.31)	3049.09 (10.86)
Beddings and others	4377.36 (12.17)	3806.99 (16.09)	4091.43 (13.74)	4012.27 (14.29)
Jewellery/ Ornaments	2830.19 (7.87)	1384.28 (5.85)	2668.57 (8.96)	2039.09 (7.26)
Total	35982.08 (100.00)	23655.41 (100.00)	29782.52 (100.00)	28087.17 (100.00)

Source: Field Survey, 2014-15.
Figures in parentheses indicate percentages.

Not even a single household has air conditioner (AC) among MGNREGS beneficiary sampled households in the rural areas of Punjab. Majority of the MGNREGS beneficiary sampled households belong to poorest sections of the society so access to costly furnishing articles and electrical appliances is very low.

The share of utensils is 9.41, 12.19, and 10.31 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all beneficiary sampled households together, this share is 10.86 per cent. The percentage share of bedding and others is 12.17, 16.09 and 13.74in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas, among all the sampled households taken together, this is 14.29 per cent. The percentage share of jewellery /ornaments is only 7.87, 5.85, and 8.96 per cent in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas among all beneficiary sampled households together, this share is only 7.26 per cent in the rural areas of Punjab. The average value of durables is the highest in Fatehgarh Sahib (₹35,982.08) as compared to Hoshiarpur (₹29,782.52) and the lowest (₹23,655.41) in Fazilka district whereas, among all the sampled households taken together, the per household average value of durables is ₹28,087.17. It is clear from field survey that in Fazilka district, MGNREGS beneficiary sampled households have low quality and less number of durable items as compared to Hoshiarpur and Fatehgarh Sahib districts in the rural areas of Punjab.

The distribution pattern of buildings of MGNREGS beneficiary sampled households has been depicted in Table 4. Land and building together, in the rural areas, clearly formed the predominant component of assets - jointly holding around 94 percent share in the total value of assets at the national level. Rest of share was

Table 4. Distribution pattern of buildings of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Buildings	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Homestead land	94905.66 (33.66)	60620.09 (29.79)	90704.76 (34.24)	76059.09 (32.08)
Dwelling house	185235.85 (65.69)	140043.67 (68.82)	170761.90 (64.45)	158261.36 (66.76)
Cowshed	1839.62 (0.65)	2286.03 (1.12)	2238.10 (0.84)	2167.05 (0.91)
Others*	0.00 (0.00)	554.59 (0.27)	1238.10 (0.47)	584.09 (0.24)
Total	281981.13 (100.00)	203504.37 (100.00)	264942.86 (100.00)	237071.59 (100.00)

Source: Field Survey, 2014-15.
Figures in parentheses indicate percentages.
**** Farm buildings, household industrial unit, shops, etc.***

Table 5. Distribution pattern of all assets of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Assets	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Productive Assets				
Land	28301.89 (7.72)	40938.86 (13.67)	23809.52 (6.99)	33806.82 (10.38)
Livestock	10037.74 (2.74)	26146.07 (8.73)	15638.10 (4.59)	19757.84 (6.07)
Implements (Human Drawn	640.66 (0.17)	747.97 (0.25)	662.29 (0.19)	701.67 (0.22)
Transport vehicle	9883.96 (2.69)	4414.85 (1.47)	6016.19 (1.77)	6114.55 (1.88)
Sub-total of productive assets	48864.25 (13.32)	72247.75 (24.13)	46126.10 (13.53)	60380.88 (18.55)
Durables				
Furnishing articles	12141.51 (3.31)	8732.18 (2.92)	10609.05 (3.11)	10001.41 (3.07)
Electrical appliances	13246.23 (3.61)	6848.56 (2.29)	9343.95 (2.74)	8985.31 (2.76)
Utensils	3386.79 (0.92)	2883.41 (0.96)	3069.52 (0.90)	3049.09 (0.94)
Beddings and others	4377.36 (1.19)	3806.99 (1.27)	4091.43 (1.20)	4012.27 (1.23)
Jewellery/ Ornaments	2830.19 (0.77)	1384.28 (0.46)	2668.57 (0.78)	2039.09 (0.63)
Sub-Total of durables	35982.08 (9.81)	23655.41 (7.90)	29782.52 (8.74)	28087.17 (8.63)
Buildings and others	281981.13 (76.87)	203504.37 (67.97)	264942.86 (77.73)	237071.59 (72.82)
Grand total	366827.45 (100.00)	299407.53 (100.00)	340851.48 (100.00)	325539.64 (100.00)

Source: Field Survey, 2014-15.
Figures in parentheses indicate percentages.

contributed by combining all other assets like livestock (1.6 percent), machinery and equipment (3 percent) and financial assets (2 percent) (Ministry of Statistics and Programme Implementation, 2016). It is important to mention here that dwelling house is a most important asset in the rural areas because it reflects the socio-economic status of a person in the village community and society. The percentage share of homestead land is worked out 33.66, 29.79 and 34.24 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively. Among all the sampled households taken together, this percentage share is 32.08. The percentage share of a dwelling house to the total value of buildings is 65.69, 68.82, and 64.45 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively. In absolute terms, the value of homestead land and dwelling house is the highest in Fatehgarh Sahib (₹2,80,141.51) as compared to Hoshiarpur (₹2,61,466.67) and the lowest (₹2,00,663.76) in Fazilka district. The analysis highlighted that the percentage share of shops, household unit, and farm buildings is very low among MGNREGS beneficiary sampled households in the rural areas of Punjab.

The per household total value of buildings is the highest in Fatehgarh Sahib (₹2,81,981.13) followed by Hoshiarpur (₹2,64,942.86) and Fazilka (₹2,03,504.37) districts whereas, as a whole, it is ₹2,37,071.59 among all the MGNREGS beneficiary sampled households in the rural areas of Punjab.

The distribution pattern of all household assets of MGNREGS beneficiary sampled households have been given in Table 5. Land, livestock, human drawn and mechanical implements and transport vehicles can be considered as productive assets because these assets help in generating income and employment opportunities for households in the rural areas. This table shows that the share of land is 7.72, 13.67, and 6.99 per cent in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively. Among all the sampled households taken together, the percentage share of land is 10.38. It is important to mention here that majority of beneficiary households are landless in the rural areas of Punjab. So the value of land to the total value of assets is very low. A study conducted by Jha *et al.* (2008) analysed that vast majority of participants (90 percent) belonged to SCs and STs. Among these, about 80 percent of the beneficiaries were nearly landless. Gireesan *et al.* (2008) in their study pointed out that among the NREGA beneficiaries about 69.57 percent were women and 53.04 percent were landless.

In the rural areas, livestock is an important asset because it is a source of income as well as livelihood security for the majority of poor households in the rural areas. This analysis reveals that the percentage share of livestock is 2.74, 8.73 and 4.59 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas as

a whole, it is 6.07. The results further show that the share of human drawn and mechanical implements is very low because the majority of the beneficiaries are landless and these implements are not required.

The percentage share of transport vehicles has been worked out 2.69, 1.47 and 1.77 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled households taken together, this share is 1.88 per cent. The absolute value of transport vehicles is the highest in Fatehgarh Sahib (₹9,883.96) followed by Hoshiarpur (₹60,16.19) and the lowest (₹4,414.85) in Fazilka district whereas, among all the sampled beneficiary sampled households taken together, the value of transport vehicles is ₹6,114.55. It is important to mention here that majority of these sampled households have old and/or second hand type transport vehicles mainly cycles and scooters/motor cycles and these findings are also supported by the study conducted by Singh *et al.* (2015) on MGNRGES beneficiaries households in Punjab.

This analysis reveals that the share of productive assets to the total value of assets among MGNREGS beneficiary sampled households are very low and due to that reason they are compelled to engage in low-paid jobs and also dependent upon the mercy of the medium and large farmers for earning their livelihood in the rural areas of Punjab. The share of productive assets to the total value of assets is only 13.32, 24.13, and 13.53 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together, it is 18.55 per cent in the rural areas of Punjab.

The percentage share of furnishing articles comes out 3.31, 2.92, and 3.11in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively, whereas the respective share of electrical appliances is 3.61, 2.29 and 2.74 per cent. Among all the sampled beneficiary sampled households taken together, the percentage share of furnishing articles and electrical appliances is 3.07 and 2.76 respectively. The percentage share of utensils is 0.92, 0.96, and 0.90 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together this share is 0.94 per cent. The percentage share of bedding and clothing is 1.19, 1.27, 1.20 and 1.23 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts and all the sampled beneficiary sampled households taken together respectively. The percentage share of jewellery/ornaments is negligible. It came out to be 0.77, 0.46, and 0.78 per cent in Fatehgarh Sahib, Fazilka and Hoshiarpur districts, respectively whereas among all the sampled beneficiary sampled households taken together this share is 0.63 per cent.

The average value of durables is the highest in Fatehgarh Sahib (₹35,982.08) followed by Hoshiarpur (₹29,782.52) and Fazilka (₹23,655.41) district. The average value per household of durables of MGNREGS beneficiary sampled households comes out to be ₹28,087.17. The percentage share of durables is 9.81, 7.90, and 8.74 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively, whereas as a whole, among all the sampled households taken together; this is 8.63 in the rural areas of Punjab.

The percentage share of buildings and others is 76.87, 67.97, and 77.73 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas among all the sampled households taken together, this percentage comes out to be 72.82. It is clear from the analysis of distribution pattern of household assets that buildings and others have the highest share in the total value of household assets. Dwelling houses constitute a major share that accounts almost three-fourths of total assets value and the remaining assets account only one-fourth. Singh & Singh, (2016) in their study pointed out that dwelling house and livestock combined claim about 84 per cent of the total assets of agricultural labourers representing a degrading condition of them as they posses hardly any asset for a better life like motorcycle, gas, TV, refrigerator, furniture, bedding etc

The total value of household assets is the highest in Fatehgarh Sahib (₹3,66,827.45) followed by Hoshiarpur (₹3,40,851.48) and the lowest (₹2,99,407.53) in Fazilka district. As a whole, the total value of assets is ₹3,25,539.64 among all the sampled beneficiary sampled households taken together in the rural areas of Punjab. Thus, this analysis clearly indicates that MGNREGS beneficiary sampled households are the marginalised sections of the society and majority of them don't have productive assets, thereby dependent upon wage work as well as others, such as medium and large farmers and other rich people, for earning their livelihood in the rural areas of Punjab.

In a nutshell, it is clear from above analysis that the total value of household assets is the highest in Fatehgarh Sahib as compared to Hoshiarpur and the lowest in Fazilka district of Punjab. It clearly indicates that socio-economic status of sampled beneficiary sampled households is marginally better off in Fatehgarh Sahib and Hoshiarpur districts as compared to Fazilka District because majority of them did not have mainly land and those who have they have uneconomic size of land holdings as well as poor quality of household assets which reflect their low standard of living. The survey highlights the fact that lack of ownership of land which is a major productive asset in the rural areas of Punjab is the main reason responsible for low levels of living of MGNREGS beneficiary households in the rural areas of Punjab. The study conducted by Singh *et al*. (2015) also supported the results of our study that majority of the scheduled caste beneficiaries are poor and landless and they have poor quality of livestock and dwelling house is their major assets and value of other assets is very low in the rural areas of Punjab.

Distribution Pattern of Per Capita Household Assets among Sampled households

The distribution pattern of per capita household assets of MGNREGS beneficiary sampled households have been given in Table 6. The results show that the per capita value of land is very low, in Fatehgarh Sahib (₹6,329.11), Fazilka (₹9,365.63), and Hoshiarpur and (₹5,296.61) districts respectively. Among all the sampled households taken together, the per capita value of land is ₹7,639.96. The per capita value of livestock to the total value of the livestock is ₹2,244.73, 5,981.47, and 3,478.81in the case Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas as a whole, it is ₹4,465.05.

The per capita value of human drawn and mechanical implements are very low because the majority of them are not in the position to purchase these implements due to their low level of income. The per capita value of transport vehicles has been worked out ₹2,210.34, 1,009.99, and 1,338.35 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled households taken together, this value is only ₹1,381.82.

Table 6. Distribution pattern of per-capita assets of MGNREGS beneficiary sampled households in rural Punjab

(₹)

Assets	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
Productive Assets				
Land	6329.11	9365.63	5296.61	7639.96
Livestock	2244.73	5981.47	3478.81	4465.05
Implements	143.27	171.11	147.33	158.57
Transport vehicle	2210.34	1009.99	1338.35	1381.82
Sub-Total of productive assets	10927.45	16528.21	10261.10	13645.40
Durables				
Furnishing articles	2715.19	1997.67	2360.06	2260.21
Electrical appliances	2962.24	1566.75	2078.63	2030.21
Utensils	757.38	659.64	682.84	689.06
Beddings and others	978.90	870.93	910.17	906.73
Jewellery/ Ornaments	632.91	316.68	593.64	460.81
Sub-Total of durables	8046.62	5411.68	6625.35	6347.38
Buildings and others	63059.07	46555.94	58938.56	53575.50
Grand total	82033.14	68495.83	75825.01	73568.28

Source: Field Survey, 2014-15.

The per capita value of productive assets to the total value of assets is ₹10,927.45, 16,528.21, and 10,261.10 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together, it is ₹13,645.40 in the rural areas of Punjab.

The per capita value of furnishing articles comes out ₹2,715.19, 1,997.67, and 2,360.06 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively, whereas the value of electrical appliances is ₹2,962.24, 1,566.75, and 2,078.63, respectively. Among all the sampled beneficiary sampled households taken together, the per capita value of furnishing articles and electrical appliances is ₹2,260.21 and 2,030.21 respectively. The per capita value of utensils is ₹757.38, 659.64, and 682.84 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together this value is ₹689.06. The per capita value of bedding and clothing is ₹978.90, 870.93, and 910.17 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together, this is ₹906.73.The per capita value of jewellery/ornaments is ₹632.91, 316.68, and 593.64 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively whereas among all the sampled beneficiary sampled households taken together this is ₹460.81.

The per capita value of durables is the highest in Fatehgarh Sahib (₹8,046.62) as compared to Hoshiarpur district (₹6,625.35) and lowest in Fazilka (₹5,411.68) district. The per capita value of durables of MGNREGS beneficiary sampled households comes out ₹6,347.38. The per capita value of buildings and others is ₹63,059.07, 46,555.94, and 58,938.56 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively whereas among all the sampled households taken together, this value comes out ₹53,575.50.

The per capita value of household assets is the highest in Fatehgarh Sahib (₹82,033.14) followed by Hoshiarpur (₹75,825.01) and the lowest (₹68,495.83) in Fazilka district. As a whole, the per capita value of assets is ₹73,568.28 among all the sampled beneficiary sampled households taken together in the rural areas of Punjab. Thus, the analysis of ownership of assets clearly indicates that MGNREGS beneficiary sampled households are the most deprived sections of the society because per capita value of productive assets is very low which reflects that there is an existence of disparities among different socio-economic groups in this agricultural developed state which has a great contribution in the total foodgrains of the country.

Distribution of Assets according to Different Range of Assets among Sampled households

Distribution of assets according to a different range of assets of MGNREGS beneficiary sampled households in the rural areas of Punjab is shown in Table 7. This table

shows that the percentage share of sampled households whose value of assets ranged between (₹0-1,50,000) is 13.54, 2.86, and 7.73 in Fazilka, Hoshiarpur districts and among all the sampled households taken together respectively and the percentage share of their assets to the total value of assets is 4.85, 0.99 and 2.57 per cent respectively.

This table also shows that majority of the sampled households (62.88 per cent) in Fazilka district have assets between the range of ₹1,50,000-3,00,000 and the percentage share of their assets to the total assets is 51.79 which reveal their low socio-economic status as compared to Fatehgarh Sahib and Hoshiarpur districts. The percentage share of sampled households whose value of assets lies in the range of ₹3,00,000-4,50,000 is 56.60, 17.47 and 60.95 in Fatehgarh Sahib, Fazilka and Hoshiarpur districts respectively and percentage share of the value of their assets is 58.14, 20.06 and 62.43 respectively. As a whole, the percentage share of sampled households those have assets between ₹3,00,000-4,50,000 is 37.27 and value of their assets is 40.98 per cent in the rural areas of Punjab.

The percentage share of sampled households whose value of assets range between ₹6,00,000 and above is 0.94, 5.24 and 0.95 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively and percentage share of the value of their assets is 8.94, 21.77, and 8.49 respectively. Among all sampled households together, the percentage share of sampled households whose value of the assets is in the range of ₹6,00,000 and above is 3.18 and value of their assets is 14.97 per cent in the rural areas of Punjab. This analysis clearly pointed out that distribution of household assets is uneven among the MGNREGS beneficiary sampled households. Majority of the sampled households have assets between the ranges of ₹1,50,000-4,50,000 which infers their worse position in the society.

Distribution of per capita assets according to different ranges of assets of MGNREGS beneficiary sampled households in the rural areas of Punjab is shown in Table 8. The table shows that majority of the persons (36.98 per cent) have per capita assets between the range of ₹60,000 to 90,000 and the percentage share of their assets to the total assets is 32.45 which reveal their low socio-economic status. The percentage share of a person whose value of assets range between ₹1,80,000 and above is only 2.11, 2.60 and 2.33 in Fatehgarh Sahib, Fazilka, and Hoshiarpur districts respectively and percentage share of the value of their assets is 18.63, 14.74 and 18.76 respectively. Among all sampled households taken

Table 7. Distribution of household assets according to different range of assets of among MGNREGS beneficiary sampled households in rural Punjab

(Percentage)

Value of assets (₹)	Fatehgarh Sahib		Fazilka		Hoshiarpur		Punjab	
	Sampled	Assets	Sampled	Assets	Sampled	Assets	Sampled	Assets
0-150000	0.00	0.00	13.54	4.85	2.86	0.99	7.73	2.57
150000-300000	36.79	25.62	62.88	51.79	31.43	22.63	49.09	37.40
300000-450000	56.60	58.14	17.47	20.06	60.95	62.43	37.27	40.98
450000-600000	5.66	7.29	0.87	1.52	3.81	5.48	2.73	4.08
Above 600000	0.94	8.94	5.24	21.77	0.95	8.49	3.18	14.97
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Field Survey, 2014-15.

Table 8. Distribution of per capita household assets according to different range of assets of among MGNREGS beneficiary sampled households in rural Punjab

(Percentage)

Value of assets (₹)	Fatehgarh Sahib		Fazilka		Hoshiarpur		Punjab	
	Persons	Assets	Persons	Assets	Persons	Assets	Persons	Assets
0- 30000	0.00	0.00	11.79	2.31	2.75	0.38	6.73	1.21
30000-60000	30.59	12.59	47.35	26.70	29.87	15.04	39.03	20.01
60000-90000	44.73	33.46	24.68	25.04	55.30	45.87	36.98	32.45
90000-120000	20.04	27.75	6.79	14.99	6.78	10.45	10.02	17.32
12000-150000	1.69	4.26	3.80	8.51	2.54	7.68	2.98	7.16
15000-180000	0.84	3.32	3.00	7.71	0.42	1.83	1.85	5.08
Above 180000	2.11	18.63	2.60	14.74	2.33	18.76	2.41	16.78
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Field Survey, 2014-15.

together, the percentage share of persons whose value of the assets is in the range of ₹1, 80,000 and above is 2.41 and value of their assets is 16.78 per cent. Overall at the state level, the share of bottom 46.76 persons in total assets is 21.22 per cent whereas the share of top 4.26 per cent persons is 21.86 per cent which clearly reflects intra-disparities among MGNREGS beneficiary households in the rural areas of Punjab.

Distribution of Assets among MGNREGS Beneficiary Sampled Households

Distribution of assets among MGNREGS beneficiary sampled households has been presented in Table 9. The table shows that bottom 10 per cent beneficiary households hold only 3.66 per cent of the total value of assets whereas top 10 per cent have 24.48 per cent of the total value of assets. District wise analysis reveals that bottom 10 per cent have 6.08, 3.27 and 4.09 per cent of total value of assets in Fatehgarh sahib, Fazilka and Hoshiarpur districts respectively whereas top 10 per cent hold 20.78, 28.56 and 21.12 per cent in respective districts of the total value of assets. The value of Gini-coefficient is the highest in Fazilka district (0.287), followed by Hoshiarpur (0.194) and Fatehgarh Sahib (0.187) districts. Among the entire sampled households taken together, the value of Gini-coefficient is 0.250 in the rural areas of Punjab.

Distribution of per capita assets among MGNREGS beneficiary sampled households has been presented in Table 10. The table shows that bottom 10 per cent persons claim only 3.60 per cent of the total value of assets whereas top 10 per cent have 26.28 per cent of the total value of assets. District wise analysis reveals that bottom 10 per cent have 4.71, 3.35 and 4.09 per cent of total value of assets in Fatehgarh sahib, Fazilka and Hoshiarpur districts respectively whereas top 10 per cent hold 24.45, 29.00 and 24.72 per cent in respective districts of the total value of assets. The value of Gini-coefficient of per capita assets is the highest in Fazilka (0.321) followed by Fatehgarh Sahib, (0.251) and Hoshiarpur district (0.241). Among the entire sampled households take together, the value of Gini-coefficient of per capita assets is 0.290 in the rural areas of Punjab. The value of Gini- coefficient of per capita assets is higher than the value of per household among MGNREGS beneficiary households in the rural areas of Punjab.

Table 9. Distribution of household assets on the basis of total value of assets of MGNREGS beneficiary sampled households in rural Punjab

(Percentage)

Households	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
10	6.08	3.27	4.09	3.66
20	12.59	8.73	11.50	9.95
30	20.40	15.96	19.47	17.23
40	28.04	23.78	28.68	25.24
50	37.50	31.88	37.42	33.84
60	47.46	40.78	47.53	42.93
70	57.04	50.24	57.18	52.83
80	68.26	60.18	68.27	63.62
90	79.22	71.44	78.88	75.52
100	100.00	100.00	100.00	100.00
Gini-coefficient	0.187	0.287	0.194	0.250

Source: Field Survey, 2014-15.

Table 10. Distribution of per capita household assets on the basis of per capita value of assets of MGNREGS beneficiary sampled households in rural Punjab

(Percentage)

Persons	Fatehgarh Sahib	Fazilka	Hoshiarpur	Punjab
10	4.71	3.35	4.09	3.60
20	10.84	8.40	10.72	9.14
30	17.63	14.63	18.26	15.67
40	25.43	21.50	26.21	23.02
50	33.54	29.11	34.47	31.08
60	42.11	37.59	43.50	39.85
70	51.87	46.86	53.12	49.41
80	62.70	57.27	63.66	60.07
90	75.55	71.00	75.28	73.14
100	100.00	100.00	100.00	100.00
Gini-coefficient	0.251	0.321	0.241	0.290

Source: Field Survey, 2014-15.

CONCLUDING REMARKS

The analysis of ownership of assets clearly pointed out that majority of MGNREGS beneficiary sampled households are landless and they are mainly dependent upon wage work for their livelihood. Therefore, the government should provide land for cultivation to these households by implementing land reforms strictly for raising their socio-economic status and for reducing their dependence on medium large farmers/others in order to save them from exploitation and discrimination. The distribution pattern of livestock among these households shows that due to the low level of income, increasing prices, increasing caring cost and lack of ownership of land have reduced the access of these poor households in having a good quality of animals and they have only the inferior or unproductive quality of livestock. It is an important fact that livestock is also a main source of income in the rural areas so government should give financial help to them for purchase good quality animals.

The analysis also shows that due to the low level of income, higher incidence of poverty and lack of gainful employment, the value of furnishing articles and electrical appliances among these poor sampled households is very low. It is very difficult for them to afford the high cost of furnishing articles and even basic electrical appliances such as AC, washing machine, cooler, etc. It is clear from the analysis that in Fazilka district, MGNREGS beneficiary sampled households have low quality and less number of durable items due to their low level of income as compared to Hoshiarpur and Fatehgarh Sahib districts in the rural areas of Punjab. The

dwelling house is a major asset among the majority of the MGNREGS beneficiary sampled households and the percentage share of shops, household industrial unit, and farm buildings are very low. The bicycle is the main transport vehicle and not even a single household have any four wheelers among MGNREGS beneficiary households in the rural areas of Punjab.

This analysis clearly pointed out that distribution of household assets is uneven among the MGNREGS beneficiary sampled households. Majority of the sampled households have assets between the ranges of ₹1,50,000-4,50,000 which infers their worse position in the society. The share of bottom 10 per cent beneficiary households is only 3.66 per cent whereas the share of top 10 per cent is 24.48 per cent in the total value of assets.

In a nutshell, the analysis clearly highlights the fact that lack of the ownership of productive assets mainly land and quality livestock, as well as unavailability of gainful employment opportunities, are the major reasons responsible for low levels of living of MGNREGS beneficiary sampled households in the rural areas of Punjab. Thus efforts should make by the government to provide them common land/ panchayat land for cultivation without any auction or charging any rent from them and should provide space for their cattle in order to encourage them for engaging in livestock activities which will not only increase their income level but also provide them food and nutritional security.

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Influencing Variable Effect on Fish Trade a View with Liberalization and WTO Regime

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ABSTRACT
In this study, attempts have been made to evaluate the effect of trade on fish production in relation to liberalization and WTO regime. The secondary data have been used in this study. The relationship between fish export and fish production have been measured by curve linear regression models. This is evidence that five order polynomial regression of fish export and fish production showed a very good fit of the model as compared to linear regression and exponential model. There is a significant increase in fish export due to production of fish. Trade-influencing variables measured by C-D function and performance was measured by Compound growth rate. The results revealed that after trade liberalization, the importing quantity increased to meet the domestic requirements and through exporting, GDP, exchange rate and export value raised. After WTO regime, the maximum CGR of 13.82 and 6.17 per cent was recorded for the import and export respectively, and before WTO regime minimum of 4.2 and -29.12 per cent respectively. After WTO regime the trade in fish and fish production were improved and per capita consumption also increased. This work will assist in policy planning and implementing measures to the fisheries sector.

Keywords
C-D function, commodities, growth rate, seafood, trend line.

JEL Codes
C82,Q17, Q22, Q27.

INTRODUCTION

Fisheries play a momentous role in economic growth and development of the nation; and tremendous growth had recorded due to the advancement of technology and improved fishing practices. Resulted that India is the second largest fish producer in the world, fish production was 9.58 MT during 2012-13 (Government of India, 2014).However, the excess productions lead to sell at lower price, which erstwhile could not generate the operating cost. So, trade was originated to overcome these issues, but at presently continuing to earn the foreign currency. The export was increased from 58,864 tonnes in 1976 to 9,83,760 tonnes with holding the value of ₹30,213.26 crores in 2012 (Government of India, 2014) due to trade liberalization and WTO regime. With all these importance, there is an essential to measure the determinants of trade, which enhanced the trade liberalization and WTO regime. As a result of this, this examination was carried out with following objectives are, to measure the impact of WTO on fish production, export performance, and determinants, to fit the appropriate model to measure the degree of fish production, and to examine the developmental pattern of per capita consumption and commodities.

MATERIALS AND METHODS

The present study was carried out to identify the impact of International fish trade on fish production by secondary data which includes details of fish exports, import and fish production (1976 to 2011) and per capita consumption. Sources for secondary data are Government of India, (2014) and Food and Agricultural Organization (2014). For compute the growth rate of fish export, import, production and per capita income by Compound Growth rate (CGR) which is given below.

log y it = log α t log β + ?

Where,

$logy_{it}$=Export/import/production/ per capita consumption at time t;

α = Constant; β= Coefficient yielding the growth rate and ? = Error term.

CGR = [exp (b) – 1] x 100

Where, *b* = Expresses the rate of change.

The one-way analysis of variance (ANOVA) was run to examine the effect of before and after trade liberalization export, import, production, and its value by the Statistical Package for the Social Sciences (SPSS) version 20.0.

The variable for Cobb –Douglass production function was selected based on the influenced factor of fish trade which is given below.

$Y = a\,FP^{b1}\,TIQ^{b2}\,GDP^{b3}\,IP^{b4}\,AER^{b5}\,MFP^{b6}\,TEV^{b7}\,PUV^{b8}\,WP^{b9}\,U$

Where,

Y = Fish export in India (tonne)

FP = Total Fish Production (tonne)

TIQ = Total Importing quantity (tonne)

GDP = Agriculture and allied activities GDP

IP = Indian population (Million)

AER = Average Exchange Rate (₹ /kg)

MFP = India's marine fish production (tonne)

TEV = Total export value

PUV = Export value per unit

WP = World Population (Billions)

U = Error term.

The curve linear regression with the exponential equation and polynomial regression was used to study the relationship between the variables.

Linear Regression Equation

$Y = a+bx$

Where a is intercept; b is slope; Y is dependent and x is independent

Exponential Equation

$b^x = b^y$

Than x = y, where b>0 and $b \neq 0$

Polynomial Regression

$P(x) = ax+b$

a and b are real numbers and $a \neq 0$

RESULTS AND DISCUSSION

Total fish production and export performance of India during 1976 to 2010 is presented in Figure 1 and 2. Among that maximum and minimum fish production was recorded in the year of 2006 (16,05,927 tonnes) and 1976 (2,02,835 t), respectively. Highest fish exports were recorded for the year of 2011 at 9,54,982 tonnes with the value of 35,50,886 USD and lowest value was documented in the year of 1976 at 58,864 tonnes with the value of $1,92,600. Also, during the financial year 2015-16, India has exported 9,45,892 MT of Seafood worth US$ 4.7 Billion (₹30,420.83 crores). Among the total export, the USA was the major importer of Indian seafood with a share of 28.46 per cent in terms of USD followed by South East Asia (24.59 per cent), EU (20.71 per cent) due to reduction in tariffs on Indian seafood imports in USA, EU and Japanese markets (Kamat & Kamat, 2007; MPEDA, 2016). For the year of 2003 was certified that high level fish import (55,191 tonnes) but during 1983 to 1988 import was not recorded. Rajeev (2008) also reported that from being a country where no imports were allowed, imports quickly increased when the borders were opened, though the level of imports is still very low. During 2011the form of fish product export, frozen form of fish (excluding fillets and meat) was highly contributed at 30.91 5 (3,47,015 tonnes) and fish live form was recorded at low level of 0.02 per cent (1,696 tonnes) in India. Among the sixteen type of fish products in India fish trade the fresh fish or chilled

Table 1. Fish export and import of India for 2011

Name of products	Export (tonnes)	Export (Per cent)	Imports (tonnes)	Imports (Per cent)
Crustaceans frozen	2,62,126	23.34	1279	3.57
Crustaceans not frozen	4487	0.40	1	0.00
Crustaceans prepared or preserved	5731	0.51	56	0.16
Fish fillets frozen	37,355	3.33	1275	3.55
Fish meat, whether or not minced, and fillets, fresh or chilled	2472	0.22	39	0.11
Fish meat, whether or not minced, frozen	37,873	3.37	2094	5.84
Fish prepared or preserved	26,916	2.40	225	0.63
Fish dried, salted or smoked	10,731	0.96	1127	3.14
Fish fresh or chilled, excluding fillets and meat	19333	1.72	19845	55.33
Fish, frozen, excluding fillets and meat	34,7,015	30.91	612	1.71
Fish live	184	0.02	29	0.08
Molluscs and other aquatic invertebrates live, fresh or chilled	44,342	3.95	771	2.15
Molluscs and other aquatic invertebrates, other than live, fresh or chilled	1,21,820	10.85	430	1.20
Molluscs and other aquatic invertebrates prepared or preserved	1696	0.15	93	0.26
Molluscs aquatic invertebrates	1,67,858	14.95	1294	3.61
Other products	32901	2.93	6698	18.67

Source: FAO Statistics (www.fao.org).

(excluding fillets and meat was contributed more at 55.33 per cent and low level contributed by live fish at 0.08 per cent (29 tonnes) were recorded. The present findings were corresponded with the observation of Shinoj *et al.* (2009) who examined the pattern of India's export of fish and fishery products.

Average of fish product export was increased from 25 to 46 per cent from the total fish production in India due to trade liberalization and policy for enhancing for trade by introduction of WTO in the year 1995. After policy liberalization the maximum CGR for export and import were 6.17 and 13.82 per cent, respectively. Minimum CGR for export and import were 4.2 and -29.13 per cent, respectively, recorded during before trade liberalization. These influences shifted from the fish trade into an apex level and results marvelous growth has detected, unlike other sector. In value terms, the CGR was increased (before 1995 to after 1995) 5.27 to 6.16 per cent for total

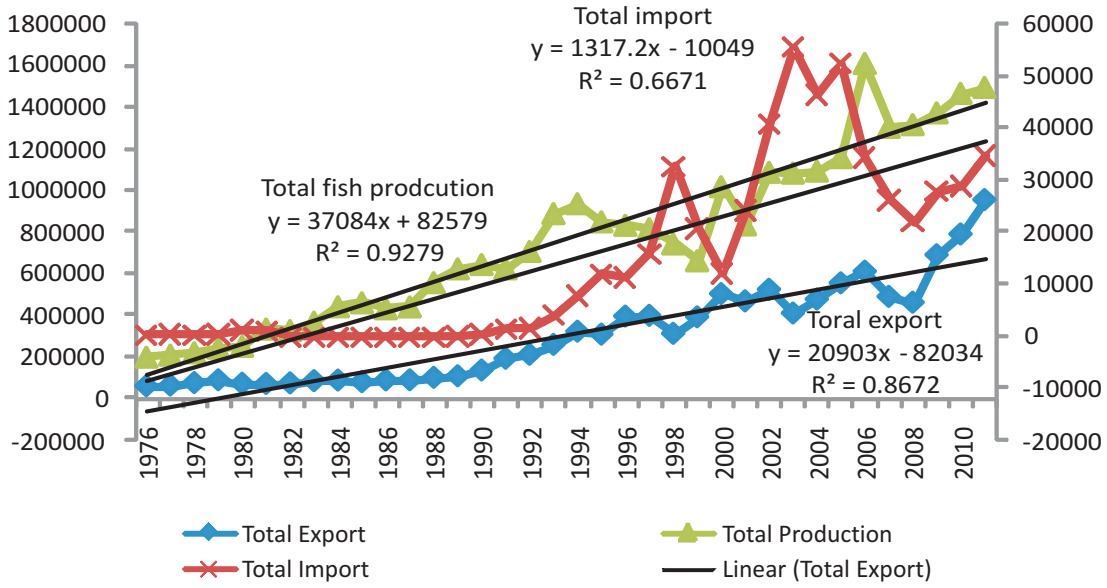

Figure 1 . Total relationship between the total export quantity and value of fish export fish production, total export, and import of fish trade in quantity term

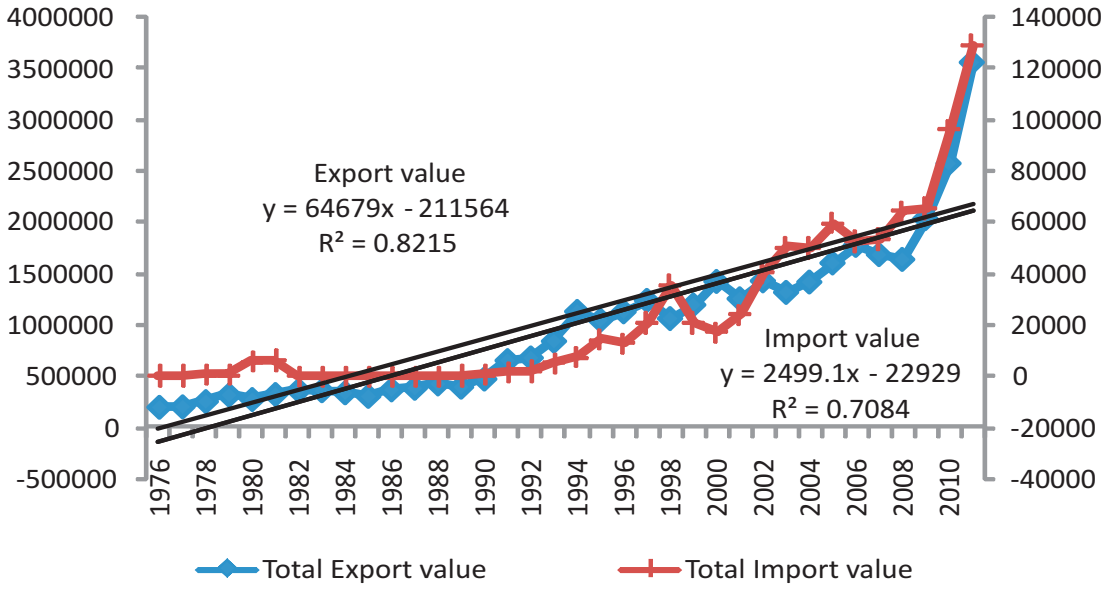

Figure 2. Total export and import of fish trade in value term

export and -29.52 to 19.34 per cent for import due to WTO introduction.

The results revealed that there was a significant difference between the before and after trade liberalization by ANOVA which helps to assess the effect of fish. In total imported quantity, there was a statically significant difference between the before and after trade liberalization as determined by one-way ANOVA (F (1, 34) = 85.51, p =0.00). For export (f value = 88.49), total fish production (f value = 52.53), for export value (f value = 56.62) and for import value (f value = 47.10) were statistically significant at the 5 per cent level.

Trade Influencing Factors

Determinants of the marine export products for India are given in Table 4. The coefficients value indicated that percentage increased in output that would result from 1per cent increases in the input factors. Total fish production elasticity of the total fish export was 0.024. An increase in total fish production by 10 per cent would bring an increase in the export about 0.24 per cent. The total export value, contribution of 10 per cent to fish export is about 7.93 per cent. An export per unit value elasticity about 10per cent would decrease of the export 6.44 per cent. It seems that, the lower market value

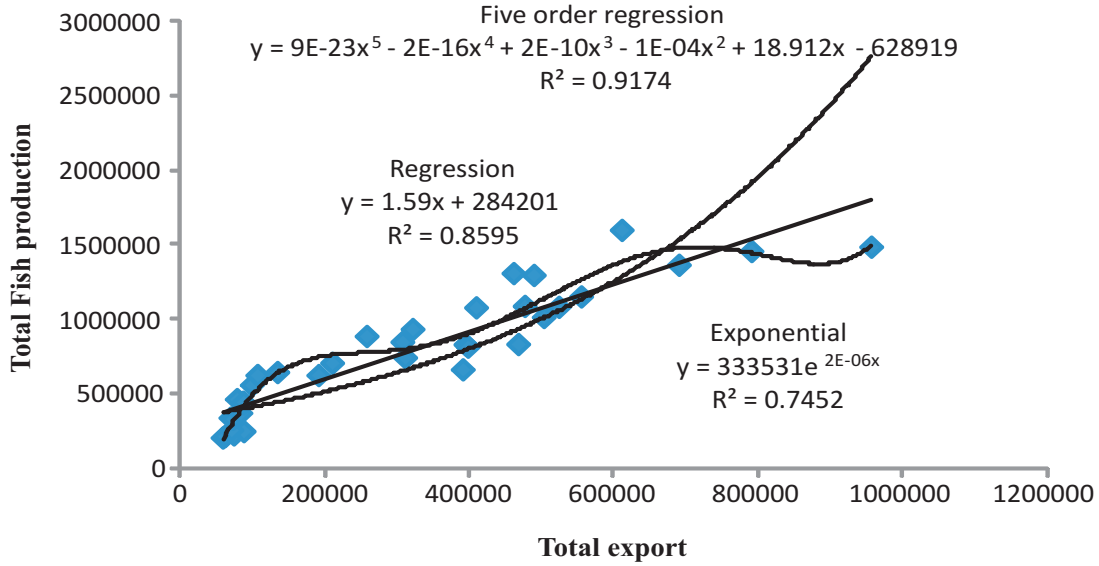

Figure 3. Relationship between the total export and total fish production

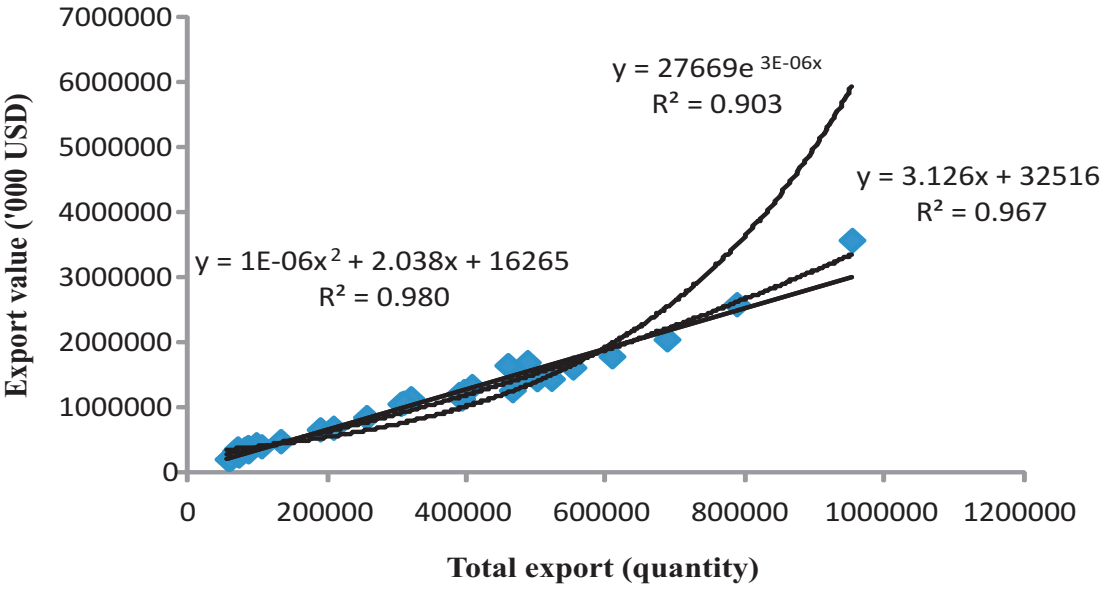

Figure 4. Relationship between the total export quantity and value of fish export

species was exported rather than higher market value species; and the value of the currency also affected. The unit value realization was staunch reduction attributed due to huge quantity export of raw material rather than processed products. Assimilar kinds of report was presented by Rao *et al.* (1999). The agriculture and allied activities GDP, India's marine fish production, export per unit value, population was negatively influenced. The net national product (NNP) was hugely diminished in 1979 and 1980. The agricultural production also dropped about 12.5 per cent and a price hike of oil at global level. However, the GDP and per capita GDP were never crossed 4 and 2 per cent growth rate respectively from 1951 to 1981. Barrows (1999) stated that, trade in fish had 18 per cent growth during 1988 to 1994.After trade liberalization, total export value passively influenced the fish export and statistically significant at the 5 per cent level. Among the nine factors, the total importing quantity, agriculture and allied activities GDP, total export value and an average exchange rate was positively affected and fish production (total and marine), population (India and world) negatively affected the trade. These variables were helps to explain around 97 per cent of the variance in fish export.

For the overall period, total export value was affected positively and export per unit value negatively influenced and it has a statistical significance at 5 per cent. This result accomplishes that, after trade liberalization total fish production was diminished (negative), and but total export value, average exchange rate and agriculture and allied activities GDP were improved in fish trade and this may be attributed due to value added products.

Trend Line

A linear regression line drawn for the total fish production, total export, and import in terms of quantity and value. The fish export and import was increased from 58,864 tonnes (1976) to 9,54,982 tonnes (2011), and 300 to 34,574 tonnes respectively and the positive trend line was noticed. A significant degree of fish production increased due to export of fish and fishery products. This is evidence that five order polynomial regression of fish export and fish production showed a very good fit model as compared to linear regression and exponential model. This study was carried out to discover the impact on fish trade on the export value of fishes. Result revealed that second order polynomial showed the best fit model which implies that the value of export increased coupled with quantity of fish export.

Per Capita Consumption

The per capita consumption patterns of food and protein supply indicated that, since 1991 the per capita consumption/kg/yr and g/capita/day increased except the demersal and pelagic group fishes (Table 5). In per capita consumption/kg/yr, the maximum and minimum of CGR were recorded at 5.395 per cent in marine fish, and -1.69 per cent in pelagic fish, respectively. The protein supply g/capita/day was increased in all resource groups but stagnant for crustaceans. In this study, CGR was found to be higher for cephalopods (13.89per cent) as compared to demersal species (0.93 per cent).

Table 2. Compound growth rate of export and import in quantity and value term

(Per cent)

Content	Quantity term		Value term	
	Total export	Total import	Total export	Total import
Before trade liberalization	4.2	-29.13	5.27	-29.52
After trade liberalization	6.17	13.82	6.16	19.34

Table 3. ANOVA result

Variables	F-value	P-value
Total imported quantity	88.51***	0.00
Total exported quantity	88.49***	0.00
Total fish production	52.53***	0.00
Export value	56.63***	0.00
Import value	47.10***	0.00

**** Significant at 0.01 level.*

Table 4. Determinants of the marine export products for India

Determinants	Before 1995	After 1995	Overall
Intercept	9.928	19.279	12.327
Total fish production (t)	0.024	-0.301	-0.011
Total importing quantity (t)	0.011	0.099	0.005
Agriculture and allied activities GDP	-0.315	0.048	-0.205
Indian population (Million)	0.434	-0.386	-0.280
Average exchange rate (₹/Kg)	0.186	0.198	0.023
India's marine fish production (t)	-0.109	-0.340	-0.031
Total export value	0.793**	1.653**	0.975**
Export per unit value	-0.644**	-1.203	-0.706**
World population (Billions)	-0.279	-2.753	-0.063
R^2	0.992	0.967	0.990
F-statistics	134.716	19.643	530.756
Significance F	0.000	0.001	0.000

***Significant at 0.05 level.*

Food Balance Sheet

The food balance sheet which was includes fish production and disposal (fish article wise given in Table 6. Among the total production, the domestic fish production was contributed high level (99.12 per cent) and low level by imports (0.88 per cent). In the total fish production, high level was contributed by total fish seafood (50 per cent) when comparing fresh water fish (27.80 per cent) and other articles. Above 95 per cent of the fish body oil,

Table 5. Pattern of per capita consumption by commodities group

Year	Cephalopods	crustaceans	Demersal	Freshwater fish	Marine fish, other	Pelagic fish
Food supply quantity (kg/capita/year)						
1991	0.2	0.2	0.9	1.9	0.2	0.6
2001	0.6	0.3	0.7	2.8	0.5	0.5
2009	0.5	0.2	0.7	3.6	0.5	0.5
CGR (1991-2009)	5.35	0.37	-1.49	3.41	5.39	-1.69
Food supply quantity (g/capita/day)						
1991	1	1	2	5	1	2
2001	2	1	2	8	1	1
2009	1	1	2	10	1	1
CGR (1991-2009)	1.1	0	-1.06	3.53	1.84	-2.88
Protein supply (g/capita/day)						
1991	0.1	0.1	0.2	0.6	0.1	0.2
2001	0.2	0.1	0.2	0.8	0.2	0.2
2009	0.2	0.1	0.2	1.1	0.2	0.1
CGR (1991-2009)	13.89	0	0.93	3.71	2.78	3.7

Source:FAO Statistics (www.fao.org).

Table 6. Balance sheet for different form of products for India in 2009

(Tonnes)

Fishery products	Domestic production	Imports	Total production	Exports	Food	Feed	Other utilization
Cephalopods	67123	2081	69204	66496	2708	-	-
Crustaceans	549898	1278	551176	261012	290164	-	-
Demersal	1094919	44	1094963	140750	826175	128038	-
Fish meal	1240	1559	2799	2384	-	8	407
Fish body oil	9900	352	10252	9912	-	340	-
Fish liver oil	-	392	392	55	-	-	337
Total Fish seafood	7850672	68984	7919656	837210	6646244	308164	128038
Freshwater fish	4411235	2902	4414137	42948	4371189	-	-
Marine Fish and other	710786	7025	717811	138267	579545	-	-
Molluscs	30198	359	30557	29450	1107	-	-
Pelagic fish	986513	55295	1041808	158288	575356	308164	-

Source: FAO Statistics (www.fao.org).

mollusks and cephalopods were exported from India to other countries of the respective total production; this followed by 85 per cent of fishmeal and 47.20 per cent of crustacean exported. Total freshwater fish production was 4.41 lakh t, of this 99 per cent utilized as food and remaining 1per cent was exported. 83.92, and 80.74 per cent of food item was consumed of the total fish seafood (79,19,656 t), and marine fish and others (7,17,811 t). Fish liver oil obtained only through imports and not produced in India of which1/3 exported and 2/3 disposed of another utilization form.

CONCLUSIONS

Considerable changes were noticed in the fish trade after the trade liberalization policies. Export enhanced with fish production; fitted trend line of five order polynomial regression line showed the good impact on the fish production. The trade liberalization and WTO regime has notable, which indirectly influenced the fish production and also boosted the earning of export value. The fish trade and fish production was improved after WTO regime and the per capita consumption too. This work will aid for future planning and policy measures for the development of the fisheries sector.

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Socio-Economic and Psychological Problems of Disabled Women in Rural Punjab

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ABSTRACT

Women are reported to be the largest group in the global disability population, and they have been historically subjected to discrimination both on the ground of their disability and gender. The present study explored the problems faced by disabled women in rural Punjab. The study was conducted in two districts of Punjab i.e. Ludhiana and SAS Nagar. Multistage random sampling technique was used for sample selection. Three blocks from each district were selected. Fifteen disabled women were selected from each block, thus a sample of 90 respondents from six selected blocks was personally interviewed for the purpose of the study. The disabled women between the age group of 15 years to 45 years and above were interviewed. The perceptions of the respondents regarding economic, social and psychological problems faced during childhood, before marriage, and after marriage were taken into consideration. Inaccessibility to education (54.4 per cent), gender biasness (61.1 per cent) and isolation (76.6 per cent) were the major socio-economic and psychological problems during childhood. Oppressive culture (93.3 per cent), insincere sympathy (87.8percent) and demand for dowry (63.3 per cent) to accommodate disability were major problems faced by sample respondents before marriage. Last, to receive resources (91.83 pe rcent), stigmatized identity (93.87 per cent) and incapacity (73.46 per cent) were the major problems which disabled faced after marriage.

Keywords
Disabled women, rural Punjab, socio-economic problems.

JEL Codes
I30, I31, J12.

INTRODUCTION

Disabled persons gained global importance in the light of the UN Convention on the Rights of the Disabled Persons on 13th December 2006 and its ratification by India on 1st October 2007. The convention brought the entire human kind, both the disabled and the non-disabled, on the platform of the campaign for the rights of the disabled. The convention envisaged a society where every individual including the disabled should have equal opportunities for access to the services needed for potential development (Natharaj, 2008). Disability locates the individual in a compromised position, not as a function of biology but also a product of a complex interaction among non-biological factors like gender, caste, class, neighborhood relations and the nature of kinship and family structure (Mehrotra, 2004).

As per Section 2(t) of the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995, "persons with disability" means a person suffering from not less than 40 percent of any disability as certified by a medical authority. Disability can occur due to genetics, disease, accidents, ageing or social stereotyping (Hans & Patri 2003). Disability is a contextual variable, dynamic over time and in relation to circumstances. One is more or less disabled based on the interaction between the person and the individual, institutional and social environment.

Nearly one third of the world's disabled persons live below poverty line. One billion people, or 15 percent of the world's population experience some form of disability and disability prevalence is higher for developing countries (World Health Organization, 2011). As per 2001 census, 1.7 percent of Punjab's population was suffering from a disability in vision, speech, hearing, movement

and mental state. Disability rate in Punjab was lower than that of the country which was 2.1 percent (Government of India, 2001). But 2011 census recorded an increase in the percentage of the disabled population in Punjab. It recorded 2.36 percent and this time disability rate in Punjab is greater than that of the country (2.21 percent) (Government of India, 2011). In India, disability population is recorded as 2.21 percent while New Zealand and Australia have 20 percent each. China has 6.3 percent and Pakistan has 2.5 percent. India has shown a low rate of disabled persons that is mainly because the parameters applied to specify disability is much narrow in India, compared to the developed nations (World Health Organization, 2011).

Nevertheless, the disabled are not seen as complete or even normal persons. They are also stereotyped as sexually incompetent. Their handicaps are often exaggerated and they are made to feel inferior. Insults are hurled at them and often they are addressed by terms like '*surdas*' (visually disabled),'*langdi*'(one with limb deformity) or '*bawali*' (to mentally challenged) that have negative connotations (Mehrotra, 2004). Women and girls are reported to be the largest group in the global disability population, and they have been historically subjected to discrimination both on the ground of their disability and gender. Disabled women not only have to negotiate with social and cultural issues but also have to deal with socio- structural inequalities at the practical level (Hans & Patri, 2003). A disabled woman in the reproductive age group could be seen as most vulnerable as she is pushed towards performing work like any other normal individual in the society. This is explained in terms of rigid division of labour and indispensability of the women's work both within the domestic as well as an agricultural sphere, especially after marriage. Disability, especially after marriage, leads to conflicts and estrangement in many cases despite the women working hard (Mehrotra, 2004). An inclusive society can play a significant role in making disabled productive by creating employment opportunities. (Ahmed, 2013). With this backdrop, the present study was conducted with the specific objective to study the problems faced by disabled women at various stages of life cycle.

METHODOLOGY

The present study was conducted in Ludhiana and SAS Nagar districts of Punjab state. A multistage random sampling design was used for the study. Three blocks from both the districts were selected randomly. Data were collected from Dehlon, Pakhowal and Sudhar blocks of district Ludhiana and from Kharar, Majri and Dera Bassi blocks of district SAS Nagar. List of disabled women was procured from anganwadis' falling in each block. Fifteen disabled women in the age group of 15 years to 45 years and above were randomly selected. Thus a total of 90 respondents from six selected blocks of Ludhiana and SAS Nagar were personally interviewed through partially structured interview schedule. The study included the cases of blindness, hearing and speech impairment, loco motor disability, limb deformity and spinal cord defects. In case the respondent was not fully capable of responding to the questions, the main caretaker was interviewed for the purpose of in depth research. Chi-Square test was used to study the association between disabilities and problems faced by the respondents during various stages of life cycle.

RESULTS AND DISCUSSION

The study investigated the perceptions of the disabled women regarding various difficulties faced by them during different stages of life. For analysis, problems were grouped into three categories viz. economic, social and

Table 1. Perceptions regarding economic problems faced during childhood

(Multiple responses)

Economic problems	Type of disability					Total (N=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Lack of special care	-	1 (11.11)	4 (11.76)	5 (13.88)	1 (14.28)	11 (12.22)
Inaccessibility to medical care	2 (50.00)	2 (22.22)	16 (47.05)	7 (19.44)	1 (14.28)	28 (31.11)
Inaccessibility to education	3 (75.00)	9 (100.00)	14 (41.17)	19 (52.77)	4 (57.14)	49 (54.44)
Treatment from quacks	-	-	4 (11.76)	5 (13.88)	1 (14.28)	10 (11.11)
Neglect due to more siblings	-	4 (44.44)	25 (73.52)	20 (55.55)	4 (57.14)	53 (58.88)

Figures in the parentheses indicate percentage.

χ^2 = 18.24.

psychological. Stages of the life cycle of disabled were categorized into childhood, pre- marital and post-marital.

Perception of the respondents regarding economic problems faced during childhood has been presented in Table 1. Data clearly show that for nearly half (54.4 percent) of the disabled respondents formal education was inaccessible. More than half (58.9 percent) felt that neglected due to larger family size and the heavy burden of household chores, their special needs were not adequately attended by their care takers (mostly mothers). Timely and adequate medical care/ treatment was inaccessible to one third (31.1 percent) of the disabled mainly due to poor economic conditions, illiteracy and unavailability of medical care within or nearby village. It was divulged by all the blind respondents that schools in the study areas had no special provision for them, that is, there was no provision of finger Braille language which could enable them to get a formal education. One blind respondent who had access to finger Braille in the private school had to leave school due to inability to pay a high fee. All the respondents who suffered from hearing and speech impairment also had no access to education due to lack of special schools. Eleven percent of them didn't get regular treatment or care and nearly half (44.4 percent) of the disabled disclosed that they got neglected due to large family size and their special needs were compromised due to economic constraints. The majority (73.5 percent) of the disabled respondents afflicted with a locomotor disability got neglected due to more siblings. Nearly one sixth of the respondents with spinal cord defects didn't get treatment for the curable disease. They disclosed that initially they just had an abscess on the spinal cord for which they started treatment and were recovering too, but due to unavailability of specialist and treatment in the government hospital and hefty cost of treatment at private doctors/ hospitals they left it mid-way and in due course of time became bed-ridden. The value of Chi-square indicated that perception regarding economic problems faced during childhood with respect to different types of disability did not vary significantly.

The study further investigated the social problems faced by the disabled respondents during their childhood (Table 2). Data reveal that more than half (52.2 percent) of the disabled suffered due to illiteracy of their parents and

Table 2. Perceptions regarding social problems faced during childhood

(Multiple responses)

Social problems	Type of disability					Total (N=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Beliefs and superstitions	2 (50.00)	5 (55.55)	5 (14.70)	15 (41.66)	3 (42.85)	30 (33.33)
Gender biasness	-	6 (66.66)	25 (73.52)	22 (61.11)	2 (28.57)	55 (61.11)
Illiteracy among parents	2 (50.00)	-	20 (58.82)	22 (61.11)	3 (42.85)	47 (52.22)

Figures in the parentheses indicate percentage.
χ^2 =19.16*

Table 3. Perceptions regarding psychological problems faced during childhood

(Multiple responses)

Psychological	Type of disability					Total (N=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Frustration	4 (100.00)	8 (88.88)	30 (88.23)	18 (50.00)	4 (57.14)	64 (71.11)
Isolation	3 (75.00)	6 (66.66)	29 (85.29)	25 (69.44)	6 (85.71)	69 (76.66)
Jealousy	2 (50.00)	3 (33.33)	15 (44.11)	14 (38.88)	4 (57.14)	38 (42.22)
Rejection from peer group	2 (50.00)	5 (55.55)	29 (85.29)	20 (55.55)	5 (71.42)	61 (67.77)

Figures in the parentheses indicate percentage.
χ^2 = 10.44 ^{NS}

two third (61.11 percent) of the disabled suffered due to gender biasness and one third suffered due to the prevalence of certain outdated beliefs and superstitions. They disclosed that instead of seeking medical treatment from doctors, their families kept believing that their disability was due to the presence of some unforeseen evil spirits. Hence, they took them to village *Saddhs* or local *babas* for treating the evil spirit through magic (*Jharah karvana*) which actually deteriorated their disability. One third of the respondents divulged that their disability was never considered and attended to seriously on account of their gender as male preference was a common norm with most of the patriarchal rural families. Half of the blind respondents suffered due to beliefs and superstitions and other half suffered due to their illiterate parents. The majority (66.6 percent) of the dumb and deaf and respondents with locomotor disability (73.5 percent) respondents suffered due to gender biasness. More than half (61.1 percent) of the disabled respondents with limb deformities divulged that they suffered due to gender biasness and illiteracy of parents and relatives.

The value of Chi-square indicated that perceptions regarding social problems faced during childhood with respect to different types of disability varied significantly.

Table 4. Perceptions regarding economic problems faced before marriage

(Multiple responses)

Economic problems	Type of disability					Total (N=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Dowry demand	2 (50.00)	7 (77.77)	19 (55.88)	23 (63.88)	6 (85.71)	57 (63.33)
Inaccessibility to supporting tools	-	-	18 (52.94)	10 (27.77)	5 (71.42)	33 (36.66)
Unemployment	-	-	12 (35.29)	9 (25.00)	6 (85.71)	27 (30.00)
Inaccessibility to education	-	9 (100.00)	14 (41.17)	14 (38.88)	2 (28.57)	39 (43.33)
Economic dependency	4 (100.00)	9 (100.00)	27 (79.41)	32 (88.88)	6 (85.71)	78 (86.66)

Figures in the parentheses indicate percentage.
χ^2 = 42.48**

Table 5. Perceptions regarding social problems faced before marriage

(Multiple responses)

Social problems	Type of Disability					Total (n=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Insincere sympathy	4 (100.00)	7 (77.77)	28 (82.35)	34 (94.44)	6 (85.71)	79 (87.77)
Social stereotype	2 (50.00)	9 (100.00)	24 (70.58)	25 (69.44)	7 (100.00)	67 (74.44)
Suitable match	2 (50.00)	3 (33.33)	19 (55.88)	6 (16.66)	4 (57.14)	~~34 (37.77)~~
Stigmatize identify	-	6 (66.66)	34 (100.00)	26 (72.22)	7 (100.00)	73 (81.11)
Oppressive culture	4 (100.00)	8 (88.88)	34 (100.00)	31 (86.11)	7 (100.00)	~~84 (93.33)~~
Domestic violence	3 (75.00)	4 (44.44)	-	-	-	7 (7.77)

Figures in the parentheses indicate percentage.
χ^2 = 89.73**

The study further disclosed that respondents had various psychological problems during their childhood. Majority of the disabled suffered due to isolation (76.6 percent), rejection from a peer group (67.7 percent) and got easily frustrated (71.1 percent). Forty two percent of the disabled disclosed that they were jealous of their siblings who didn't have any disability, who were preferred and taken everywhere (to ceremonies at relatives) by their parents while they were always left behind alone to no one's care. They were also jealous of their siblings and friends, who could play out the door and went to school. All the blind respondents easily got frustrated, the majority (75 percent) faced isolation, half (50 percent) of the respondents got jealous from other children (who were normal) and suffered due to lack of acceptance from the peer group. The majority of dumb and deaf and locomotor disabled respondents easily got frustrated and felt isolated. The disabled felt dejection, sorrow and self-pity among themselves which was the main cause of their frustration. Majority of disabled divulged that they suffered on account of unaccommodative social system and lack of infrastructural facilities.

Perception of the disabled regarding economic problems they faced before marriage is presented in Table 4. The data show that majority (87 per cent) of the respondents considered themselves as a burden upon their families as they were economically dependent, 63 percent suffered due to hefty demands of dowry. It was further divulged by the majority that due to their disability the parents of the prospective grooms demanded more dowry compared to normal girls in order to accommodate their disability. 43 percent didn't get higher education due to economic problems. Disabled girls revealed that their parents would rather spend the eager resource on the mate finding and marriage rather than on their education. One third of the respondents were unable to get supporting tools and gainful employment. The majority (86.6 percent) of disabled were economically dependent on the family as they had no individual income. Chi-square

Table 6. Perceptions regarding psychological problems faced before marriage

(Multiple responses)

Psychological problems	Type of Disability					Total (N=90)
	Blind (n_1=4)	Dumb and deaf (n_2=9)	Loco motor (n_3=34)	Limb deformity (n_4=36)	Spinal cord defects (n_5=7)	
Inferiority complex	2 (50.00)	9 (100.00)	30 (88.23)	28 (77.77)	7 (100.00)	76 (84.44)
Rejection	1 (25.00)	3 (33.33)	19 (55.88)	20 (55.55)	7 (100.00)	50 (55.55)
Emotional pressure	1 (25.00)	3 (33.33)	19 (55.88)	18 (50.00)	6 (85.71)	47 (52.22)

Figures in the parentheses indicate percentage.
*χ^2 = 32.76**

Table 7. Perceptions regarding economic problems faced after marriage

(Multiple responses)

Economic problems	Type of Disability					Total (N=49)
	Blind (n_1=1)	Dumb and Deaf (n_1=5)	Loco motor (n_3=25)	Limb Deformity (n_4=17)	Spinal cord Defects (n_5=1)	
Medical negligence	1 (100.00)	1 (16.66)	25 (100.00)	15 (88.23)	1 (100.00)	43 (87.75)
Last to receive resources	1 (100.00)	5 (100.00)	25 (100.00)	13 (76.47)	1 (66.66)	45 (91.83)
Economic dependency	1 (100.00)	5 (100.00)	23 (92.00)	13 (76.47)	1 (66.66)	43 (87.75)
Undue demands from parents	1 (100.00)	4 (83.33)	22 (88.88)	13 (76.47)	1 (100.00)	41 (83.67)
Material barriers	1 (100.00)	5 (100.00)	22 (88.88)	16 (94.11)	1 (100.00)	45 (91.83)

Figures in the parentheses indicate percentage.
χ^2 = 16.23^{NS}

significantly varied the association between disability and problems of the disabled.

The study further highlights the social problems of the respondents before marriage. As is clear from the Table 5 a significant majority of respondents divulged that oppressive culture (93.3 per cent), insincere sympathy (87.8 per cent) and stigmatized identity (81.8 per cent) were the major problems which bothered them before marriage. A perusal of the data revealed that all the blind, locomotor disabled and respondents with spinal cord defects revealed that normative culture was not at all accommodative to the disabled. Rather it was oppressive for disabled in general and for disabled women in particular. They were blamed for their disability, their family felt ashamed of then especially in presence of others. They were considered as a burden on the family by the society as well as by their own family. The majority were pained by undue and insincere sympathy extended by neighbours, relatives as many confided about indecent overtures by acquaintances while showing sympathy for their disability. They were stigmatized and were pained when called by names like *goongi, langdi, tundi, etc*. Three fourth of the respondents have disclosed about the prevalence of social stereotypes. They divulged that many considered them unreliable as it was a notion that most of the "disabled are dishonest and unfaithful". (Their disability was considered curse on them because of their own misdeeds in prior birth). More than one third of the respondents disclosed that finding a suitable match was a nightmare for their parents. Chi-square significantly

Table 8. Perceptions regarding social problems faced after marriage

(Multiple responses)

Social problems	Type of disability					Total (n=49)
	Blind (n_1=1)	Dumb and deaf (n_1=5)	Loco motor (n_3=25)	Limb deformity (n_4=17)	Spinal cord defects (n_5=1)	
Domestic violence	1 (100.00)	3 (60.00)	9 (36.00)	9 (52.94)	1 (100.00)	23 (46.93)
Discrimination	1 (100.00)	4 (80.00)	23 (92.00)	12 (70.58)	1 (100.00)	40 (81.63)
Stigmatize identity	1 (100.00)	5 (100.00)	25 (100.00)	15 (88.23)	1 (100.00)	46 (93.87)
Segregation	1 (100.00)	4 (80.00)	25 (100.00)	11 (64.70)	1 (100.00)	41 (83.67)
Oppressive culture	1 (100.00)	2 (40.00)	25 (100.00)	15 (88.23)	1 (100.00)	44 (89.79)

Figures in the parentheses indicate percentage.
$\chi^2 = 8.54^{NS}$

Table 9. Perceptions regarding psychological problems faced after marriage

(Multiple responses)

Psychological problems	Type of disability					Total (N=49)
	Blind (n_1=1)	Dumb and deaf (n_2=5)	Loco motor (n_3=25)	Limb deformity (n_4=25)	Spinal cord defects (n_5=17)	
Verbal abuse	-	4 (80.00)	15 (60.00)	12 (70.58)	1 (100.00)	32 (65.30)
Incompetence	-	-	20 (80.00)	15 (88.23)	1 (100.00)	35 (71.42)
Incapacity	1 (100.00)	1 (20.00)	20 (80.00)	13 (67.47)	1 (100.00)	36 (73.46)
Rejection	-	5 (100.00)	18 (72.00)	11 (64.70)	1 (100.00)	35 (71.42)
Incompatibility with husband	1 (100.00)	4 (80.00)	7 (28.00)	9 (52.94)	1 (100.0)	22 (44.89)

Figures in the parentheses indicate percent.
$\chi^2 = 18.38^{NS}$

varied the association between disability and problems of the disabled.

Table 6 reveals the psychological problems of respondents before marriage. A significant majority (84.4 percent) felt inferior mainly because of disability and substantiated because of their being illiterate and unemployed. More than half of the disabled respondents felt rejected as they were rarely accompanied for family functions and functions at neighbourhood and relative's place. Instead of love or compassion, people extended undue sympathy. More than half of the respondents faced rejection during matrimonial proposals and were emotionally pressurized by the parents to marry an unsuitable match (too much age gap, divorcee/widower with children, too disabled and poor). All the respondents with spinal cord defects had an inferiority complex and felt rejected. Chi-square significantly varied the association between disability and problems of the disabled.

Table 7 highlights economic problems of the disabled after marriage. A large majority of the respondents revealed that they were last to receive the basic resources (91.8 per cent) in their marital house. They got least and left over resources pertaining to food and clothing. Due to the economic distress, they were forced to use worn out supporting tools like crutches, stick, wheelchair etc. They were rarely taken to doctor (87.7 percent) for their medical problems/ check-up and in case of emergency were best taken to RMP doctors or local *deras*. As the majority of them were not gainfully employed, they were dependent upon their marital family/ husband for all their needs. The study further revealed that 83.7 percent disabled were pressurized to take monetary help time and again from their parents. As is clear from the data the situation of blind, deaf and dumb respondents and respondents with spinal cord defects was comparatively vulnerable compared to the respondents with locomotor disability and limb deformities.

The perusal of Table 8 further highlights the social problems of respondents. Appraisal of the data divulged that stigmatized identity (93.8 percent) was the major problem reported by the disabled. They were considered low and notions of being unreliable, dishonest and clever was frequently hurled upon them just because of their being disabled. The majority reported the cultural practices too oppressive (89.8 percent) as rather than accommodating the disabled they were rarely excused from daily household chores. All the blind, polio afflicted and spinal cord defect respondents reported about oppressive culture. Instead of lending a supporting hand, family members in their marital house resorted to violence (46.9 percent) on account of their being inefficient and incompetent.

All the blind and disabled with spinal cord defects, 60 per cent of dumb and deaf respondents and half of the respondents with limb deformities (52.94 percent) and one third (36 percent) of polio rideen respondents reported about domestic violence. Eighty three percent of respondents reported that they were segregated from rest of the family. They were not allowed to meet and interact with anyone outside the family and if at all they were allowed their meeting was strictly monitored.

The study further highlights the psychological problems of respondents after marriage. Majority of the respondents generally suffered due to the feeling of incompetence (71.4 percent), incapacity (73.5 percent), rejection (71.4 percent) and verbal abuse (65.3 percent). The study further revealed that all the blind and respondents with spinal cord defects felt highly incapacitated due to their disability to perform daily household chores and rearing of kids whereas one fifth of dumb and deaf (20 percent) felt so. All the women with spinal cord defects were verbally abused and 80 percent of dumb and deaf had incompatibility with husbands. The majority (80 percent) of the locomotor disabled respondents felt incompetent and incapable.

CONCLUSIONS

Though it has been claimed by academia that discourse in the disability sector has moved from the welfare-based charity approach to a rights-based perspective but the study found that disabled women in rural Punjab were yet far away from achieving minimum standards of well-being least to talk about their entitlements. Disabled faced twin disadvantages, that is, disadvantage on account of their disability and due to gender. Gender played a deciding role in situating them in the most vulnerable and many a times worse situation. Keeping aside their rights guaranteed through various welfare schemes by the government, they had been subjected to humiliation for meeting their very basic sustenance needs. Rather than giving due consideration to their welfare aspect, the study revealed that it was severely compromised within the structure of family and marriage institutions. Role of prevalent cultural constructs on disability was too oppressive and need to be corrected in order to ensure not only their agency aspect but in order to guarantee their survival and promote their well-being.

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A Study of Selling Orientation and Customer Orientation of Life Insurance Agents in Ludhiana City

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ABSTRACT

The study assessed the selling and customer orientation scores of life insurance agents through SOCO scale and further associated these scores with the demographic profile of life insurance agents. Primary data were collected from 100 randomly selected insurance agents through the use of a questionnaire. The gender, age, job profile and experience of agents were found to be significantly associated with selling orientation. Agents having an age of 35-50 years were found to explain significantly more variance in the selling orientation score as compared to agents having an age of 25-35 years and above 50 years. The determinants namely gender, job profile, and experience were found explain significantly more variance in the customer orientation score as compared to females.

Keywords
Customer orientation, determinants, regression, sezlling orientation.

JEL Codes
G22, M10, M30, M31.

INTRODUCTION

The customer wants and needs are always changing. A company focussing on selling, and customer orientation understand that what it can do to accommodate these changing needs and even try to anticipate them in the future. As opposed to production or product orientation, a sales orientation focuses primarily on the selling and promotion of a particular product. Selling orientation relates to a product to attain the highest sales possible. Such a modern day orientation may suit scenarios in which a firm holds dead stock, or otherwise sells a product that is in high demand, with little likelihood of changes in consumer tastes that would diminish demand.

Customer orientation is an approach to sales and customer-relations in which staff focus on helping customers to meet their long-term needs and wants. Here, management and employees align their individual and team objectives around satisfying and retaining customers. Customer orientation refers to a group of actions taken by a company to support the needs of its clients by engaging sales and support staff in order to ensure customer satisfaction is the major priority. Examples of customer orientation include providing quality products or services, responding quickly and thoroughly to customer feedback and complaints and being sensitive to the community's needs. Customer orientation is a business strategy in the lean business model that requires management and employees to focus on the changing wants and needs of its customers. In other words, it's a company-wide philosophy that the customer's wants and needs are the first priority of all management and employees.

Most modern companies have transitioned to a more customer-oriented approach to product design, development, and marketing strategy, but a company that truly embraces this idea changes its entire operations to fit consumer needs. An attempt has been made to present, in brief, a review of selected studies, which have a direct or indirect relevance to this study. Kohli (2006) studied the secondary market for life insurance policies that the increase in secondary market transactions for life insurance policies (commonly known as life settlements). Part I of this Article discusses the life settlement transaction: who is involved, how the process works, and

why people are using life settlements. Part II discusses the emergence of the market in light of its troublesome history and analyses its future potential given demographic trends in the United States. Part III discusses the regulatory landscape of the life settlement industry, analyzing model statutes developed by the National Association of Insurance Commissioners (NAIC) and the National Conference of Insurance Legislators (NCOIL). Part IV addresses certain deficiencies in these model statutes and recommends certain actions to help ensure the proper growth of the secondary market for life Insurance. Dash *et al.* (2007) studied the risk-return characteristics of life insurance policies that they were no longer seen solely as a means of insuring life due to many new features introduced by life insurers. The study discussed the rates of return given by different types of policies, and the effect of mortality on these rates of return across age, sum assured, and maturity period in each type of policy studied. Comparisons in different categories were made for both the unadjusted and mortality-adjusted rates of return. The analysis was made to determine the type of relationship that the unadjusted and mortality-adjusted rates of return follow and to determine their degree of sensitivity to mortality. The findings indicated that different types of policies give different rates of return and that mortality did not have an effect on the rates of return. The study also revealed that the unadjusted and mortality-adjusted rates of return follow a linear relationship that was very similar to the capital asset pricing model. Pliska & Jinchun (2007) studied the problem of optimal life insurance purchase, consumption and portfolio investment strategies for a wage earner under an uncertain lifetime. The study was conducted by using two techniques named as dynamic programming technique and martingale technique. The results were bankruptcy condition, the existence of optimality, characteristics of admissible consumption, etc. Liebenberg *et al.* (2010) studied the demand for life insurance policy loans. The study was conducted using aggregate policy loan data which reveals that there was a positive relation between loan demand and income shocks or recent expenses. In support of the policy loan emergency fund hypothesis, this research was the first U.S. evidence. Menquc & Boichuck (2012) studied the contingency role of co-worker support. This study examined the dissimilarities of customer-orientation between co-workers. The model proposed that sales unit identification mediates the relationship between dissimilarities and customer-directed extra-role behaviour. Gountas & Mavondo (2014) studied the effect of individual factors of real estate agents and organizational factor such as service delivery standards, support of supervisor and co-worker support on customer orientation. Self-efficacy and job satisfaction were examined under individual factors. This research offered a new vision of customer-orientation in a high-pressure selling-orientation industry. Bhardwaj & Vohra (2015) concluded that the customer-orientation has a tremendous impact on customer's loyalty. It had a significant effect on sales performance as well as intentions and satisfaction level of the customers. Salespersons had a tremendous impact on loyalty exhibited by customers, to the extent that customers may cease to be loyal to a firm when a particular salesperson was transferred or leaves the firm. The study aims to:

i. to assess selling orientation and customer orientation of life insurance agents, and
ii. to examine the association of selling and customer orientation with the demographic profile of life insurance agents.

DATA AND METHODOLOGY

The study consisted of those life insurance agents who have been serving in life insurance industry since last two years. A sample of 100 respondents was selected on the basis of convenience. SOCO Scale (Saxe & Weitz, 1992) was modified and used to get the information on selling and customer orientation. The collected data were analyzed using various statistical tools like mean score, standard deviation, factor analysis, analysis of variance and dummy regression.

FINDINGS FROM FIELD SURVEY DATA

Demographic Profile

The profile of respondents consisted of a total of 100 life insurance agents out of which 53 percent respondents were males and 47 percent were females. Most of the agents (49 percent) were in the age group of 25-35 years. Only 6 percent agents were found to be under graduate whereas 39 percent were post-graduates. It was found that 64 percent agents worked as full time life insurance agents. A number of agents with experience of 3-5 years were found to be highest. Most of the agents earned an income of more than ₹15000 a month.

Agreement regarding Selling Orientation and Customer Orientation of Life Insurance Agents

The agreement regarding the selling orientation, customer orientation and satisfaction of the life insurance agents on various aspects has been discussed in following tables.

Table 1 depicts the agreement regarding the selling orientation of the life insurance agents. It has been observed that the focus of the agents is mainly on selling the products rather than customer satisfaction. Mostly agents agreed on pressurizing the customers to buy the product even though they are not sure whether the product is suitable depending on their needs and this statement has mean 3.53, standard deviation 0.94 and the calculated t-value is 5.593 (p value < 0.05). The less number of agents believes that it is necessary to stretch the truth during the description of the product have mean 2.31, standard deviation 1.01 and the calculated t-value is -6.818 ($P < 0.05$) which indicates that there is a significant difference statistically. The agents spend more time in convincing a customer to buy rather than discovering his needs has mean 2.95, standard deviation 1.14 and the calculated t-

value is -.438 ($p < 0.05$). The agents try to sell those products which they can convince customers to buy, without considering the satisfaction of them, in the long run, have mean 3.10, standard deviation 1.02 and the calculated t-value is .971 ($p < 0.05$) and found to be non-significant statistically.

Customer orientation of life insurance agents agreement on various aspects is presented in Table 2. The maximum agents focusing on the exact needs of the customer have mean 1.69, standard deviation 0.73 and the calculated t-value is -17.839 ($p < 0.05$). The less number of agents helping customers achieving the financial goals have mean 2.24, standard deviation 0.79, and the calculated t-value is -9.585 ($p < 0.05$). Majority of life insurance agents agreed to focus on customer's interest , interact with customers to discuss their needs, focus on providing accurate and adequate information to customers, emphasize on relating the best suitable product with the need of the customer, always try to suggest best possible product according to need of the customer, always try to guide the customer to a better decision, try to make sure that the customer's expectations are fulfilled by the product, achieve goals by satisfying customers. All statements were found to be statistically significant statistically.

Association of Selling Orientation and Customer Orientation with demographic profile of Life Insurance Agents

In this section, the demographic profile is associated with selling orientation followed by customer orientation of the life insurance agents.

The selling orientation associated with the demographic profile of Life Insurance Agents are presented in Table 3. Depending on p-value, the significant selling orientation relevant with the demographic profile of agents is found. It is noteworthy that the gender, age, job profile and experience of agents are agreed more significantly associated with selling orientation while the qualification, company, and income are non significant enough in this case of study. On the

Table 1. Agreement regarding selling orientation of life insurance agents

Statements	Mean	SD	t- test
I try to convince a customer to buy more than what is required.	3.07	1.02	0.681
I try to focus on selling rather than satisfying a customer.	3.29	1.02	2.821***
I keep on looking for the weak points on the personality of the customer to pressurize him for buying the product.	3.41	0.99	4.117***
I pressurize the customer to buy the product even if I am not sure that the product is suitable for him.	3.53	0.94	5.593***
I try to sell those products which I can convince customers to buy, without considering the satisfaction of them in the long run.	3.10	1.02	0.971
I present my products as if they are the best.	2.45	0.84	-6.506***
I spend more time in convincing a customer to buy rather than discovering his needs.	2.95	1.14	-0.438
During the description of the product, It is necessary to stretch the truth.	2.31	1.01	-6.818***
To please the customers, I pretend to agree with them.	2.73	1.02	-2.638***
Even if something is in my control, I still pretend it is not.	2.94	1.17	-0.509
Without exploring the customer's needs, I begin the sales talk for a product.	3.11	1.23	0.894
I treat a customer as a rival	3.39	1.33	2.927***

*** *and* ** *Significant at 1 and 5 per cent level.*

Table 2. Agreement regarding customer orientation of life insurance agents

Statements	Mean	SD	t-value
I help customers to achieve their financial goals.	2.24	0.79	-9.585***
I focus on customer's interest.	1.81	0.76	-15.630***
I interact with customers to discuss their needs with me.	1.83	0.72	-16.127***
I try to find out the exact needs of the customer.	1.69	0.73	-17.839***
I focus on providing accurate and adequate information to customers.	1.84	0.84	-13.655***
I emphasize on relating the best suitable product with the need of the customer.	1.86	0.89	-12.679***
I always try to suggest best possible product according to the need of the customer.	1.93	0.72	-14.692***
I always try to guide the customer to a better decision.	1.89	0.83	-13.220***
I try to make sure that the customer's expectations are fulfilled by the product.	1.88	0.81	-13.869***
I achieve my goals by satisfying customers.	2.03	1.03	-9.334***

*** *and* ** *Significant at 1 and 5 per cent level.*

basis of Tukey test, the agents having age in the range 35-50 are found to lie in Group B while the agents with age less than 25, 25-35 and above 50 years are grouped in Group A. The agents having experience more than 10 years are in Group B while the rest agents with experience less than 10 years lie in Group A. Although, the income of the agents in this case study is non-significant statistically but the agents were also categorized in Groups A and B on the basis of Tukey test. Group A contains the agents with income 25000 or less, while the agents with income more than 25000 lie in Group B.

The customer orientation associated with the demographic profile of Life Insurance Agents are tabulated in Table 4. The agent's age, company profile to which they belong, and the income of the agents are non significant in terms of association with customer orientation. The gender, qualification, job profile and income of agents are significant statistically. Also, groups were formed on the basis of Tukey test. It was noted that the agents who are under graduates are found to be in Group A with a mean of 1.43, SD 0.52. While the agents with graduate (mean 2.02, SD 0.44) and post-graduate (mean 1.80, SD 0.52) qualifications were grouped in group B. The t/f value was counted to be 5.296. The full time and part time agents with a mean of 2.02, SD 0.48 and mean of 1.67, SD 0.46, respectively, agree significantly with the association of customer orientation with t/F value of 12.206. The agents having experience of 2-3 years, 3-5 years and 5-10 years were classified in Group A and agents with experience above 10 years were found to lie in Group B. t/F value of 4.363 shows the agents with experience agree significantly associating with customer orientation.

Determinants of Selling Orientation score and Customer Orientation score

Table 5 depicts determinants of sales orientation score. Linear regression analysis using dummy variables was applied and dependent variable used was selling orientation score.

The various determinants tested were satisfaction score, gender, age, job profile, experience, and income. The regression model was found to be significant ($F= 5.48$, $p < 0.05$). Adjusted R^2 was found to be 0.352.The determinants related to dummies namely age, experience and income were found to be significant statistically. Agents having an age of 35-50 years were found to explain significantly more variance in the selling orientation score as compared to agents having an age of 25-35 years and above 50 years. The life insurance agents having experience 5-10 years and more than 10 years were found to explain significantly more variance as compared to less experienced agents whereas all the dummies of monthly income were found to significantly explain variance in selling orientation.

Table 3. Association of selling orientation with the demographic profile of Life Insurance Agents

Social demographic profile	Categories	Mean summated	SD	t/F value	Groups formed on the basis of Tukey test
Gender	Male	2.92	0.52	4.456***	-
	Female	3.15	0.58		
Age (years)	<25	3.10	0.64	3.903**	**Group A:** < 25, 25-30, and > 50 years
	25-35	3.01	0.52		**Group B:** 35-50 years
	35-50	2.81	0.46		
	>50	3.53	0.45		
Qualification	Under Graduate	3.46	0.18	2.091	
	Graduate	2.97	0.56		
	Post Graduate	3.03	0.57		
Company	Public	2.94	0.54	1.759	-
	Private	3.09	0.57		
Job profile	Fulltime	2.89	0.51	11.439***	-
	Part time	3.27	0.56		
Experience (years)	2-3	3.22	0.52	6.156***	**Group A:** 2-3, 3-5, and 5-10 years
	3-5	2.77	0.53		**Group B:** >10 years
	5-10	3.04	0.53		
	Above 10 years	3.65	0.05		
Income (₹per Annum)	Less than 15000	3.65	0.11	1.344	**Group A:** < 15000, and 15000-25000
	15000-25000	3.20	0.56		**Group B:** 25000-40000, and Above 40000
	25000-40000	2.92	0.43		
	Above 40000	2.81	0.58		

*** *and* ** *Significant at 1 and 5 per cent level.*

Table 4. Association of customer orientation with demographic profile of life insurance agents

Social demographic profile	Categories	Mean summated	SD	t/F value	Groups formed on the basis of Tukey test
Gender	Male	1.79	0.56	-2.27**	-
	Female	2.02	0.40		
Age (years)	<25	2.00	0.38	0.928	
	25-35	1.87	0.51		
	35-50	1.90	0.62		
	>50	1.63	0.45		
Qualification	Under Graduate	1.43	0.52	5.296***	**Group A:** Under Graduate
	Graduate	2.02	0.44		**Group B:** Graduate Post Graduate
	Post Graduate	1.80	0.52		
Company	Public	1.91	0.52	0.026	-
	Private	1.89	0.49		
Job Profile	Fulltime	2.02	0.48	12.206***	-
	Part time	1.67	0.46		
Experience (years)	2-3	2.03	0.45	4.363**	**Group A:** 2-3, 3-5, and 5-10 years
	3-5	1.98	0.43		**Group B:** >10 years
	5-10	1.70	0.57		
	Above 10	1.40	0.11		
Income (₹/year)	Less than 15000	1.72	0.34	2.482	-
	15000-25000	2.04	0.50		
	25000-40000	1.96	0.49		
	Above 40000	1.74	0.50		

*** and ** *Significant at 1 and 5 per cent level.*

Table 5. Determinants of selling orientation score

Independent variables	Coefficient	t-value
Constant	3.331	7.491***
Satisfaction score	0.041	0.359
Dummy-Gender	0.092	0.824
Dummy-Age 25-35 Years	0.011	0.081
Dummy- Age 35-50 Years	-0.503	-2.254**
Dummy- Age above 50 Years	-0.048	-0.155
Dummy-Part Time	0.055	0.432
Dummy-Experience 3-5 Years	-0.095	-0.651
Dummy-Experience 5-10	0.501	2.096**
Dummy-Experience >10	1.263	4.047***
Dummy-Income 15000-25000	-0.409	-2.015**
Dummy-Income 25000-40000	-0.675	-2.999***
Dummy- Income >40000	-0.906	-3.649***

F-value (p value)= 5.48 (0.00).
Adjusted R^2 = 0.352.
*** and ** *Significant at 1 and 5 percent level.*

Table 6. Determinants of customer orientation score

Dependent variables-Customer orientation score		
Independent variables	**Coefficient**	**t-value**
Constant	1.181	3.056**
Satisfaction Score	0.122	1.213
Dummy- Gender	0.280	2.735**
Dummy- Graduate	0.359	1.806
Dummy- Post Graduate	0.111	0.550
Dummy- Part Time	-0.414	-4.143***
Dummy- Experience 3-5 years	-0.056	-0.496
Dummy- Experience 5-10 years	-0.110	-0.832
Dummy- Experience >10 years	-0.520	-2.105**

F value (p value)= 6.44 (0.00).
Adjusted R^2 = 0.305.
*** and ** *Statistically significant at 1 and 5 percent level.*

Table 6 depicts determinants of customer orientation score. Linear regression analysis using dummy variables was applied and dependent variable used was customer orientation score. The various determinants tested were satisfaction score, gender, education, job profile, and experience. The regression model was found to be significant ($F= 6.44$, $p < 0.05$). Adjusted R^2 was found to be 0.305.The determinants related to dummies of namely gender, job profile and experience were found to be significant statistically. Males were found to explain significantly more variance in the customer orientation score as compared to females where as people working as part time insurance agents were found to explain significantly less variance in comparison to full time. The life insurance agents having experience more than 10 years were found to explain significantly more variance as compared to fewer experience agents.

CONCLUSIONS

The study revealed that mostly agents agreed on

pressurizing the customers to buy the product even though they are not sure whether the product is suitable depending on their needs. The less number of agents believed that it is necessary to stretch the truth during the description of the product. The gender, age, job profile and experience of agents are agreed more significantly associated with selling orientation while the qualification, company, and income are non significant enough in this case of study. The agent's age, company profile to which they belong, and the income of the agents is non-significant statistically in terms of association with customer orientation. The gender, qualification, job profile and income of agents are more significant. Agents having an age of 35-50 years were found to explain significantly more variance in the selling orientation score as compared to agents having an age of 25-35 years and above 50 years. The life insurance agents having experience 5-10 years and more than 10 years were found to explain significantly more variance as compared to fewer experience agents. The determinants namely gender, job profile, and experience were found to be significant. Males were found to explain significantly more variance in the customer orientation score as compared to females.

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Gender Difference in Online Buying Behaviour: An Empirical Study in Punjab

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ABSTRACT

Online buying is no more just a buzz word rather has become a helpful medium to transact and buy things while sitting at home. Shopping online not only provides the comfort of buying at home but also enjoying a wide and huge variety of products with few clicks. Online buying has been substantially increasing globally as well as in India. The rise of digital natives, better broadband facilities and lesser rate of the internet is fuelling the demand for online products and increasing the number of online consumers. The number of online consumers in India is expected to grow from 69 million in 2016 to 100 million online consumers by 2017(Assocham,2016). These growing numbers have kindled great interest in this field and in understanding the consumer's decision of indulging in or refraining from online shopping these days. Different demographics play a vital role in consumer behaviour studies. Gender is one of the most significant demographic in studies of consumer behaviour. It becomes eminent to study that who buys online, for whom are they buying and what kind of products consumers prefer to buy. Therefore this research paper throws light on whether gender plays any significant role in online buying or not. The results of this study show that there is a significant difference in frequency of buying goods online as well as in the amount of money spent by male and female. Some of the products bought online also showed significant difference specially buying electronic items, apparels, and jewellery, etc. while no significant differences are found between males and females for other products like toys and games, books and stationery items and gifts and flowers etc.

Keywords
Consumer behaviour, gender, online buying, online consumers.

JEL Codes
C82, C83, D03, M10, M31.

INTRODUCTION

Online buying has witnessed an unprecedented growth over the last few years. With growing internet penetration, increasing number of smartphone users, evolving consumer mindset, changing consumer behaviour and varying lifestyle of consumers, the online space has touched new heights (Tiwari, 2014). This steady increase of online business has kindled great interest in understanding the consumer's decision of indulging in or refraining from online shopping these days (Cho, 2004). A larger number of people are easily becoming the part of the internet community, as it offers many benefits like easy to operate and convenient to use (Lee & Tan, 2003).Approximately 42 per cent of the whole world's internet population lives in Asian countries, who are buying goods online through their smartphones and smart mobile devices (Digital landscape in Asia statistics and trends, 2015). The estimated B2C e-commerce sales in Asia pacific had reached up to approximately $855.7 Billion in 2016 from $383.9 billion in 2013. It is projected to reach up to $1052.9 Billion by 2017. As per Meeker's internet report in the year 2016, India was the silver lining, otherwise bleak global internet market landscape. India has substantially grown at 40 per cent in terms of internet user growth comparing to worldwide internet user growth at 9 per cent (Meeker, 2016). Though many consumers have already initiated the use of the internet to browse product and its related information still a smaller percentage actually make anonline purchase. Out of the total internet users, 27 per cent consisted of men and 17 per cent women with mainly young population online in India under a global attitude

survey (Poushter, 2016). Global tech companies see India's vast offline population as the untapped market (Zainulbhai, 2016).The rise of digital natives, better broadband facilities and lesser rate of the internet is fueling the demand for online products and increasing the number of online consumers. The numbers are expected to grow from 69 million online consumers in 2016 to 100 million online consumers in India by 2017 (Assocham, 2016).

Gender Difference in Online Buying

There are differences in online shopping behavior of men and women (Straughn & Miller, 2001). Both men and women show a different attitude onthe internet and traditional/ in-store shopping environment (Dittmar *et al*., 2004). The demographic factors including the gender have limited role in predicting internet usage behavior (Blake *et al*., 2007). Studies have consistently shown results that gender influence a consumer's propensity to shop online. While another view point is that gender has no influence regarding the computer-related benefits, yet it has a significant effect on the perception of benefits associated with store shopping (Dholakia & Uusitalo, 2002). Lohse *et al*. (2000) found the evidences of gender difference in online buying where male respondents were found to be 54 per cent (approx.) and females 46 per cent the ratio of male and female respondents reached to 50 per cent in next few years.

More educated males are cybershoppers also inclined to buy more online than were females (Li *et al*., 1999; Donthu & Garcia, 1999). In New Zealand, it was found to be 57 per cent males and 43 per cent of female online shoppers. The same study found out the percentage of online shoppers as 60 per cent male and 40 per cent female in China (Felix, 1999**)**. The male-female differences that exist in the perception of store shopping may not exist in electronic shopping. Even though males are found to be more webs apprehensive, still the role of women cannot be negated in contribution to online business (Alreck & Settle, 2002).

The demographic difference exists amongst the number of internet users (Li *et al*., 1999). Increase in a number of internet users has also led to more online buying over the years. In the early years of internet usage, most of the men, almost 95 per cent were the users of the internet (Bae & Lee, 2011). The ratio of male online surfers was usually higher than female indicating a closer gender distribution as to traditional shoppers. Slowly and steadily the trend has changed, the number of respondents in the form of online shoppers increased and found to be 47.8 per cent males and female shopper 52.2 per cent of the total sample investigated during a study by Liu *et al.* (2005).

With the evolving internet technology more and more common people became techno-savvy and the dominance of male users faded in making online transactions. The population of female internet users is much comparable these days to the male online community. The leading numbers of females in both internet usage, as well as online shopping, indicates comparable results in internet usage to that of males now. Some Studies show a positive trend of females towards internet usage. Shopping is also institutionalized as a female-typed activity (Scott & Spitze, 1994). Women after the post-industrial economies have become the primary shoppers for household (Dholakia, 1999). The attitude of women is quite similar to men in conventional buying, but evidence of gender difference in online buying can be depicted. Once they get engaged in online buying, then their attitude resembles those of male buyers. Since women and men don't appear to shop differently online, women-focused sites run the risk of missing out on male shoppers" (Wallace & Peg, 2000).

The gender differences were pronounced in some studies but now this gap has been diminishing. According to a study conducted by Kwon & Wen (2010), out of the total respondents in the study, males were only 43 per cent and rest 57 per cent were females from the total sample of 208 valid respondents. In their study males showed more (interests) variety in unpopular items (both in visiting and purchasing). In the category of grocery shopping study, 75 per cent were women from the total sample, who used online grocery store for shopping, as it helps them to save free time also facilitates them the comfort of shopping at home and saving time (Rajas &Tuunainen, 2006).Since the advent of Technology, the gender gap has been evident regarding the usage of internet as well as online shopping. The gender difference in internet usage leads to different online shopping behaviour between males and females (Bae & Lee, 2011). At the evolutionary stage of the internet, many users were males even many studies have investigated and found that females invest less time and effort in using the internet. But over the years trend is changing where more females shop online than men now. With the increasing use of the internet by women, changing power equations in urban households, greater women empowerment of more number of working women, also their dominant influence on household shopping behaviour they are influencing buying decisions (Wallace & Peg, 2000). Not only this when they get online, they shop also. Women's online behaviour is significantly a matter to watch for all marketers, brands, and business. As the average time spent by women on online apps is 46 min/day as compared to25 minutes/day by men. Females are not only spending more time on internet related activities, but they are becoming a significant contributor to the growth of e-shopping in India (Men versuswomen: who is more active on social media 2017). A survey puts an end to the gender wars on who is shopping online and depicted that 74 per cent of the female respondents use their plastic money also their debit and credit cards for online transactions, beating out men. Also, the women app users are higher than men .

Buying Behaviour

Consumer buying behaviour can be defined as the

study of how individuals, groups, and organizations select, buy, use and dispose of goods, services, ideas or experiences to satisfy their needs and wants (Kotler *et al,* 2013). Online buying behaviour is somewhat similar to how consumers behave in the traditional world. Due to an immense number of benefits of online buying, people today are encouraged to buy all type of products online, without any hesitation. Individual actions were found to be influenced by demographic attributes before they engage in a given behaviour (Ajzen & Fishbein, 1980).Evidence from the previous researches proves that role of demographics including gender has a significant impact on consumer's online buying behaviour. Demographics are important indicators of who goes online to start with (Lohse *et al*., 2000). Gender is an important consumer demographic to judge the perception of online shopping behaviour (Akhlaq & Ahmed, 2016).

Even the shopping habits of men and women differ in traditional as well as online buying. Amongst the most common purchases made are consumer electronics, books, clothing and apparel, household goods, etc. Online shopping is popular among both genders, with almost three-fourths of women (72 per cent) and more than two-thirds of men (68 per cent) having shopped online in the past 30 days (What-clicks-with-the-online-shopper 2015). Consumers of both sexes age 35 to 54 years had the highest levels of online shopping activity (74 per cent). Women led most online purchase categories except music, auctions and computer hardware (Todd, 2011)**.** A research showed that 98 per cent of the connected population in India is using the internet to shop books, tickets etc., while 96 per centuses it to browse social media. Indians are using the internet more and more for shopping than social media (What-clicks-with-the-online-shopper 2015)). Men's clothing and footwear are the most frequently purchased products online also the north Indian men are expected to buy more apparel, footwear, and accessories in coming future.

Rationale of the study

In a developing country like India, Online Retailing is picking up the pace and growing rapidly. Slowly and steadily people are accepting and getting used to the online shopping due to its easy and convenient use. Rapid Urbanization, growing internet penetration and varying consumer behaviour are also leading the way to buy more and more products online. It, therefore, becomes imminent to study the changing mind set of consumers who are getting involved in online shopping these days. Gender can have important role to play in online buying behaviour. While studies of online shopping are abundant and widespread in previous literature, studies of gender differences in buying behaviour are limited and the findings too are inconsistent. Research in this area shows conflicting views in online buying behaviour of men and women. These contradictory reviews draw more attention for better understanding and need to study onlinebehaviour of men and women of gender difference in online buying. Moreover whatever work has been conducted in aspect of consumer behaviour, mainly comes from the western countries only. Hardly any research is available that highlights the online shopping behaviour, particularly, focusing on gender behaviour in Indian context that too specifically in Punjab.

The literature reviewed in this context showed that gender is one of the most prominent demographic that determines the online buying behaviour of the consumers also to find out whether gender matters or not while studying online buying behaviour in the current scenario. Therefore, the present study was conducted to analyze the gender difference in online buying behaviour.

RESEARCH METHODOLOGY

The present study was conducted in five cities of Punjab. These cities were selected on the basis of highest urban to total population ratio (Statistical Abstract of Punjab, 2012). These cities were Ludhiana, Jalandhar, Amritsar, Mohali, and Patiala. The sample of the study consisted of online shoppers, 100 respondents from each of the selected city, a list of all the operational internet service providers was procured from their official websites and from that list, four service providers were chosen on a random basis. Further, 25 respondents who had made online purchases at least three times during the past six months were selected on the basis of systematic random sampling from each of the selected internet service provider, leading to 100 respondents from each city. The respondents were personally contacted and were asked to fill the questionnaire for the purpose of this study. Thus the total sample was comprised of 500 respondents. A personal visit was made to each of the selected service provider of each city to collect the data from 25 online retail customers.

Tools and Techniques Used

Self-structured questionnaire: A self-structured non-disguised questionnaire was used as an instrument to find the buying behaviour of the online shoppers in Punjab. The questionnaire was developed by reviewing the related literature to operationally define the constructs for the purpose of the study. The first draft of the questionnaire was refined by the experts of this field and their suggestions were added to the instrument. Then the questionnaire was used for a pilot study on 50 online customers. On the basis of the results of the pilot study, the questionnaire was finalized.

For assessing the frequency of online buying and the amount spent on online buying, the respondents were asked to select and tick the appropriate category for the number of times they have shopped online and the amount in rupees they have spent on online buying in a period of last one year. The other important construct for buying behaviour is the various persons for whom online shopping is done. The respondents were asked to rate each category on a Likert type scale of 1-5 classifying as 1(Never), 2 (Rarely), 3 (sometimes), 4 (Often), and 5 (Always). The data were tabulated and analyzed using

percentage, mean scores, and χ^2, t-test, etc.

RESULTS AND DISCUSSION

The study was conducted to find out the buying behaviour of online shoppers in Punjab. So the sample from, various cities of Punjab had been collected to find how many times people buy products online, how much money they spend, what do they buy more frequently online and for whom do they buy.

In this section, the table and results of the study are being presented

Table 1 portrays the gender wise distribution of the online buyers according to the frequency of online buying. The sample consists of a total number of 218 male online shoppers and 282 female online buyers across five cities in Punjab, who had purchased products online three times or more in past six months. The percentage frequency of online buying is almost equal in case of a male 31.65 per cent and female 30.85 per cent online shopping for buying less than 5 times in last one year. Most of the males and females had shopped 6-10 times in the last year, where more females (43.62 per cent) had shopped less than 10 times as compared to males (36.24 per cent) in last year. 19.27 per cent of the male respondents as compared 18.44 per cent of the female respondents have shopped less than 15 times in a period of last one year, whereas Number of males (12.84 per cent) had shopped online more than 15 times as compared to their female counterparts (7.09 per cent) last year. The z values revealed no significant differences between male and female online buyers except for buying products online for more than 15 times. Number of males had shopped more than 15 times in a period of last one year than their female counterparts.

The chi-square test revealed that there is no significant association between the gender and the frequency of online buying. The values of $\chi^2$are 5.96 (p-value .113) which come out be to be non-significant for the frequency of online buying. Thus no significant association had been seen in this study between the gender and frequency of online buying. This means that it is important to see the difference between male and female online shoppers as their shopping behaviour differs in respect of a number of times they shop online.

Table 2 depicts the gender wise distribution of the respondents with regard to the amount spent by them on online buying in a period of last one year. The table shows a significant gender difference in amount spent on online buying. A number of females (27.30 per cent) had spent less than 5000 ~~Rupees~~ as compared to 22.02 per cent of male counterparts. In the category of 5000-10000 ~~rupees~~, a number of females 53.90 per cent has spent on buying things online than the males. 43.12 per cent. Even the larger percentage of males (16.06 per cent) had made a non line purchase to the tune of 10000-20000~~Rupees~~as compared to females (12.77 per cent). As more number of male respondents 18.81 per cent have reported spending more than 20000 ~~Rupees~~ for buying goods online in last one year time period as compared to 6.03 per cent of female respondents.

Z-test was applied to find the gender difference between male and female regarding the amount spent on online buying. It signifies that male had spent higher amounts for buying goods online in last one year. The significant difference had been found between the male

Table 1. Gender-wise distribution of the respondents as per frequency of online buying

No. of Times	Male (n_1=218)		Female (n_2=282)		Z-value	Total (N=500)	
	Frequency	Per cent	Frequency	Per cent		Frequency	Per cent
3-5 times	69	31.65	87	30.85	0.19^{NS}	156	31.20
6-10 times	79	36.24	123	43.62	1.67	202	40.40
11-15 times	42	19.27	52	18.44	0.23	94	18.80
<15 times	28	12.84	20	7.09	2.16**	48	9.60
			χ^2 = 5.96 (p value .113)		d.f. =3		

***Significant at 5 per cent level.*

Table 2. Gender wise distribution of the respondents as per the amount spent on online buying

Amount spent (₹/annum)	Male (n_1=218)		Female (n_2=282)		Z-value	Total (N=500)	
	No.	Per cent	No.	Per cent		No.	Per cent
<5000	48	22.02	77	27.30	1.35^{NS}	125	25.00
5001-10000	94	43.12	152	53.90	2.39**	246	49.20
10001-20000	35	16.06	36	12.77	1.04^{NS}	71	14.20
>20000	41	18.81	17	6.03	4.42**	58	11.60
			χ^2 = 22.53** (p value .000)		df = 3		

***Significant at 5per cent level.*
NS: Non-significant.

and female buyers for the amount of ₹5000-₹10000 also for more than ₹20000. As a higher percentage of female had significantly spent more for ₹5000-₹10000 whereas more male had spent more than ₹20000 for buying products online. The chi-square test revealed the significant association between the gender and the amount of money spent on online buying. Thus, the gender and amount spent on online buying are associated. Gender plays a significant role on the amount of money spent for buying goods online. As male respondents spent a higher amount of online buying than the female respondents. The results of this data made it clear that the males were found to spend significantly with the greater amount as compared to their female counterparts.

Table 3 presents the difference between the mean scores of males and female respondents. The significant gender differences were found in case of frequency of online shopping for self and spouse. The mean value (3.84) is significantly (t = 2.05) higher in case female respondents than that of male online shoppers the mean value (3.64) when they were buying for themselves. It revealed that females buy more frequently for themselves (self) than their male counterparts. On the contrary, male online shoppers buy significantly more for their spouse (t= 2.18) higher mean value (1.81) than the female online shoppers (mean =1.58). No significant differences were found between the male and female online shoppers while shopping for their children, other family members, and friends.

It signifies that male online shoppers more frequently buy for their spouse than for self and female spend more for themselves than their spouses.

Table 4 shows significant gender differences in buying different categories of products online. The significant gender differences were found in case of shopping for electronic items online. The mean value (2.94) is significantly (t = 7.84) higher in case male respondents than the mean value (2.02) of female online shoppers while buying online electronic items. The gender difference is found to be significant in case of Apparel (t = 2.89), where female respondents buy the apparel more frequently (3.29) than male respondents (2.97). The difference is found to be significant in buying jewellery and accessories online by males and females. The mean

Table 3. Gender differences in frequency of online shopping for various persons

Person	Male (n_1=218)	Female (n_2=282)	Total (N=500)	t-value
	Mean score (SD)	Mean score (SD)	Mean score (SD)	
Self	3.64 (1.21)	3.84 (1.04)	3.74 (1.13)	2.05** (0.04)
Spouse	1.81 (1.29)	1.58 (1.09)	1.70 (1.19)	2.18** (0.03)
Children	1.69 (1.60)	1.52 (1.07)	1.61 (1.34)	1.67^{NS} (0.09)
Other family members	2.69 (1.17)	2.71 (1.18)	2.81 (1.18)	0.16^{NS} (0.87)
Friends	2.30 (1.18)	2.24 (1.16)	2.27 (1.17)	0.55^{NS} (0.58)

***Significant at 5 per cent level.*
NS: Non-significant.
Figures in parentheses are-values.

Table 4. Gender difference in frequency of online shopping of various products

Products	Male (n_1=218)		Female (n_2=282)		Total (N=500)		t-value
	Mean	SD	Mean	SD	Mean	SD	
Electronics	2.94	1.39	2.02	1.23	2.68	1.34	7.84**
Apparel	2.97	1.23	3.29	1.21	3.33	1.20	2.89**
Grocery	2.00	1.13	1.96	1.15	2.15	1.21	0.30^{NS}
Toys & games	2.06	1.18	2.07	1.21	2.30	1.28	0.18^{NS}
Health care products	2.12	1.27	2.13	1.19	2.35	1.31	0.09^{NS}
Jewellery & accessories	1.95	1.16	2.63	1.29	2.44	1.28	6.12**
Home products	2.61	1.24	2.66	1.20	2.86	1.23	0.42^{NS}
Books & stationery	2.75	1.37	2.76	1.30	2.94	1.33	0.06^{NS}
Gifts & flowers	2.22	1.34	2.27	1.33	2.35	1.41	0.45^{NS}

***Significant at 5per cent level.*
NS: Non-significant.

value (2.63) in the case of female buying jewellery online is higher than mean value (1.95) of male respondents; it shows that female buy more jewellery online than male. No significant differences are found amongst the other product categories like grocery, toys and games, healthcare products, home products, books and stationery, gift flowers, etc.

The most frequently shopped product by the male respondents is apparel with highest (mean value 2.97). On the other hand female also frequently bought Apparel with highest (mean value 3.29) amongst all the products. The other frequently bought products by male are electronics (mean = 2.94), Books and stationery items (mean = 2.75), home products (mean = 2.61) etc.; while females more frequently bought Books and stationery items (mean = 2.76), home products (mean=2.66), jewellery and accessories (mean = 2.63), gifts and flowers (mean = 2.27), etc. The less frequently products shopped by amale are toys and games (mean = 2.06), groceries (mean = 2.00) and jewellery and accessories (mean = 1.95), while female less frequently bought electronics (mean 2.02) and groceries (mean = 1.96), etc.

CONCLUSIONS

Gender is an important consumer demographic in finding online shopping behaviour. Both male and female show different attitude while shopping online. The paper focused on finding whether any gender difference lies in online buying behaviour of consumers in Punjab**.** The review of the literature is presented that gives an insight and direction to understand what all is included in online buying behaviour and to specifically understand the differences between buying behaviour of men and women. The genderdifferenceis found in case of frequency of buying as males had significantly bought products more than 20 times than female in a period of last one year. Secondly, significant gender differences are found in case of the amount spent on online buying as male respondents had spent more than female. The gender and frequency of online buying were not found to be associated with each other. The results show that males do more shopping online than females. Gender tends to play a significant role in theamount of money spent for buying goods online, as male respondents spend a higher amount on online buying than the female respondents. While shopping online, men buy products with bigger amounts while it was found that women generally buy more products ranging between ₹5000- ₹10000.

The analysis for gender difference with regard to frequency of online shopping for various persons like self, spouse, children, other family members and friends by the respondents was studied. It was found that females buy more for themselves (self) than their male counterparts. While no significant differencewas found between the male and female online shoppers while shopping for their children, other family members, and friends. From this, it can be drawn that women mostly buy products online for themselves and males buy for their spouses. While conducting analysis for the gender difference in online shopping of various items, significant gender differences were found in case of shopping for few items like electronic products, apparels, and jewellery. On the other hand, no significant differences were found amongst the other product categories like grocery, toys and games, health care products, home products, books and stationery and gift flowers etc. This research paper has thrown light on the role of gender in online shopping, but other demographics such as age, generation, marital status, internet usage etc. may also be studied to understand their role while buying a product online.

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Forecasting of Area and Production of Cotton in India and Karnataka Using ARIMA Model

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ABSTRACT

Cotton is most important commercial crop in India and since 2015-16 India stands first in both area and production of cotton in the world. The study focuses on the forecasting of the area and production of cotton in India and Karnataka using auto regressive integrated moving average (ARIMA) model. The time series data on area and production of cotton in India and Karnataka for the period of 60 years from 1955-56 to 2015-16 was analysed. The study revealed that ARIMA (0,1,0) and ARIMA (1,1,1) are the best fitted models for forecasting area and production of cotton in India respectively and ARIMA (0,1,0) is the best fitted model for forecasting both area and production of cotton in Karnataka. Based on selected models the forecasts for 2016-17 to 2019-20 are calculated. The analysis shows that if the present trend continues, the cotton area and production in India in the year 2019-20 will be 122.91 lakh hectares and 316.65 lakh bales(170 kg each) and it will be 8.52 lakh hectares and 24.81 lakh bales (170 kg each) respectively in Karnataka.

Keywords
Area, ARIMA model, Box and Jenkins, forecasting, production of cotton.

JEL Codes
C18, C53, C81, C87.

INTRODUCTION

Cotton is the most important fibre crop in the world and also one of the most important commercial crops in India. Since 2015-16 India stands first in both area and production in the world. During 2014-15 area under cotton was varying between 110-121 lakh ha with a production of 34.81 million bales. India has constituted around 25 per cent of the total area in the world. Out of this 65 per cent is rainfed and remaining 35 per cent is irrigated area. Thus cotton is important rainfed crop in India. During 2015-16 crop year the cotton production of India declined to 30.80 million bales which is the lowest during the last five years. This drastic reduction was due to the sucking pest and white fly attack especially in the northern region. The country is expected to produce about 35.15 million bales during 2016-17 on account of the better weather conditions across all cotton growing regions of the country (Government of India, 2016).

Cotton is grown in nine major states in different zones of the country. Punjab, Haryana and Rajasthan in north zone, Maharashtra, Gujarat and Madhya Pradesh in central zone and Andhra Pradesh, Karnataka and Tamil Nadu in the south zone are the major cotton growing states in India. Gujarat, Maharashtra, Andhra Pradesh and Madhya Pradesh are the four main states which contribute 80 per cent of the total production in the country. Karnataka contributes 5.63 per cent of the total area and 4.21 per cent of the total production in the country. Most of the cotton production comes from north Karnataka plateau. Of these Belgaum, Bellary, Dharwad and Raichur are the major cotton growing districts, contributing more than 60 per cent of the state's cotton production. The decadal data revealed that the area under cotton for a state showing a declining trend over the years. It was 11.16 lakh hectares in 1980's declining to 6.97 lakh hectares in 1990's then 5.46 and 4.57 lakh hectares in 2000's and 2010's respectively. The higher variation in cotton area over the years was mainly due to price fluctuations, competitions for area from other high valued crops like sugarcane and paddy and severe incidence of the pest and diseases. However the production of cotton in the state showed the increasing trend.

Crop area estimation, forecasting of production and crop yield are an essential procedure in supporting policy decision regarding land use allocation, food security and environmental issues. Statistical techniques able to provide crop forecast with reasonable precessions well in advance (Payyaomozhi & Kachi, 2017). Various approaches have been used for forecasting such agricultural systems. Several studies have been carried out on the univariate time series models known as Auto regressive integrated moving average (ARIMA) models. The popularity of ARIMA model is due to its statistical properties as well as known Box and Jenkins methodology. An empirical study was conducted by Muhammed *et al.* (1992); on modelling and forecasting of rice production in Pakistan using ARIMA model. Similar studies have been done by Mishra *et al.* (2015); Iqbal *et al.* (2005) for forecasting wheat area and production in India and Pakistan, respectively. Rahman (2010) for forecasting boro rice production in Bangladesh, Debnath *et al.* (2013) have conducted a study for forecasting area, production and yield of cotton in India to reveal the growth pattern and to make the best forecast of cotton area, production and yield in India by using ARIMA model for the year 2016-2020. Rajan & Palanivel (2014), Borkar *&* Tayade (2016) and Payyamozhi & Kachi (2017) have conducted the studies for forecasting cotton production in India using ARIMA model. Similarly, Vishawajith *et al.* (2016) conducted a study on forecasting sugarcane production in India.

The objective of this study was to develop appropriate ARIMA models for the time series data on cotton area and production in India and Karnataka state to predict expected area and production of the crops for the future years. This study helps to the policy makers to get an idea about the future requirements, enabling to take appropriate measures like selection of high yielding varieties, conducting trainings to farmers to improve cultural practices, adequate supply of inputs and use of latest technologies. Import and export of these crops can also be planned.

MATERIAL AND METHODS

The data on cotton area and production of India and Karnataka was collected for 60 years from 1955-56 to 2015-16 from www.indiastat.com (Statistical database). By using SAS 9.3 and SPSS software the data was analyzed to fit the best model using auto regressive integrated moving average (ARIMA). The selected best models were used to forecast the area and production of cotton crop up to 2019-20.

Description of ARIMA Model

In general, an ARIMA model is characterized by the notation ARIMA (p, d, q) where, p, d and q denote orders of auto-regression, integration (differencing) and moving average respectively. A first order auto-regressive process is denoted by ARIMA (1,0,0) or simply AR(1) and is given by, $y_t = \mu + \Delta_1 y_{t-1} + \varepsilon_t$ and a first order moving average process is denoted by ARIMA (0,0,1) or simply MA(1) and is given *by* $y_t = \mu - \theta_1 \varepsilon_{t-1} + \varepsilon_t$. Alternatively, the model ultimately derived, may be a mixture of these processes and of higher orders as well. Thus a stationary ARMA (p, q) process is defined by the equation: $y_t = \Delta_1 y_{t-1} + \Delta_2 y_{t-2} + \ldots + \Delta_p y_{t-p} - \theta_1 \varepsilon_{t-1} - \theta_2 \varepsilon_{t-2} - \ldots - \theta q\, \varepsilon_{t-q} + \varepsilon_t$ where ε_t's are independently and normally distributed with zero mean

Table 1. Diagnostic tools and model selection criteria for area and production of cotton in India

Model	AIC	SBC	Normalized BIC	RMSE	MAE	MAPE	R^2
Area (lakh ha)							
ARIMA (1,1,1)	997.39	1003.91	12.66	509.29	389.65	4.72	0.871
ARIMA (0,1,1)	997.09	1001.44	12.60	510.98	397.29	4.80	0.868
ARIMA (1,1,0)	997.15	1001.50	12.60	510.79	397.68	4.80	0.868
ARIMA (0,1,0)	995.30	997.47	12.52	507.54	397.56	4.63	0.868
ARIMA (0,1,2)	996.38	1002.91	12.64	494.23	379.63	4.60	0.874
ARIMA (2,1,0)	997.32	1003.84	12.65	501.94	381.19	4.62	0.872
ARIMA (1,1,2)	996.94	1006.64	12.69	507.89	375.65	4.56	0.877
ARIMA (2,1,1)	995.07	1003.76	12.66	503.64	366.14	4.45	0.881
Production(lakh bales)							
ARIMA (1,1,1)	1171.48	1176.01	15.51	1.914E3	1.385E3	14.10	0.954
ARIMA (0,1,1)	1175.51	1179.86	15.35	2.014E3	1.399E3	13.76	0.949
ARIMA (1,1,0)	1175.89	1180.23	15.35	2.020E3	1.395E3	13.57	0.948
ARIMA (0,1,0)	1174.29	1176.39	15.28	2.009E3	1.388E3	13.38	0.948
ARIMA (0,1,2)	1173.72	1180.24	15.37	1.972E3	1.403E3	14.24	0.952
ARIMA (2,1,0)	1174.70	1181.22	15.38	1.987E3	1.359E3	13.80	0.951
ARIMA (1,1,2)	1173.06	1181.76	15.38	1.924E3	1.384E3	13.99	0.955
ARIMA (2,1,1)	1173.15	1181.85	15.43	1.969E3	1.396E3	14.11	0.952

AIC- Akaike information Criterion, Normalized BIC, SBC- Schwartz's Bayesian Criterion, RMSE- Root Mean Square Error MAE- Minimum Absolute Error, MAPE- Minimum Absolute Percentage Error, R^2 – Coefficient of Determination.

and constant variance σ^2 for t = 1,2,...n. This equation entails several important special cases of ARIMA family of models. If q=0 the model is autoregressive model of order p and p=0 the model reduces to moving average of order q. One central task of the ARIMA model building is to determine the appropriate model order (p,q).

The basic stages involved in developing an ARIMA model are Identification stages, Estimation stages, Diagnostic stages and Forecasting stage. Appropriate values for the p, d, and q in ARIMA modelling can be partially resolved by looking at the Auto Correlation Function (ACF) and Partial Auto Correlation Functions (PACF) for the 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. Determine whether the series is stationary or not by considering the graph of ACF. If a graph of ACF of the time series values either cuts off fairly quickly or dies down fairly quickly, then the time series values should be considered stationary. If a graph of ACF dies down extremely slowly, then the time series values should be considered non-stationary. The second step is to estimate the parameters of the model.

Here, the method of maximum likelihood is used for this purpose. The third step is to check whether the chosen model fits the data reasonably well. For this reason the residuals are examined for white noise. To test the white noise of the residuals, the ACF and PACF of residuals and the Ljung and Box (1978) statistic are used. In case of two or more competing models passing the diagnostic checks the best fitted model is selected using the following criteria Akaike Information Criterion (AIC), Schwart'z Bayesian Criterion (SBC), Normalized BIC, maximum R^2, Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE). By using the results of ARIMA (p, d, q), forecasts from the year 2016-17 to 2019-20 are made.

RESULTS AND DISCUSSION

The ARIMA model was applied according to four steps namely model specification, model estimation, diagnostic checking and forecast. Fifty-five years data of cotton area and production was used for modelling purpose and last five years data was used for model validation purpose. The model specification involved the plots of the Auto Correlation Function (ACF), Partial Auto Correlation Function (PACF) and the plot of the differenced series. The autocorrelation functions of 1st differenced time series shows stationarity for cotton area and production, as the autocorrelation declines faster than the auto correlation of un-differenced series. Now it is clear that ACFs of all the 1st differenced series decline rapidly.

Model Identification and Diagnostic Checking

Observing the nature of ACF and PACF plots of the series and their theoretical properties, the order of auto-regression and moving average is selected by estimating the tentative ARIMA models at different p, d, q values for cotton area and production series using SAS 9.3. The best models are selected by comparing Akaike Information Criterion (AIC), Schwartz's Bayesian Criterion (SBC), Normalized BIC; minimum values of Root Mean Squared Error (RMSE), Mean absolute error (MAE) and Mean Absolute Percentage Error (MAPE) and maximum values of R^2.From the Table 1 & 2, it is

Table 2. Diagnostic tools and model selection criteria for area and production of cotton in Karnataka

Model	AIC	SBC	Normalized BIC	RMSE	MAE	MAPE	R^2
Area (lakh ha)							
ARIMA (1,1,1)	711.55	717.79	9.38	98.14	72.77	11.32	0.86
ARIMA (0,1,1)	710.33	714.49	9.31	97.92	73.75	11.52	0.86
ARIMA (1,1,0)	710.34	714.50	9.31	97.93	73.80	11.52	0.86
ARIMA (0,1,0)	708.35	710.43	9.23	97.09	73.83	11.53	0.86
ARIMA (0,1,2)	708.73	714.96	9.33	95.82	70.46	10.89	0.87
ARIMA (2,1,0)	709.55	717.86	9.31	94.90	70.13	10.83	0.87
ARIMA (1,1,2)	710.71	719.03	9.42	96.97	70.44	10.89	0.87
ARIMA (2,1,1)	710.93	719.46	9.40	95.73	70.21	10.84	0.87
Production (lakh bales)							
ARIMA (1,1,1)	791.86	798.10	10.75	194.32	132.08	21.80	0.72
ARIMA (0,1,1)	790.17	794.33	10.66	192.64	131.96	21.79	0.72
ARIMA (1,1,0)	790.27	794.43	10.66	192.80	131.99	21.76	0.72
ARIMA (0,1,0)	788.88	790.96	10.59	192.12	134.17	21.80	0.72
ARIMA (0,1,2)	792.07	798.30	10.74	194.18	132.65	22.03	0.72
ARIMA (2,1,0)	791.72	797.87	10.74	193.48	133.20	21.86	0.72
ARIMA (1,1,2)	793.72	802.03	10.83	195.36	133.53	21.03	0.72
ARIMA (2,1,1)	793.45	802.09	10.84	194.65	133.47	21.84	0.72

AIC- Akaike information Criterion, Normalized BIC, SBC- Schwartz's Bayesian Criterion, RMSE- Root Mean Square Error MAE- Minimum Absolute Error, MAPE- Minimum Absolute Percentage Error, R^2 – Coefficient of Determination.

revealed that ARIMA (0, 1, 0) and ARIMA(1, 1, 1) are the best models for cotton area and production in India and ARIMA (0,1, 0) is the best model for both cotton area and production in Karnataka. The selected models are used for forecasting of cotton area and production in India and Karnataka.

Model Estimation

At the identification stage one or more models are tentatively chosen that seem to provide statistically adequate representation of the available data. Then attempts are made to obtain the precise estimate of parameters of the best fitted model by least squares as advocated by Box and Jenkins by using standard computer packages SPSS 16 and SAS 9.3 which are presented in the Table 3. After analyzing the best fitted ARIMA model, the model residual plots of ACF and PACF are depicted in Figure 1 & 2, it is clear that all the autocorrelation and partial autocorrelation lie between 95 percent confidence limit. This confirmed the goodness of fit of the selected model. This implies that the selected model *i.e.* ARIMA (0, 1, 0) and ARIMA (1, 1, 1) are the best fitted models for forecasting of cotton area and production in India respectively and ARIMA (0, 1, 0) is the best fitted model for forecasting of cotton area and production in Karnataka respectively.

Forecast of area and production of cotton in India and Karnataka

Four year forecasts of cotton area and production are estimated using the best selected model and presented in Table 4.

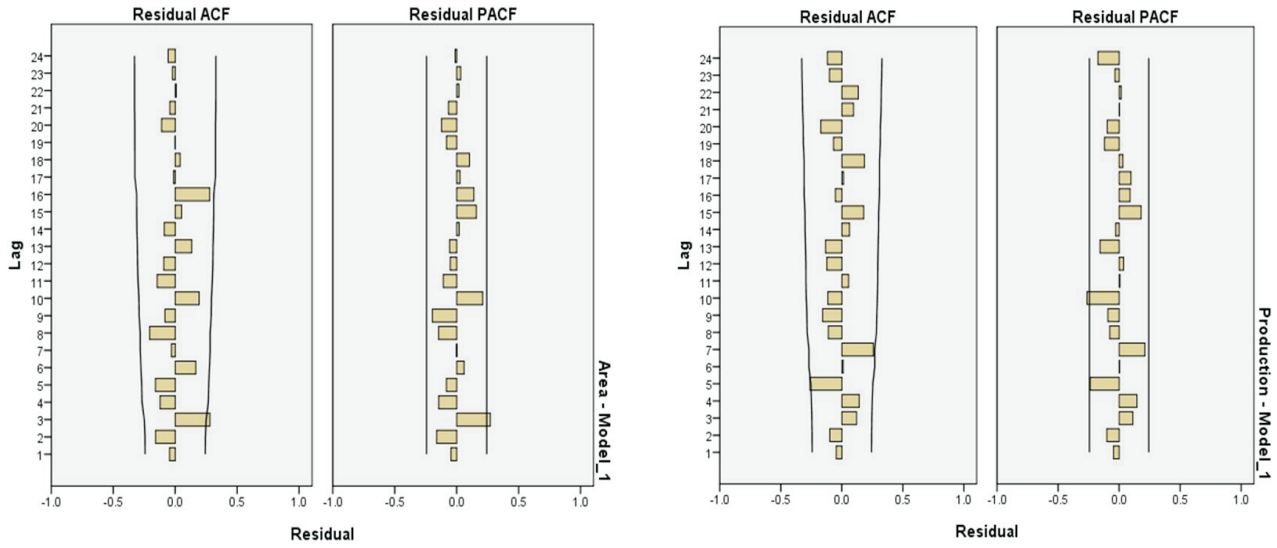

Figure 1. ACF and PACF of residuals of fitted model for cotton area and production in India

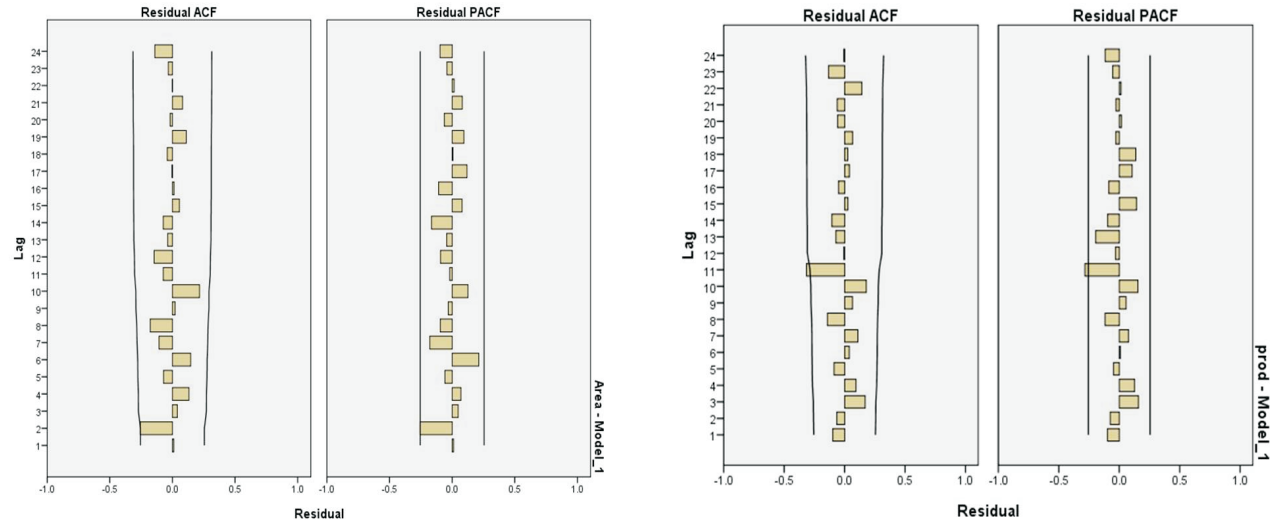

Figure 2. ACF and PACF of residuals of fitted model for cotton area and production in Karnataka

Table 3. Estimation of parameters of best model for cotton area and production in India and Karnataka

	Model	Type	Coefficients	Standard error	t-value
India			**Area**		
	ARIMA (0,1,0)	Constant	92.88	62.95	1.48
			Production		
	ARIMA (1,1,1)	MA1	-0.956	0.053	-18.06
		AR1	-0.726	0.119	-6.10
Karnataka			**Area**		
	ARIMA (0,1,0)	Constant	-4.69	12.64	-0.37
			Production		
	ARIMA (0,1,0)	Constant	37.068	25.01	1.36

Table 4. Forecast of cotton area and production in India and Karnataka for the period 2016-17 to 2019-20

Year	Area (lakh ha)			Production (lakh bales)		
	Forecast	Lower limit	Upper limit	Forecast	Lower limit	Upper limit
India						
2016-17	12012	11017	13007	29905	26104	33706
2017-18	12105	10698	13512	30654	24630	36676
2018-19	12198	10475	13921	30785	23533	38038
2019-20	12291	10301	14280	31665	22830	39899
Karnataka						
2016-17	866	592	1140	2379	1835	2923
2017-18	861	524	1199	2413	1747	3079
2018-19	856	468	1245	2447	1678	3216
2019-20	852	417	1286	2481	1621	3341

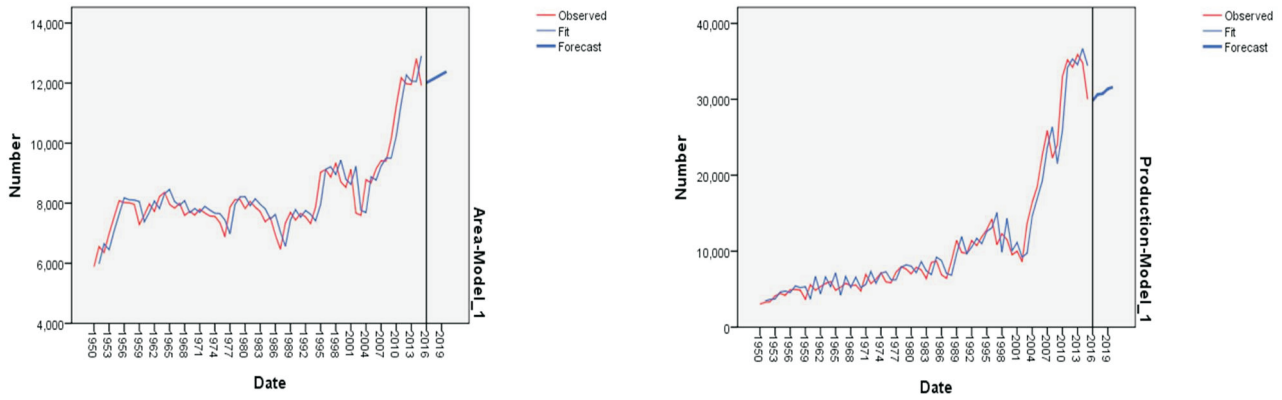

Figure 3. Forecast of area and production of cotton in India

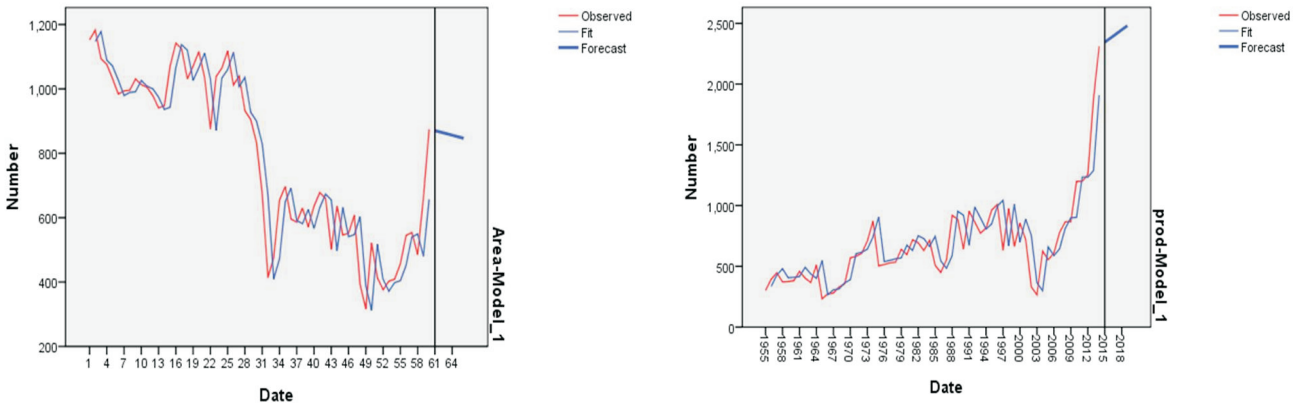

Figure 4. Forecast of area and production of cotton in Karnataka

CONCLUSIONS

Cotton production in India has a major success story in recent years in the global cotton production. In recent decade area, production and productivity of cotton have shown tremendous growth in India. The results of present study on forecasting area and production of cotton in India and Karnataka indicated an increasing trend of area and production of cotton in India in future. The area under cotton in India during 2019-20 is expected to be 122.91 lakh hectares and the production of cotton is expected to be around 316.65 lakh bales (170 kg each), which is less than the present production. Special attention such as high density planting of cotton and cultivation of high yielding varieties is required to boost the production of cotton in India. Whereas with respect to Karnataka the area under cotton showed a declining trend, at the same time the production of cotton showed an increasing trend. It can be said that area under cotton followed declining trend but the increase in productivity accounts for an increase in total production. The cotton area and production in Karnataka during 2019-20 is expected to be 8.52 lakh hectares and 24.81 lakh bales, respectively. The decline in area under cotton is mainly due to replacement of area by other crops like pigeon pea, groundnut and chilli. The success in efforts to increase productivity and production without any addition to area under cotton can be made possible only by large scale cultivation of high yielding varieties. In addition, high density plantation and the mechanized harvesting of cotton will enhance yields of Indian cotton farms and thereby the total cotton production in India.

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Contractual Pisciculture in South West Punjab: Prospects and Constraints

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ABSTRACT

The employment of the farm labour forced out by changing scenario of agriculture is the prior need of the agriculture sector in the state. Fish farming being an allied occupation can provide part-time as well as full-time employment to the unemployed youth, farmers, fishermen and landless agricultural labourers. The present study was therefore exclusively designed in South West Punjab being bitter water zone with the objectives to know the economics, marketing status and problem of contractual fish farming in village ponds. The weighted average value worth ₹20088 per acre was taken as the mean contract value of an acre pond in the present investigation. On an average, the total cost of rearing fish in the local ponds came out to be ₹44639 per acre if sold from the pond site and ₹52430 per acre for approaching Ludhiana market. With the average productivity of 10.25 quintal fish per acre, the net returns were ₹47611 and ₹96195 per acre if sold locally as well as in the Ludhiana market, respectively. The fish rearing invillage ponds having regular water availability, access to animals and water drainage facility can offer better family income coupled with employment opportunity for the rural youth.

Keywords
Contract, distant market, employment generation, pisciculture.

JEL Codes
O49, Q12, Q13, Q22, Q26, Q57.

INTRODUCTION

During the last four decades ending 1980's the cropping pattern in Punjab has witnessed a shift in favour of paddy-wheat rotation due to pro-food grain crop policies of the Centre Government. The transformation of agriculture in the state through an increase in area under irrigation and high-yielding varieties, application of fertilizers along with effective price policy, particularly for wheat and rice crops, was accompanied by an increase in employment in agriculture up to the early eighties. The simultaneous and massive use of labour-saving techniques like mechanisation of farm operations, slowdown in productivity of two major crops wheat and rice since mid-1980's and non-viability of small and marginal holdings gradually overpowered the growth in agricultural employment (Oberai & Ahmed, 1981). Consequently, the demand for human labour in the crop sector had decreased significantly since the late 1980s in the state (Sidhu & Grewal, 1991). Further, the share of agriculture in the states' gross domestic product has declined. The significance of agriculture for absorbing labour force has decreased rather casualisation of agricultural labour has emerged as a new trend. The employment of the farm labour forced out by changing scenario of agriculture is the prior need of the agriculture sector. The integrated approach in agriculture taking other allied occupations along side creates the employment opportunities in the farming sector. Singh *et al*., 1997 also favoured the integrated approach in agriculture for the employment of hired as well as family labour. The fishery is an important agriculture allied occupation that can offer an additional employment opportunity.

Fish is one of the favourite items in the food menu of more than 60 per cent Indians. The domestic demand for fish by 2015 has been projected at 6.7-7.7 million tonnes (Kumar *et al*., 2005). So market demand is always high for fish items. If we add the global demand the gross total fish requirement becomes very high. The main source of fish is from the sea but the global fish harvesting from the sea is decreasing rapidly. The only way that can ensure the availability of fish to meet its increasing demand is through fish farming. We have a large number of natural

ponds here that can be converted to avail this small-scale enterprise opportunity. Aquaculture in the state of Punjab is a fast developing income generating activity, providing a quality and low-cost protein diet to the people (Agarwal, 1999). Being traditionally an agricultural state, Punjab was reluctant at first to evolve into fish farming. The state has huge water base as four major rivers, several rivulets, reservoirs and lakes support a vast irrigation system and water is also extracted from a rich groundwater resource (Dhawan, 2006). However from 1980's onward, facilitated by access to the states' abundant water resources, aquaculture production in the state expanded.

Aquaculture/Pisciculture/Fish farming being an agriculture allied occupation can provide part-time as well as full-time employment to the unemployed youth, farmers, fishermen and landless agricultural labourers. Fish farming is done on agriculture land, low-lying areas and in village ponds. Apart from this comparatively poor soil such as waterlogged, salt-affected, alkaline, etc. which are unfit for agriculture can also be used for fish farming. Besides, a good source of income, it also generates self-employment opportunity. Various studies have shown that well-organised and integrated farming system with crops and other labour-intensive enterprises like dairy, poultry, fishery, vegetable, fruits, mushrooms, etc. can augment the income and employment of farm families particularly small and marginal farmers having surplus family labour (Pasha, 1991; Saleth, 1997; Singh & Sharma, 1988; Alam *et al.,* 2001; Bhalla, 2004; Toor & Bhalla, 2006; Gill & Toor, 2007).

Though Punjab Government has formulated many incentive programmes to promote fish culture in the state usually marginal and small farmers do not have surplus funds to invest for reclamation and renovation of existing watersheds as well as the construction of new ponds. Initial expenditure for fish culture over fish toxicant, fish seed, and supplementary feed is itself a considerably big amount to be exclusively borne by marginal and small farmers themselves without any credit support. Hence the only opportunity left in this profession with the unemployed rural youth is the contractual fish farming in village ponds. The ownership of these ponds vested with the village panchayats. Most of the panchayats lease out their village ponds for fish farming. These village ponds are generally visited by village animals for drinking water. The animals answer their dung and urine in the ponds. The organic wastes released by these animals are recycled into manure and help in the production of plankton which is basic food for fish. However, there is no study available exclusively on the contractual fish farming in Punjab. Moreover, the brackish underground water available in most parts of South West Punjab has the great potential to accommodate fish farming. The present study was therefore exclusively designed in South West Punjab with the objectives to know the economics, marketing status and problem of contractual fish farming in the bitter water zone of Punjab.

OBJECTIVES

1 The cost structure and returns from contractual fish farming in South West Punjab,
2 The marketing status of pond fishes in the local as well as distant market, and
3 The problems faced by the farmers in contractual fish farming in South West Punjab

METHODOLOGY

The present study was conducted in Bathinda being the central district of South West Punjab having sufficient amount of brackish underground water which is otherwise unfit for agriculture. The list of fish farmers/ fish contractors in the district was prepared after taking the information from Department of Fisheries. Generally, the village panchayats lease out the village ponds on a contractual basis to contractors through an open auction for the period of one year to rear the fishes. If the contract is to continue for more than one year then after every year the contract rates are increased at the rate of 10 percent of the original amount of the contract. Mostly the canal water which is reserved for the pond is used for filling the water in the village pond. From the sampled population, total 10 pond fish farms that were regularly rearing fishes were included purposively for the present study. A well-structured and pre-tested schedule was used for the collection of data. The selected farmers were personally interviewed to collect the data on various components. The collected data were calculated and analyzed on per acre basis. Tabulation and simple statistical tools were used for interpreting the results.

RESULTS AND DISCUSSION

Farmers profile

As it is clear from Table 1 that only 3 of the 10 sampled farmers have 2 to 5 acres of cultivable land while rest of them were landless. Two of the fish farmers had adopted the fish farming as their main occupation while others were doing this job as a part-time enterprise.

Majority of the respondents were primary to higher secondary pass whereas one of them was a graduate. None of them acquired any training prior to starting the fish farming. All the sampled farmers were not new in this enterprise but had the experience of 3 to 13 years in fish farming.

Contractual behaviour of water ponds

The contract value of the fish pond is decided by the selected village panchayat every year. It has been observed that there is a wide range of contract value of fish pond depending on the size of the pond, type of soil, availability of canal water, drainage of excess water, the location of the pond, distance from market etc. It ranged from ₹15,000 to 1,35,000.

The weighted average value worth ₹20088 per acre was taken as the mean contract value of an acre pond in the present investigation (Table 2). This contract includes the free canal water supply to the fish pond as per the official canal command area time reserved for that.

Seed cost

Generally, 25,000 fish seedlings are recommended for rearing in an acre fish pond. The fish culture takes place through out the year. The fish growth is slow during winter in the months of December and January due to low temperature. The species produced by the sample farmers consists of Indian major carps: Catla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus cirrhosus*) and exotic carps like Golden carp, Silver carp and Grass carp. The price of seedlings varies with the fish breed as well as the size grade selected for production. The purchase price ranged from ₹90 to ₹110 per 1000 fish seedlings for various breeds. For Rohu and Catla breeds it was ₹100 and ₹90 per 1000 'A' grade seedlings, respectively and for Golden Carps and Mrigal breeds,the price was ₹95 and ₹110 per 1000 seedlings, respectively. Further for 'B' grade, the cost price was ₹140 per 1000 seedlings for all the breeds. The overall average price per 1000 seedlings came out to be ₹98.75. To avail the maximum productivity in a specified time period, the fish farmers mostly grow the higher number of seedlings per unit area. Against the recommended number of 25000, the average number of seedlings in the sample came out to be 45000 per acre pond. The average seedling cost, thus,was taken as ₹4443.75 per acre (Table 3).

Other costs

The other costs including feed cost, labour cost, irrigation cost and interest on the working capital were discussed in Table 4. Apart from this the extra cost incurred to avail the higher price in the distant market was also discussed in this table. Finally, all the costs were added to calculate the total cost of rearing fish in an acre pond. However, the average yield of the fish produced in the sample ponds was compiled to work out the cost of production of fish in the village pond. The detailed costs were:

Feed cost

Farmers fed the fish with supplementary feed like pellet feed or with farmers' homemade feed mixtures where there were fewer visits of the village animals at the fish pond. Rice bran along with mustard oil cake was commonly used as a fish feed by the sampled farmers. The large majority of farmers applied feed by broadcasting. Fish were generally fed once a day. However irregular feeding was also reported by some of the farmers under the traditional practice. The objective of feeding was to provide the nutritional requirements for good health, optimum growth, optimum yield and minimum waste within reasonable cost so as to optimize profits. Feed is the major component in fish rearing where the tube-well water is used. The cost of feed varied with the quantity of seed fish stocked in the pond. However, the feed cost was assessed on per acre basis for uniform comparison. The readymade feed comprising mustard oil cake, groundnut

Table 2. Contract value of sample fish ponds

Sr. No.	Size of fish pond (m^2)	Contract value (₹)	Average contract value (₹/acre)
1	10,000	45,000	18,000
2	4,000	15,000	15,000
3	12,000	80,000	26,667
4	20,000	1,15,000	23,000
5	8,000	38,000	19,000
6	16,000	90,000	22,500
7	30,000	1,35000	18,000
8	8,000	38,000	19,000
9	12,000	63,000	21,000
10	16,000	64,000	16,000
Mean	**136000**	**683000**	**20088.00**

Table 3. Breed wise cost of fish seedlings used

Breed	Price (₹/1000 seedlings)	No. of seedlings (per acre)	Average cost (₹ per acre pond)
Rohu	100.00	40000	4000.00
Catla	90.00	45000	4050.00
Golden carps	95.00	50000	4750.00
Mrigal	110.00	45000	4950.00
Mean value	**98.75**	**45000**	**4443.75 ®4444.00**

Table 1. Average holding size, education, occupation, years in fish of sampled farmers

Sampled farmers	Household size (Acre)	Education	Year since in farming	Occupation	Training acquired
1	05	5^{th}	2007	Agriculture	No
2	-	10^{th}	2011	Contractor of wheat straw	No
3	-	10^{th}	2004	Vegetable seller	No
4	-	8^{th}	2012	Fish farming	No
5	-	12^{th}	2011	Fish Farming	No
6	-	8^{th}	2013	Labour	No
7	-	Graduate	2009	Job in Refinery	No
8	-	10^{th}	2010	Agriculture	No
9	02	5^{th}	2003	Agriculture	No
10	04	Illiterate	2010	Agriculture	No

oil cake, rice bran etc. were used for pond fish by the respondents. The quantity of feed varied from 160 kg to 200 kg per acre per year over different fish ponds. On an average 180 kg of feed per acre was applied per year by the sampled farmers. Thus, feed cost worth ₹2880 per acre per year was incurred on fish ponds. Further unslaked lime costing ₹700 per acre was also applied around the fish pond to prevent any type of infectious disease to the growing fish.

Labour cost

The labour required for fish seedling distribution, fish feeding, pond water aeration, irrigating water pond, guarding the fish pond etc. has been assessed on the present market rates. On an average 43 man-days were applied for different operations in rearing pond fish. This accounted for ₹12900 per acre per year at the prevailing market rates. Further an additional labour worth ₹2400 per acre was also used for fishing, loading, transportation and the marketing of fish for the distant market of Ludhiana. This is the second major cost after seed in village pond fishing.

Irrigation cost

Though the village ponds were regularly irrigated with the canal water under the canal command area during the annual canal closings, the farmers had to irrigate the fish pond by the hired tubewells. On an average hired tubewells were used for 22 hours to irrigate the fish pond twice in a year costing ₹.1100 per acre.

Interest on working capital

The opportunity cost of the working capital was also assessed to cover all the possible costs in this profession. The prevailing bank rate of interest on the working capital for half of the operational period was taken as the opportunity cost of the capital invested periodically. Up to local market, the capital investment of ₹42112 was charged with the 12 percent rate of interest for half of the period accounting ₹2527. Further to make the output available for the distant market of Ludhiana an additional amount worth ₹7350 were spent on labour and transport. Thus, ₹2968 were charged as the interest on total investment of ₹49462 at the prevailing bank rate.

Total cost of rearing fish

This cost involves all the expenses incurred for the production of fish in an acre pond including the interest on the working capital for half of the productive period. On an average, the total cost of rearing fish in the local ponds came out to be ₹44639 per acre if sold from the pond site. However, this cost increased to ₹52430 per acre when the fish farm product was sold in the distant market of Ludhiana to avail the better price.

Productivity of fish pond

The productivity of fish in the sampled village ponds varied from 8.10 to 12.20 quintal per acre. The overall average productivity was worked out 10.25 quintal per acre pond. The fish producers used both local as well as distant market of Ludhiana for the marketing of produce.

Cost of production

With the average productivity of 10.25 quintal fish per acre from the sampled village ponds, the cost of production of fish when sold locally from the fish pond came out to be ₹4355 per quintal. However, to avail the benefits from higher prices prevailing in the distant market, the cost of production of fish came out to be ₹5115.12 per quintal by incurring additional expenses worth ₹7350 on transportation etc.

Returns from pond fish

The fish produced in the village ponds was sold both from the production site as well as in the distant market of Ludhiana. At the local level, the producer had to only supervise the scene whereas the catching, weighing and

Table 4. Total annual cost structure of fish farming in village ponds

(₹per acre)

Particulars	**Rate (₹per unit)**	**Average cost (₹)**
Contract cost of an acre pond	15000 to 26667	20088.00
Seedling cost (45000 seedlings used)	98.75 per 1000	4444.00
Feed cost (Mustard oil cake + groundnut oil cake + Rice bran) 180 kg	16	2880.00
Un slaked lime-100 kg	7	700.00
Labour cost-43 man days	300	12900.00
Irrigation cost -hiring tubewell for 22 hours	50	1100.00
Interest on working capital of ₹.42112 @ 12 percent for half period	-	2527.00
Total rearing cost (I) if fish sold directly from the local pond (₹per acre)		**44639.00**
Cost of production (₹ per quintal) @ Average yield of 10.25 quintal		**4355.00**
Transportation cost for distant market		
(a) Own vehicle use 90-litre diesel for 2 rounds	55	4950.00
(b) Skilled labour 6 man days	400	2400.00
Interest on working capital of ₹49462 @ 12 percent for half period	-	2968.00
Total rearing cost (II) (if sold in the distant market)		**52430.00**
Cost of production (₹per quintal) @ Average yield of 10.25 quintal		**5115.00**

loading of the fish was carried out by the buyer at his own level. While the producer himself had to catch, load, transport, weigh the produce for selling fish in the distant market. Further, he has to transport the living fish up to the distant market. The average price per quintal of fish received at the local level production site was ₹9000 while that in the distant market was ₹14500. Thus, with the average production of 10.25 quintal fish from an acre pond, the gross returns has been worked out to be ₹92250 when sold in the local market. These returns ultimately increased to ₹148625 when sold in the distant market of Ludhiana (Table 5).

The net returns after deducting the cost of rearing fish in the village pond have been estimated worth ₹.47611 per acre per year if sold at the production site. However, the net returns increased to ₹.96195 per acre per year if sold in the distant market at a better price. On per quintal basis the net returns came out to be ₹4745 in the local market while increased almost double to ₹9385 in the distant market.

Problems of the farmers:

The problems being faced by the fish rearing farmers were also analyzed for its inclusion in policy framework so as to boost this enterprise as a new employment opportunity in rural Punjab. Some of the problems highlighted by the fishing farmers are as:

- The electricity bill is charged at the rate of industry unit. Flat rate of electricity bill should be charged from fish growers.
- The fishes are often stolen during the night hours. Further sometime rivalry grouse cause loss to the fish farms. FIR's are not often written by the police. Thus, fish farm insurance must be mandatory. Insurance companies are not coming forward voluntarily for this cause.
- Poly-Aquatic Clinics at government fish seed farms and District Health Care Center at district level should be strengthened by the Punjab Government to aware the farmers of technical know-how.
- Due to the perishable nature of fish and fear of exploitation by the wholesaler's majority of the fish farmers sold their fish at the production site. Here the middlemen invariably pay lower prices to the farmers. Market-oriented information must be disseminated through extension programmes to avoid such exploitation.

Table 5. Returns from fish farming in village ponds

(₹/acre/year)

Particulars	Price (₹per quintal)	Amount (₹)
Gross returns		
I) At local market	9000.00	92250.00
II) At distant market	14500.00	148625.00
Net returns		
I) Local market=Gross returns (I) – Total cost (I)		47611.00
II) Distant market=Gross returns(II)–Total cost (II)		96195.00
Net returns per quintal		
I) At local market		4645.00
II) At distant market		9385.00

SUMMARY

With the continuous increase in the number of farming families in the state, their average size of holding is decreasing. Over the last one and half decade, the number of farming families has increased from 997672 to 1052554. Further, the percentage share of marginal and small farmers among the total farming families in the state has increased from 29.66 to 34.19 percent. About 64000 farming families have been transferred to these categories during the above said period (Government of Punjab, 2014). Further, the almost cent percent mechanization in paddy-wheat crop rotation has snatched a major portion of work from the agriculture workforce. The above equations are increasing the unemployment or underemployment in the agriculture sector over the period of time. There is, thus, an urgent need to offer more working hours to the surplus agriculture workforce. Many agriculture, as well as non-agriculture allied activities, are available in the state which is able to consume the so spared additional workforce besides giving better returns. Various studies have also shown that well-organized integrated farming system with crops and other labour-intensive enterprises like dairy, poultry, fishery, vegetable, fruits, mushrooms, etc. can augment the income and employment of farm families particularly small and marginal farmers having surplus family labour. Fish farming being an agriculture allied occupation can provide part-time as well as full-time employment to the unemployed youth, farmers, fishermen and landless agricultural labourers. Fish farming can be started on poor soil such as waterlogged, salt-affected, alkaline etc. which are otherwise unfit for agriculture. Further, the contractual fish farming in village ponds is also a common practice in the state. The present study was therefore exclusively designed in Bathinda being the central district of South West Punjab having sufficient amount of brackish underground water with the objectives to know the economics, marketing status and problem of contractual fish farming in village ponds. The contract value of the fish pond is decided by the selected village panchayat every year. The weighted average value worth ₹20088 per acre was taken as the mean contract value of an acre pond in the present investigation. The seedling price ranged from ₹90 to ₹110 per 1000 fish for various breeds. The average seedling cost, thus, was taken as ₹4443.75 per acre. The feed cost comprising mustard oil cake, groundnut oil cake, rice bran, unslaked lime came out to be ₹3580 per acre per year. Further, the irrigation cost, labour cost and interest on working capital accounted for ₹16527 per acre per year. On an average,

the total cost of rearing fish in the local ponds came out to be ₹44639 per acre when sold from the production site. However, this cost increased to ₹52430 per acre when the output was sold in the distant market of Ludhiana. With the average productivity of 10.25 quintal fish from the sampled village ponds, the cost of production of fish came out to be ₹4355 per quintal if sold locally while it was ₹5115.12 per quintal for the distant market. The net returns after deducting the cost of rearing fish in the village pond have been estimated worth ₹47611 per acre per year when sold at the production site and ₹96195 per acre per year when sold in the distant market. On per quintal basis these returns came out to be ₹4745 and ₹9385 in the local and distant markets, respectively. This enterprise can be started individually or by a group of farmers in one or cluster of villages depending upon the available resources. The village ponds having regular water availability, access to animals and water drainage facility can be of great support for harvesting good returns from contractual fish farming in village ponds. This practice can offer better family income coupled with employment opportunity for the rural youth.

SCOPE OF THE STUDY

Presently there are 6063 *Panchayati* ponds in the state covering 8242.20 ha area under fish farming. More area under ponds in 12581 villages of Punjab can be utilized for this enterprise through a suitable policy framework. The study can be used as a tool for generating employment opportunity at mass level by framing policy at the cooperative level by the Government.It will not only generate an alternate source of income for the farmers in the state but also explore the employment opportunity for the unemployed youth and landless farmers who have no agricultural land. Further, the pond water after regular harvesting of fish can also be recycled as irrigation water for crops. The practice can be highly useful in the southwestern districts of Punjab where canal water is in severe shortage and underground water is brackish and not fit for crop irrigation. This may not only clean the village atmosphere but overcome the shortage of irrigation water. Pond fish farming can also be promoted for beautification and tourism in rural Punjab. This practice coupled with boating is already adopted by many villages of Punjab recently.

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Effect of Weather Parameters on Rice Productivity in Manipur

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ABSTRACT

Climate change and agricultural sector are inseparable. The paper focuses on the interrelationship between crop production and climate change in general and effect of weather parameters on rice productivity. Increased population increases demand for food which has to be met through increased production/or productivity. Increase production of the rice crop and its residues increases emission of the greenhouse gas methane (CH_4). Variations in weather parameters viz. rainfall, temperature, relative humidity and sunshine during the study period 1999-2000 to 2013-14 could be observed through Linear trend analysis. There exists positive correlation between selected weather parameters and productivity of rice. Highest variation in rice productivity was due to sunshine hour (19 %). Multiple regression analysis revealed that rainfall, temperature, relative humidity, and fertilizers have significant effects on the productivity of the crop.

Keywords
Climate change, linear trend, multiple regression, productivity, Spearman's correlation.

JEL Codes
C24, C81, Q15, Q56.

INTRODUCTION

Climate change is one of the foremost immerging challenges faced by living beings including mankind in recent pass. Since the Industrial Revolution which began around 1750, human activities have contributed substantially to climate change by adding CO_2 and other heat-trapping gases to the atmosphere. Thereby, leading to increase temperature and precipitation affecting the environment as evident from highly erratic instances of weather deviations and induced extreme events like melting ice in the polar region, decline in snowfall period, decline in rainfall, increase instances of cloud burst, rise in sea level, storm and cyclone surges, severe drought, *etc*. These changes have affected many activities of humans directly or indirectly. The agricultural sector is an area to be focused the impact of climate change as it provides food to over 7.49 billion people besides millions of livestocks in the world. "The overall impact of climate change on worldwide food production is considered to be low to moderate with successful adaptation measures and adequate irrigation" (Ministry of Environment and Forest, 2013). India has a population of about 1.34 billion making it the second most populous country in the world (U.S. Census Bureau, 2011). Of these 1.34 billion people in the country i.e., about 56 per cent are dependent on agricultural and allied sector. The country is an agrarian state with 60 per cent of the total geographical land area under agriculture. Rice is one of the important staple food crops in India and the country is the second largest producer in the world (as in 2016) (Sharma, 2017). The country also cultivates other crops like maize, pulses, cotton, groundnut, *etc*. The performance of Indian agriculture is heavily dependent on weather and climatic conditions. Any adverse changes in temperature, precipitation, and CO_2 concentration affect the performance of Indian agriculture significantly (Kumar & Gautam, 2014). India has experienced 23 large scale droughts starting from 1891 to 2009 and the frequency of droughts is increasing. Climate change is posing a great threat to agriculture and food security. Water is the most critical agricultural input in India, as 55 per cent of the total cultivated areas do not have irrigation facilities. Owing to the importance of climate change, the paper examined the effect of climate change in rice productivity

in Imphal West district in India's north-eastern state Manipur.

METHODOLOGY

Study Area

Manipur is an agrarian state of North-East India. Rice is the only single crop grown which occupies about 50 per cent of the gross cropped area in the state (Government of Manipur, 2015). It has 16 districts, of which Imphal West district has been chosen purposively to study the effects of variation in climatic factors like rainfall, temperature, relative humidity, sunshine hour and fertilizer on the productivity of rice. Fertilizer has been considered as because the state is the third highest fertilizer consuming state among the North Eastern states (Government of India, 2013). The productivity of rice is thus affected by the fertilizer consumption. Rice requires hot and humid conditions. The temperature should be fairly high that is, 24°C mean monthly temperature with the average temperature of 30°C to 32°C. Rainfall ranging between 150 to 300 cm is suitable for its growth. Crop Model, the impact of climate on various crops in terms of area cultivated, production and yield rates are of different orders. Under rain-fed agriculture, the influence of temperature and rainfall, both quantum and periodicity are of overwhelming nature (Nianthi, 2005).

Data

The paper has been prepared based on secondary data. Data on climatic factors like temperature, rainfall, relative humidity, sunshine hour. And on fertilizer and productivity of rice have been collected from various sources *viz*. Directorate of Economics and Statistics, Manipur, Department of Agriculture, Government of Manipur, Experimental Agromet Advisory Service ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal, *etc*.

Analytical Tools

Linear trend analysis

Linear trends of the time-series data on rainfall, temperature, relative humidity and sunshine hour pertaining to the study area have been conducted for the selected study period (1999-2000 to 2013-14) to check the existence of variation.

Correlation and regression

In order to determine the degree of relationship between the effect of weather parameters and rice productivity, correlation analysis was carried out. To examine how climatic factors affect the productivity of rice linear regression analysis was employed. The linear equation so adopted is as under:

$Y_1=a+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+U$

Where, Y_1- productivity

X_1 = Rainfall

X_2 = Temperature

X_3 = Relative humidity

X_4 = Fertilizer

X_5 = Sunshine hour

U = Random term

Also, the independent variables were tested for their stochastic independence.

RESULTS AND DISCUSSION

Interrelation between Climate Change and Crop Production

Agricultural sector plays its role in global warming, it is considered as a specific example of "climate change". Global warming is caused by the increased concentration of greenhouse gases (GHG) in the atmosphere. GHG is comprised of four main gases i) Carbon dioxide (CO_2), ii) Methane (CH_4), iii) Nitrous Oxide (N_2O) and iv) Fluorinated gases (F-gases).

A flow chart depicting the interrelationships between global warming and crop production has been given in Figure 1. It can be stated that increase population increases demand for food and other consumer goods. Rice is the staple food for Asian countries, cultivation of which is a source of emission of one of the greenhouse gas, methane (CH_4). Increase production of crop and crop residues raises increase emission of the gas which adds to global warming. More carbon dioxide in the atmosphere and rising temperatures causes' rice agriculture to release more of the potent greenhouse gas methane for every kilogram of rice it produces (Science Daily, 2015). Global warming as said earlier is an example of climate change which leads to change in climatic conditions causing erratic rainfall, the rise in temperature, *etc*. Thus there exists the problem of water scarcity. Rice requires around 450 to 700 mm of water during its entire growing period. In India, most of the paddy cultivation is rain fed. In order to increase production of the crop, new technological methods have been adopted. Utilization of fertilizer is also an important one to be considered. In recent times, fertilizer utilization has increased tremendously leading to increasing demand. Increasing demand is met through increase manufacturing and producing by the fertilizer industries which increases the emission of GHG like carbon dioxide into the atmosphere. Also, utilization of chemical fertilizer leads to the emission of another GHG, nitrous oxide NO_2. The cycle continues leading to increasing GHG emission in order to meet the ever increasing food demand.

Effects of Change in Rainfall, Temperature, Relative Humidity and Sunshine Hour on the Rice Productivity in Imphal West District of Manipur

Linear trends in selected climatic factors

Variation in weather factors *viz.,* rainfall, temperature, relative humidity and sunshine (hr) of Imphal West district in Manipur for a period of 15 years (1999-2000 to 2013-2014) have been shown in the following Figs. 2 to 6.

Rainfall

It can be seen in Figure 2 that there are fluctuating trends in rainfall during the study period. Highest was recorded in 2000-01with annual rainfall of 1854.70 mm and the lowest recorded in 2009-10 with 1021.20 mm annual rainfall. Slope co-efficient (-14.22) indicates that there was declining trend in annual rainfall during the study period.

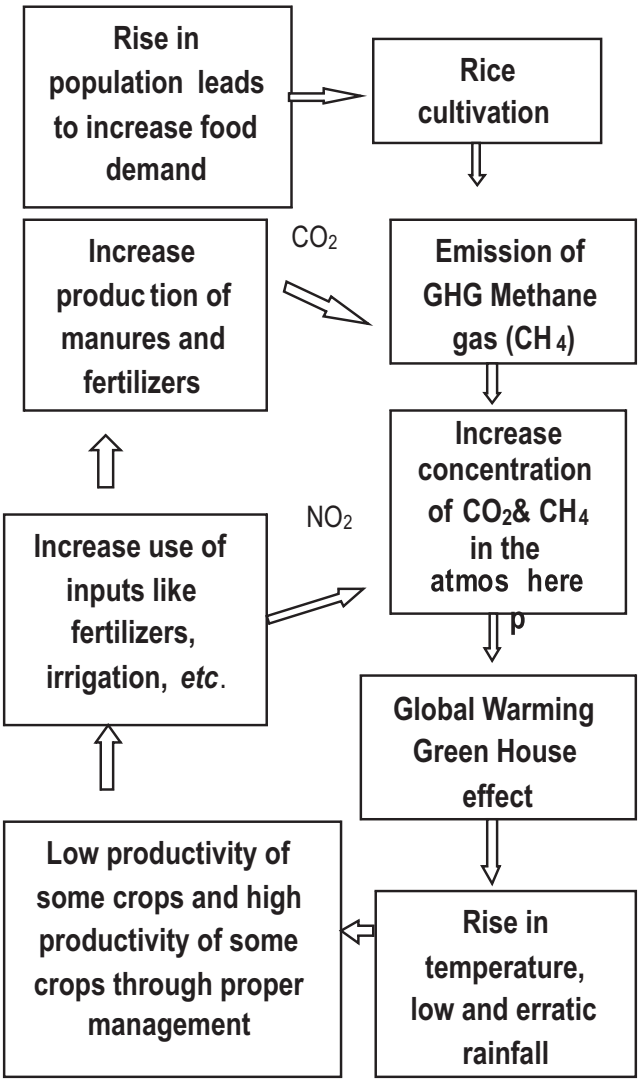

Figure 1. Interrelationship between crop (rice) production and climate change

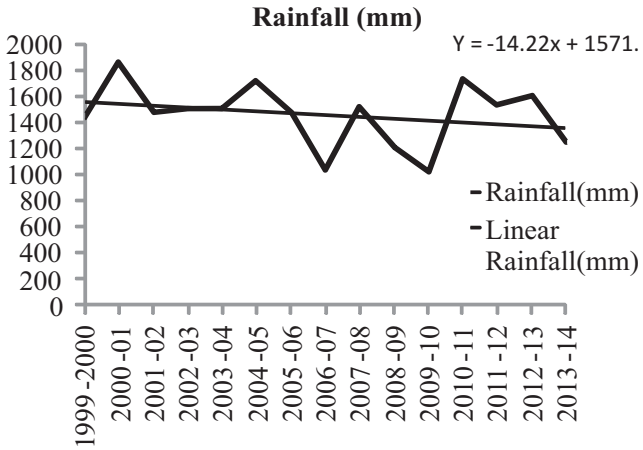

Figure 2. Trends in annual rainfall (mm) of *Imphal West* district during the period from 1999-2000 to 2013-14

Temperature

Average annual temperature in the district also showed fluctuating trends with a prominent rise in the year 2013-14 (22.98 ^{0}C). Average annual temperature in the district ranged from 20.33 ^{0}C to 22.89 ^{0}C during the study period. The overall trend was found to be positive with 0.033 slope coefficient.

Relative humidity

Relative humidity in the district is quite high ranging from 72.00 to 84.30 per cent. It showed a steady trend during 2001-02 to 2005-06 with sudden fall in 2006-07. Thereafter it showed a sharp increase up-till 2011-12 (84.30 %) which again had a drastic fall during 2013-14 (72.39 %). The overall trend was found to be positive with slope co-efficient of 0.26.

Sunshine

It can be observed from the Figure 5 that there has been increasing trend in the sunshine (hr) during the study period recording a slope co-efficient of 0.032. The annual sunshine hour during the study period ranged between 4.10 to 6.16 hours.

A summary of linear trend analysis of the selected climatic factors *viz*., rainfall, temperature, relative humidity and sunshine hour has been presented in Table 1. It could be observed from the table that slope co-efficient of all the factors except annual rainfall was found to be positive. Thus, it could be concluded that there has been fall in rainfall over the years and rise in all the other three climatic factors in the selected district over the years. Contradicting to the results of my finding, it has been concluded that during 1984-2013, rainfall, relative humidity, sun shine hours and evaporation indicated declining trend, however, the minimum temperature and maximum temperature indicated increasing trend in Hiriyur in Karnataka (Kumar *et al.,* 2015). Another finding of a study in Bangladesh has reported that the trend of annual rainfall and mean temperature showed increasing trend during 1961-2009 (Rahman *et al.,* 2017).

Correlation between Rice Productivity and Climatic Factors

Correlation between rice productivity and annual rainfall, average annual temperature, average annual relative humidity and average annual sunshine hr have been presented through scatter diagram in Figures 6, 7, 8, and 9 below. A summary table of correlation co-efficient (r) has been given in Table 2. It can be observed from Fig. 6 that rice productivity is positively correlated with

Table 1. Linear trend analysis

Climatic factors	Slope
Annual rainfall (mm)	-14.22
Average annual temperature (^{0}C)	0.032
Average annual relative humidity (Percent)	0.258
Average annual sunshine (hr)	0.032

Source: Computed by the author.

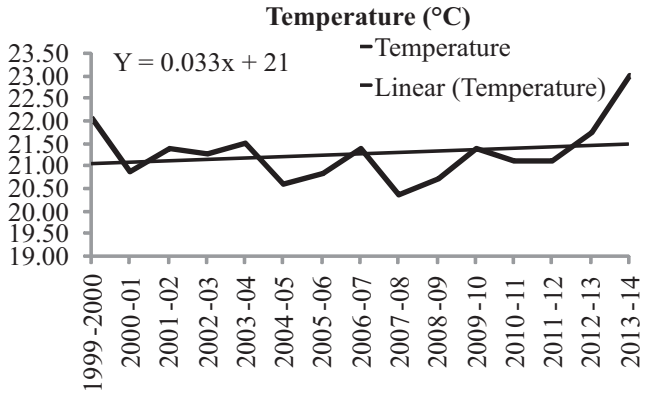

Figure 3. Trends in average annual temperature (°C) of Imphal West district during the period from 1999-2000 to 2013-14

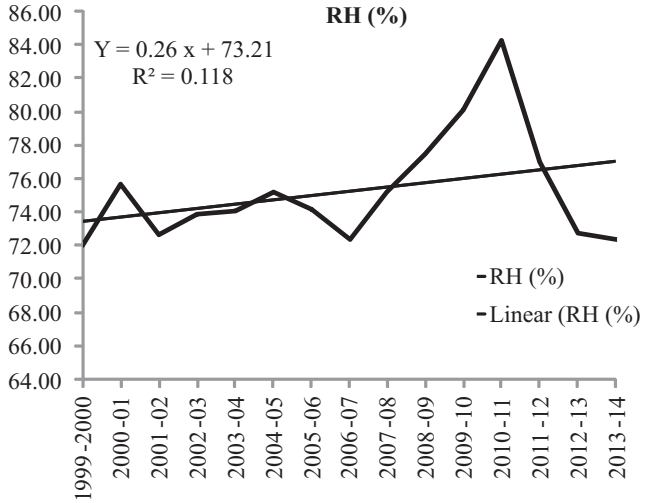

Figure 4. Trends in average annual relative humidity (%) of Imphal West district during the period from 1999-2000 to 2013-14

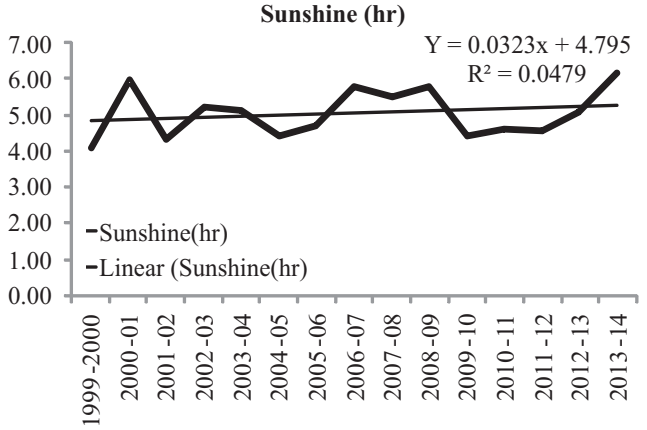

Figure 5. Trends in average sunshine (hr) of *Imphal West* district during the period from 1999-2000 to 2013-14

Table 2. Correlation results

Correlation between rice productivity and	Correlation co-efficient (r)
Annual rainfall	**0.37**
Average annual temperature	0.24
Average annual relative humidity	0.18
Average annual sunshine	0.44

Source: Computed by the author.

annual rainfall during the study period. Correlation co-efficient was found to be 0.37, as given in Table 2. Similar to the finding, significant positive correlation between rice productivity and rainfall was found to be dominant in Bihar and UP (r = 0.73 and 0.45 respectively) (Asada & Matsumoto, 2009). The average annual temperature was also found to have a positive correlation with rice productivity with a correlation coefficient (r) = 0.24. Contradicting to the result of my study, negative correlation (r = -0.51) was found between mean temperature and rice productivity in Haryana during 1992-2006 (Bemal *et al*., 2009). Similar results were also found for relative humidity and sunshine hour during the period under consideration with correlation co-efficient (r) of 0.18 and 0.44 respectively. Co-efficient of determination has revealed that highest variation in rice productivity was due to a sunshine hour (19 percent). Thus, it can be concluded that increase in productivity is positively associated with the selected weather parameters.

Linear multiple regression analysis

Linear multiple regression analysis has been conducted to determine the effect of factors like annual rainfall, temperature, relative humidity, sunshine hour, and fertilizer on the productivity of rice. The analysis results the following estimated equation:

Productivity = -247.25 + 0.55 rainfall + 170.69 temp. - 24.32 RH + 56.21 sunshine hour + 0.05 fertilizers.

$R^2 = 0.82$

It can be interpreted from the result of multiple regression analysis that while keeping other factors constant, with 1 unit increase in rainfall, the productivity of the rice crop increases on an average by 0.55 kg. Expressing in percentage, Chung *et al.* (2015) stated that one percent increase in rainfall without a change in temperature would increase rice yield in Winter-Spring (WS) and Summer-Autumn (SA) season by 0.808 per cent and 0.409 per cent respectively in Central Highlands of Vietnam during 1986 to 2012. In a very unusual result, it has been reported by Raza and Anwer (2015) that rainfall does not affect any stage of rice production of Punjab during 1980 to 2012. And a unit increase in average annual temperature in the district during the study period, rice productivity increases on an average by 170.69 kg. Increase one percent of relative humidity decreases 24.32 kg in rice yield. Similar to this, regression analysis in the study conducted by Abdullahi (2015) in

Kano State, Nigeria during 1994-2013 indicates a negative relationship between rice and relative humidity with β-co-efficient of -0.009. Sunshine hour and fertilizer application has positive impact in the rice yield as 1 per cent increase each in the two factor results 56.21 and 0.05 kg increase in rice productivity while keeping other factors as constant.

The results of the test significance of the estimated co-efficient have been presented in Table 3. It can observe that beta co-efficient of rainfall, temperature, relative humidity, and fertilizers were found to be significant at 5 per cent level of probability and the sunshine hour was found to be significant at 1 per cent level of probability. It is clear from the table that the selected predictors significantly contribute to change in the value of dependent variable. Co-efficient of multiple determinations (R^2) was found to be 82 per cent, which means that 82 per cent of the variation in rice productivity i.e.more than 50 per cent of the variation in productivity in *Imphal West* district of Manipur was explained by the effects of the selected factors during the study period. Akin to the result of the study, high value of R^2, 88 percent of variation in the Kharif rice is explained

Table 3. Multiple regression analysis

Particulars	Co-efficient	p-value
Rainfall	0.55**	0.021
Temperature	170.69**	0.054
Relative humidity	-24.32**	0.044
Sunshine	56.21***	0.003
Fertilizers	0.05**	0.054

Source: Computed by the author.
****** and ** Significant at 1 and 5 percent level.***

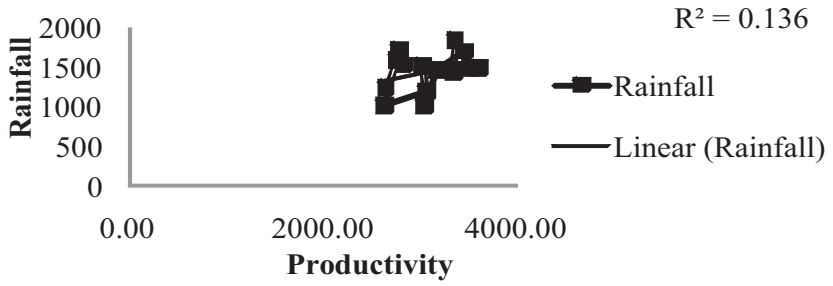

Figure 6. Correlation coefficient between rice productivity and annual rainfall

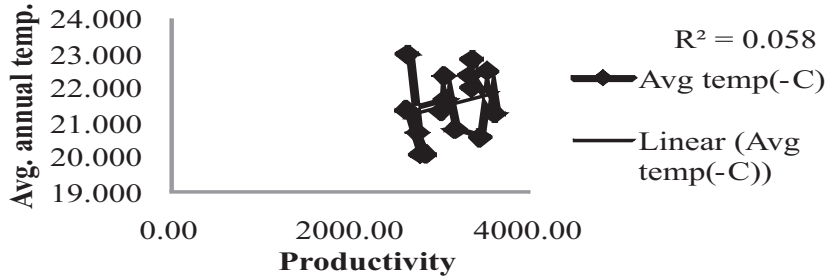

Figure 7. Correlation coefficient between rice productivity and annual temperature (^{0}C)

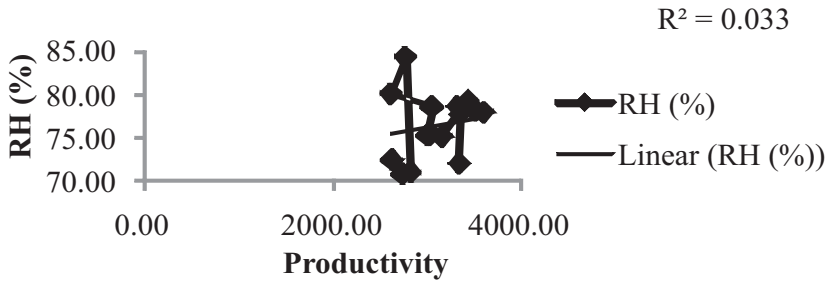

Figure 8. Correlation coefficient between rice productivity and annual relative humidity (%)

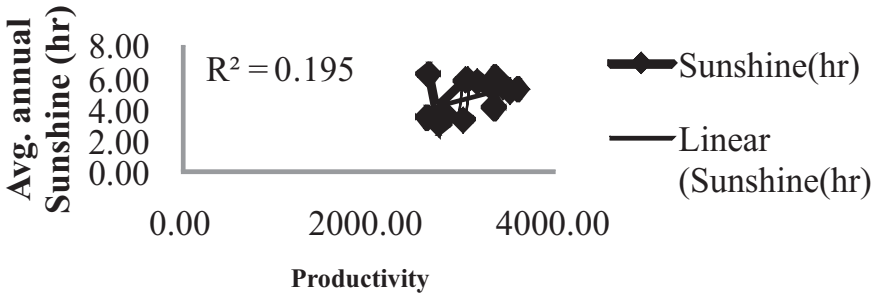

Figure 9. Correlation coefficient between rice productivity and annual sunshine hour

by climate variables (temperature and rainfall) in India during 1974-2011 (Farook & Kannan, 2015) Similar to this finding, Mahmood *et al.* (2012) found out that 67 per cent of rice productivity in Punjab was explained by temperature and precipitation.

CONCLUSION AND POLICY IMPLICATIONS

Rice productivity in *Imphal West* district of Manipur is affected due to changes in weather parameters as indicated by the positive correlation coefficient (r) values and variations in the average value of weather parameters during the study period. Hence, climate change is imminent in the region. Overall Indian agriculture is likely to suffer losses due to the negative impact of climate change if similar results are obtained in other parts of the country. Adaptation and mitigation strategy and technology can help minimization of the negative impacts. The technology should transfer and disseminate among the farmers. Agriculture development policies in India should focus on reducing greenhouse gas emissions through collective measures, *viz*., reduction of deforestation; improving forest conservation and management; effective control of wildfires; promotion of agro-forestry for food or energy; restoring land through controlled grazing; improving minimization of the negative impacts.

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Production and Consumption of Marine Fish after Globalisation

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ABSTRACT

India ranks seventh in marine fish production. In this study; three objectives had been put forth that is to study Marine fish production with respect to inland fish production and export instability of marine fish after globalization, to study the per capita availability of marine fish in response to different factors in India and to study the probable market for marine fish after globalization. The data were collected from various publications like a Hand Book of fishery Statistics (2014), Manual on fishery Statistics (2012), World Review of Fisheries and Aquaculture (2014), etc. and Cudde Della Valle Index technique was used for analyzing the instability. After analysis of data, it was observed that marine fish production was more in 1991 and inland fish production was overtaking former due course of time. Domestic consumption of marine fish was also decreased down to 74 percent from 93 percent. In the part of instability the export value was showing medium instability in comparision to export volume of marine fish in between 1991-2011, but in between 2005 to 2014, both value and volume were showing medium instability. Here per capita, availability of the marine was dwelling between 7.34 to 5.87 kg. Marine fish export increased continuously in value whereas the volume of export marched at the same pace. The international market for marine fish export was showing the same degree of instability with its volume whereas remarkable changed has been observed in the value of export with its corresponding instability. Here the European Union is regarded as a best export destination for Indian marine fish.

Keywords
Domestic marine fish consumption, growth trend of marine fish, International instability, per capita availability.

JEL Codes
A11, F10, F13, F68.

INTRODUCTION

India is bestowed with a long coastal line of 8118 km, 3827 fishing villages, 1914 traditional fishing trading centers and restores various categories of fishery species in its both inland and marine resources. India is home to more than 10 per cent of the global fish diversity and it ranks second in overall fish production and seventh in marine fish production (Food and Agricultural Organization, 2014). Out of total fish production of 9.58 million tonnes, 36 Percent contributes from marine resource (3.44 million tonnes) and inland resource contributes the rest and this percentage for marine fish recedes from 71 per cent marine fish production in 1950-51 to 64 per cent in 1980-81 and 36 per cent in 2013-14 Government of India (2014). Though in the first time in the history of Marine Products Industry; the exports crossed the 2.8 billion mark (CSO-MFS, 2011) yet in overall fish consumption to production pattern we are getting many anomalies in India. Here Lakshadeep tops in fish consumption and Andhra Pradesh ranks one in fish production. Arunachal Pradesh rural fish consumption (2.18 kg per person) is more than its urban consumption (1.119 kg per person) and Southern and North-eastern regions fish consumption is higher than Northern India fish consumption (Singh *et al.*, 2014). Food is the biggest items of expenditure of Indian households. About 51 Percent of the total consumption expenditure of households was spent on food and out of them, meat, egg, fish consumption lies near to 4 percent (Vyas, 2012). Again About 35 Percent of Indian population is fish eaters and the per capita consumption is 9.8 kg whereas the recommended intake is 13 kg (CSO-MFS, 2011). Fish as a food contains omega-3 fatty acid that is good for the heart and fisheries are estimated to provide 16 percent of the

world population's protein (Vyas, 2012).

Taking all above substances into consideration, three objectives were established by the researcher like to study Marine fish production w.r.t inland fish production and export instability of marine fish after globalization, to study the per capita availability of marine fish in response to different factors in India and to study the probable market for marine fish after globalization.

METHODOLOGY

Particularly in agricultural commodity production (here it is fish as a commodity) to check instability, we use Coefficient of Variance (CV), dispersion, Cuddy Della Valle Index (CDI) etc. The present study based on the analysis through Cuddy Della Valle Index. This index first de trends the trend and gives a clear picture of instability. Actually when we check instability with a coefficient of variance, the result many times show a high picture of instability and many times CV also reflects high instability rate even though the production trend is at a constant rate. But calculation through CDI, establish a clear instability rate by de trend the CV with the calculation of the coefficient of determination (R^2). A low value of indices shows low instability for fish production.

Cuddy-Della valle index = $C.V.*(1 – R2)^{0.5}$

The ranges of instability are as follows (Sihmar, 2014)

- Low instability= between 0 to 15
- Medium instability= Greater than 15 to 30
- High instability= Greater than 30

Per capita availability of a particular product means average per person or for each person or for each head. Per capita availability may be taken into per day or per year. Here the researcher had taken per year calculation of marine fish to understand any difference with the national average of fish consumption. Per capita availability of a product depends mainly on population growth of the nation, post-harvest marketing of a particular product both within and outside of the nation and production of that product in that nation. Here the researcher had taken all the parameters into account and observed their impact on per capita availability through multiple regression techniques. Multiple regression is an extension of simple regression where the impacts on independent variable observed in the response with many dependent variables.

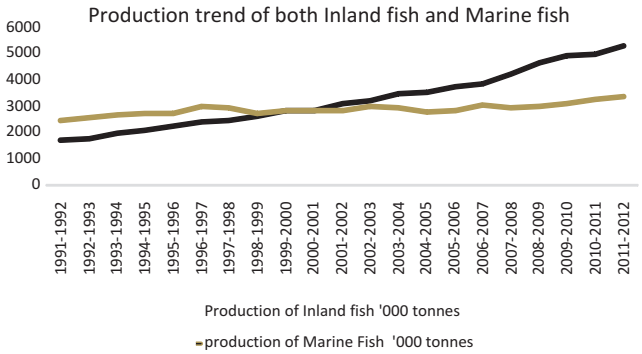
$Y=a+b_1X_1+b_2X_2+b_3X_3+……..+bnXn+U$

Here Y = Per capita availability

X_1, X_2 are the three independent variables like the population of India, domestic consumption and production of marine fish and their contribution to dependable variable have been calculated through multiple regression techniques.

RESULTS AND DISCUSSION

From the Figure 1 it has been observed that though marine fish production was more in 1991 than inland fish production yet it had been continuously decreasing and in 2011 it was quite less than the inland fish production. The time in between 1999-2000, both the production of marine and inland fish were moving at same pace.



Source: Central Water Commission, Government of India (ON153) & Ministry of Agriculture, Government of India. (14268) & (ON463).

Figure 1. Production trend of both Inland fish and Marine fish from 1991-2011

Hopefully, the continuous demand for fish after globalization may put pressure on inland fish production. Besides that maritime Government regularly take steps like gear restrictions (mesh size regulation, hook size regulation), spatial restrictions and temporal fishing restrictions for 30 to 145 days to check on overfishing of marine fish (Devaraj & Vivekanandan, 1999). Side by side Government also takes many initiatives for increasing inland fishery in its various schemes and programme for rationing demand hike for fish as a food (Government of India, 2015). Again in another study, FAO (2014) has been stated that developed country prefer more nutritional marine fish to less nutritional inland fish where as in developing and underdeveloped country preferential choice just opposite.

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Form the above figure it was seen that percentage of domestic consumption of marine fish was decreased down from approximately 93 percent in 1991 to 74 percent in 2011 and almost nineteen percentage point

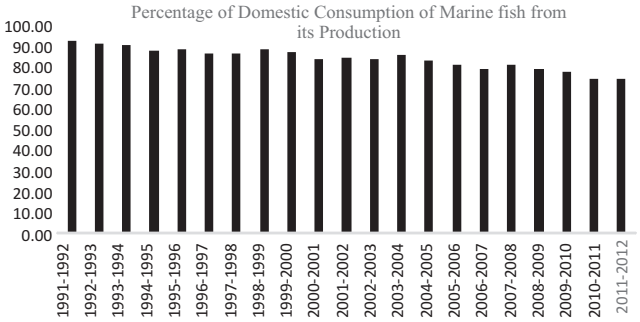


Figure 2. Percentage of domestic consumption of marine fish from its production

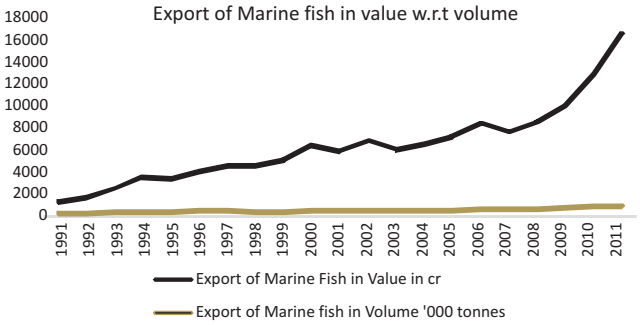


Figure 3. Export of marine fish in value w.r.t volume

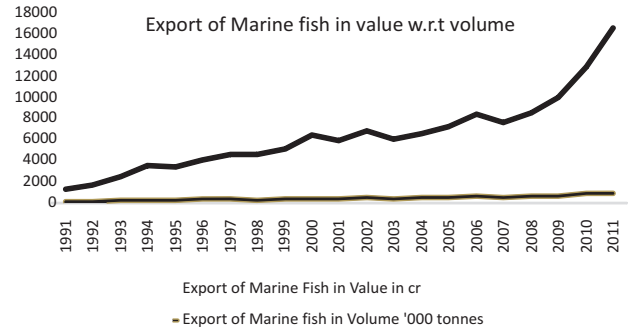


Figure 4. Per capita availability of Marine fish per year in kg

decrease was found in twenty one years. This scenario may be due to wide market availability after globalization, introduction of fish as commodity for export in Focus Product scheme (Government of India, 2006-07) or may due to demand of Indian fish due to stability in production from Indian ocean (FAO, 2014) or may be due to decrease in value of Indian currency after recession in 2008 (Government of India 2009-10).

From the above table it was observed that in between 1991-2011, the marine fish export in volume was showing low instability whereas value was in medium instability from India. But the condition was little bit worsen after 2005-14; where both marine fish exports were showing medium instability in value and volume wise. It may happen due to the global recession that impacts everywhere. No doubt Sunami in Japan in 2011, reduced vessel numbers in China, depletion of the marine resource due to over fishing in the Gulf of Thailand, climatic variation in Southeast Pacific added an extra edge to India in time of crunch of supply throughout the world. Besides that increase in fish production due to increase in fish feed and medicine was also a challenge fish supply though out the world (FAO, 2014). Both increases in demand and crunch in supply may make the market volatile and instable.

In Figure 3, it was observed that export of marine fish was showing increasing trend in value terms where as volume was approaching at a steady rate. Hike in value in comparision to the volume of marine fish export may be due to the devaluation of money after global recession (Government of India, 2009-10) or may be due to supply crunch that had been earmarked in many countries of the world (FAO, 2014).

From the above figure, it was seen that per capita availability of marine fish lies in between 7.34 kg in 1991 to 5.87 kg in 2011 in the Indian Market. Though its share is higher in comparision to inland fish (Government of India, 2014) yet decreasing demand of

Table 2. Correlation Matrix to understand relationship of per capita availability of marine fish with different variable

Variables	PI	PM	PC
DC	0.083	0.545	0.246
PI		0.834	-0.943
PM			-0.619

Data showing inside the table represents Pearson coefficient.
PI represents as Population of India in million.
PM represents as Production of Marine Fish '000 tonnes.
PC represents as Per capita availability of marine fish in India per year per kg.
DC represents as Domestic Consumption of Marine fish in India '000 tonnes.

Table 1. Instability analysis of Marine fish Export in value and volume from 1991-2011 and 2005-2014

(Value in ₹Crore; Quantity in 000 tonnes)

Country	Year	Export in	Average	Std (P)	CV	CDI	Remarks
India	1991-2011	Quantity	450.53	180.68	40.10	13.05	Low instability
		Value	6399.46	3548.2	55.45	21.82	Medium instability
	2005-2014	Quantity	692216.78	211133.39	30.50	17.76	Medium instability
		Value	12933.23	7506.44	58.03	29.81	Medium instability

Source: Handbook of Fishery Statistics, 2014, Lokshabha Unstarred Question No.387, dated 11.07.2014.

marine fish among the Indian consumers makes the producer think about international market in an astute way as the day comes.

From Table 2 it was seen that per capita availability of marine fish was showing strong negative correlation with a population of India and production of marine fish but poor correlation with domestic consumption of marine fish. That's why the effect of domestic consumption may be redundant in further multiple regression analysis. In the same time, both population of India and production of marine fish were showing a strong positive correlation between them. That's why there may exist a multicollenearity effect on the dependent variable. So one variable effect may be redundant or both of them are taken into consideration for understanding the impact of independent variables (Population of India and Production of Marine fish) on dependent variable (Per capita Availability)

From the Table 3, it was observed that the combined effect of both the independent variable i.e. Population of India and Production of marine fish were showing the improved impact on per capita availability of the marine fish in India. Here maximum regression value with a high degree of R square, adjusted R square and F value with very less standard error improved the status for per capita availability.

From the Table 4, it has been observed that USA, European Union, South-East Asia, China and Hong Kong market were showing high instability both in value and volume of export although they had a significant export share in comparision to other countries like Japan, Middle East, and few small countries. South East Asia was absorbing the maximum volume of marine fish where as India was getting maximum revenue from the European Union through marine fish export.

From the Table 5, it was observed that the countries were showing the same type of reflection in CDI index with their volume of import of marine fish from India. It may be inferred that the country that imports more volume of marine fish was showing more instability from

Table 3. Regression analysis between per capita availability of marine fish with production of marine fish and population of India

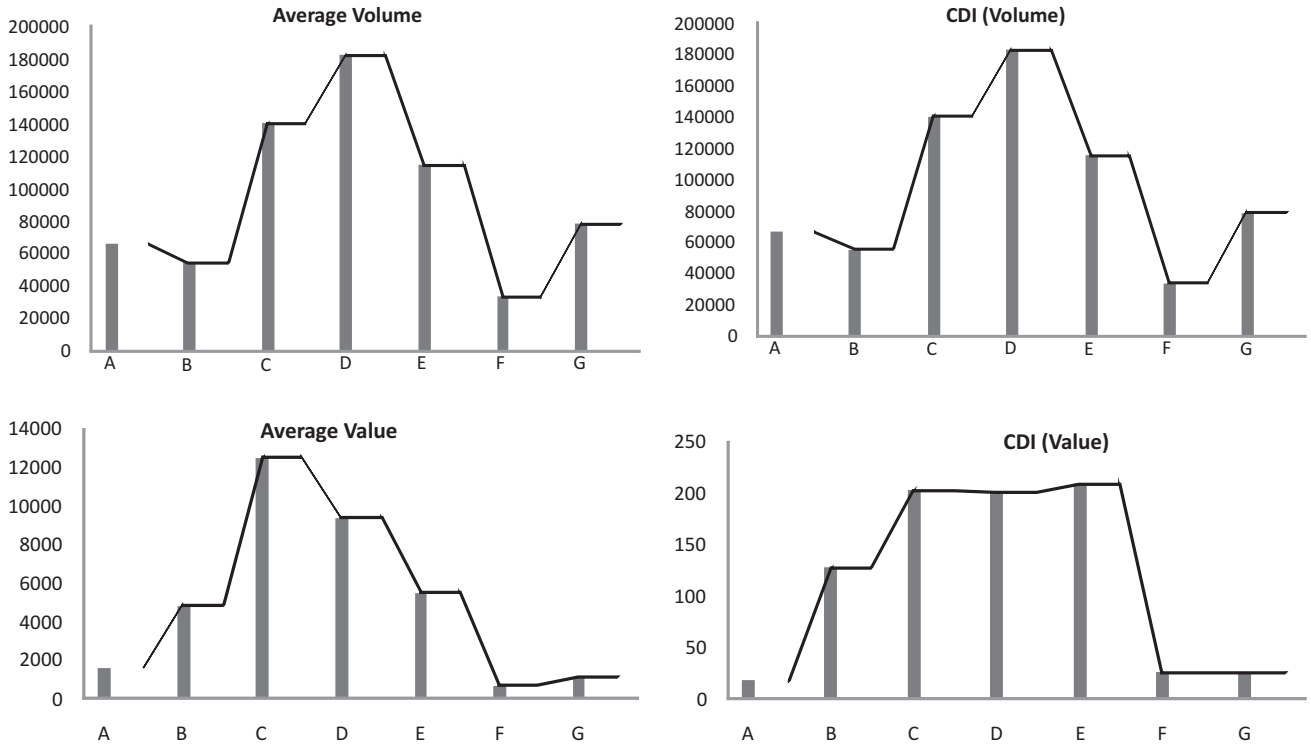
Relationship	Regression value	R Square	Adjusted R square	Standard Error	F value	P Value
PCPM	0.619	0.384	0.351	0.190	11.82	0.003
PCPI	0.943	0.890	0.884	0.8037	153.57	0.000
PMPI	0.991	0.982	0.980	0.033	491.18	0.000

PCPM represents as Per-capita availability with Production of marine fish.
PCPI represents as Per-capita availability with Population of India.
PMPI represents as Per-capita Availability with production of Marine fish and Population of India.

Table 4. Export of marine fish to different country in value and volume with their CDI from 2005-2014
(Value in Crore and quantity in Metric ton)

Country	Parameter	Average	Std (P)	CV	CDI	Remarks
Japan	Quantity	65924.44	14177.91	21.50	19.12	Medium Instability
	Value	1563.11	516.75	33.05	18.63	Medium Instability
USA	Quantity	54620.56	31021.90	56.79	42.41	High Instability
	Value	4790.14	6192.76	129.28	128.37	High Instability
European Union	Quantity	139906.26	50631.74	36.18	34.47	High Instability
	Value	12505.78	25443.49	203.45	202.47	High Instability
Southeast Asia	Quantity	182251..53	137182.01	75.27	31.53	High Instability
	Value	9377.18	18899.66	201.54	201.47	High Instability
China and Hong Kong	Quantity	114668.97	55922.84	48.76	44.28	High Instability
	Value	5498.72	11578.87	210.57	209.15	High Instability
Middle East	Quantity	33580.11	12726.03	37.89	20.02	Medium Instability
	Value	682.84	421.96	61.79	27.06	Medium Instability
Others	Quantity	78419.33	28823.79	36.75	15.71	Medium Instability
	Value	1108.91	603.01	54.38	26.71	Medium Instability

Source: Lokshabha Unstarred Question No.387, dated 11.07.2014.



A= Japan, B= USA, C= European Union, D= Southeast Asia, E= China and HongKong, F= MiddleEast, G= others

Table 5. Comparison of value and volume of export with their corresponding CDI index among different exported countries

an Indian perspective. But the picture was different in CDI index with its corresponding value of export. Though European Union, China and Hong Kong and South East Asia had high value export market for Indian marine fish yet the degree of instability was less in the European Union in comparision to other two countries.

CONCLUSIONS

After globalization marine fish production continuously decreases down unlike inland fish production and percentage of domestic marine fish consumption is decreased approximately one percentage point every year. We export more marine fish after globalization as marine fish export garner more value in these days and Per capita availability of marine fish is also dwelling 7-6 kg that compels the producer to look into another prospective market outside the India. The European market is a better destination for Indian marine fish export by considering its degree of instability with other countries.

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Public Distribution System in India: Key Issues and Challenges

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ABSTRACT

Food security is essential for a country's growth and in a nation like India where one-fifth of the population is believed to be undernourished it becomes even more important. The government of India runs the largest food security programme known as Public Distribution System to ensure food security to the masses. Public Distribution System (PDS) ensures food availability and economic access to the beneficiaries through the Fair Price Shops (FPS) by providing foodgrains to them at fairly cheap prices. PDS is run by the coordination of centre and state governments. People accessing PDS for meeting their dietary needs has increased over the years and hence the food and nutritional security of masses has improved. It has made a positive impact on poverty reduction, income transfer and nutritional security considerably. Despite all these certain issues like inaccurate identification of beneficiaries, leakages, inadequate storage capacity, and non-viability of Fair Price Shops plague the system. To counter these problems governments have taken up various reforms over the years which have led to the system becoming more efficient comparatively. PDS is the largest food security programme and its efficient functioning is a must for making India a food secure nation.

Keywords
Fair price shops, food security, issues, public distribution system.

JEL Codes
H53, I31, I38, Q18.

INTRODUCTION

India is home to 1.2 billion people, therefore, adequate and high foodgrain production becomes important to feed the teeming population. Agricultural production has quadrupled over the years increasing from a mere 120 million tonnes in 1980 to over 252 million tonnes in 2014-2015 which helped to achieve national food self-sufficiency (www.indiastat.com). Despite the high food grain production, India is home to one-fifth of the world's undernourished population. The State of Food Insecurity in the World, 2015 report of Food and Agriculture Organization (FAO) reveals that 194.6 million people are undernourished in India. In this scenario ensuring food security to the masses becomes a matter of prime importance. FAO defines food security as all people having physical and economic access to safe, sufficient and nutritious food to meet their dietary needs at all times for a healthy life. Food availability, access to food and utilization of food are the basic pillars of food security.

High agricultural production solves the problem of food availability but economic access to food and food utilization still pose a big problem. Food inflation and low income of people prevent individual food security. Another aspect of India's food insecurity situation is on account of serious problems related to the distribution and economic access to food (Ittyerah, 2013). The government of India, in order to ensure food security to the economically vulnerable sections of the society, provides them with subsidized food items through the Public Distribution System.

Public Distribution System

Public distribution system (PDS) is a food security system responsible for providing basic food and non-food commodities to the economically vulnerable sections of the society through government-sponsored shops (Fair Price Shops) at cheap prices in every nook and corner of the country. PDS was established under the Ministry of Consumer Affairs, Food, and Public Distribution and managed jointly with state governments.

The responsibility of procurement, storage, transportation and bulk allocation of essential

commodities to the states, rests with the Centre Government while the operational responsibility of allocation within state, identification of eligible families, issue of ration cards and supervision of the functioning of Fair Price Shops (FPS) rests with the state governments. With a network of more than 500000 Fair Price Shops where each FPS covers around 2000 people, the PDS is perhaps the largest distribution machinery of its type in the world (Planning Commission, 2005).

Need of PDS

PDS plays four important roles for safeguarding the economically vulnerable sections and ensuring food security in the country. These are price stability, price support to farmers, making grains affordable through distribution and maintaining buffer stock.

Evolution of PDS

History of PDS dates back to the time of World War II when the first structured public distribution system of cereals in India was introduced by the British government in Bombay and Calcutta. With the end of World War II, the rationing system came to an end but later after attaining independence, due to the inflationary pressures in the economy, the rationing system was reintroduced in 1950 (Pal, 2011).

In 1992 PDS was revamped on the grounds that it catered primarily to the urban areas and was not reaching out far and wide. The system then came to be known as Revamped Public Distribution System (RPDS) covering 1752 blocks of drought-prone, desert, tribal and hilly areas of the country. Despite revamping the system, it failed to cater the targeted beneficiaries. Hence in 1997, it was converted into Targeted Public Distribution System (TPDS) under which population was classified into Below Poverty Line (BPL) and Above Poverty Line (APL) households.

Antyodaya Anna Yojana (AAY) was launched in 2000 to serve the poorest of the poor among the BPL households' *viz*. landless agricultural laborers, marginal farmers, rural artisans destitute and people earning their livelihood on a daily basis in informal sectors. National Food Security Mission (NFSM) was launched in 2013 by UPA government aiming to make 'right to food' a legal entitlement for all. Under NFSM 75 percent of rural and 50 percent of the urban population of the country will be covered.

Identification of eligible households under existing TPDS

Categorization of beneficiaries

Under TPDS, beneficiaries are categorized as BPL and APL. A total number of BPL households was calculated state-wise by Planning Commission. The state government was vested with the responsibility of identifying eligible BPL households based on the inclusion and exclusion criteria evolved by the Ministry of Rural Development. Any household above the poverty line could typically apply for an APL ration card (Balani, 2013). The entitlements under TPDS for each beneficiary household are given in Table 1.

Table 1. Entitlements under TPDS

Category	No. of Beneficiaries (crore families)	Entitlement of food grains (kg/family)
AAY	2.43	35
BPL	4.09	35
APL	11.52	15-35
Total	**18.04**	

Source: Ministry of Consumer Affairs, Food and Public Distribution (2013).

How Does Public Distribution System work?

Centre and state governments share responsibility in running the largest food distribution programme of the country. FCI on behalf of Centre Government procures the food grains from farmers at Minimum Support Price (MSP) which are announced by the Government of India at the beginning of the sowing season for certain crops on the basis of recommendations of the Commission for Agricultural Costs and Prices (CACP). FCI then further allocates these commodities to different states at Central Issue Prices (CIP) which are determined by the central government. Specifically, FCI performs the following functions:

a. **Procurement**: Currently, procurement is carried out in two ways, i.*e*. centralized and decentralized procurement.
b. **Storage**: Food and buffer reserves are maintained for meeting the requirements of TPDS and emergencies, respectively. Food grains are normally stored in covered godowns, silos, and in the open referred to as Covered and Plinth (CAP).
c. **Allocation**: Allocation for BPL and AAY families is done on the basis of the number of identified households. On the other hand allocation for APL families is made on the basis of (a) availability of food grains stock in the central pool and (b) past offtake (lifting) of food grains by the state from the central pool.
d. **Distribution**: FCI is responsible for the interstate transport of food grains to the state godowns of consuming states from procuring states. On receipt of food grains state allocates the grains to each district and further to each Fair Price Shop within the first week of the month. (Balani, 2013).

Procurement and offtake scenario in the country from 2004-05 to 2013-14 (Figure 1) and increasing trend is observed in both procurement and offtake over the years under PDS. Owing to the wheat crisis of 2006-07 and 2007-08, a decline was observed in procurement and offtake.

Pricing of food grains for PDS

PDS provides support to both farmers and consumers. Table 2 shows the MSP and CIP of rice and wheat over years. MSP has been increased continuously over the years thus ensuring better remuneration to farmers. CIP has been kept fixed by the government since 2002 to

provide economic access to vulnerable sections.

Impact of PDS

People accessing PDS to meet their dietary requirements have increased over the years. Table 3 shows that one-fifth (19.7 percent) of the total consumption of rice and wheat in 2011-12 was catered by PDS. 44.8 percent households accessed PDS to meet their cereal requirements in 2011-12 comparatively higher to previous years. The sharp increase in food inflation and steps by the state government to reform the PDS have made it more attractive to the masses.

The better access of PDS to masses has also made a positive impact on poverty reduction. PDS has been instrumental in reducing poverty among the targeted groups with poverty reduction of 10.1 percent points in case of AAY and 8.0 percent in case of BPL card holders. The average impact on poverty gap has also been considerable at 5.90 percent and 3.02 percent for AAY and BPL households respectively (Kumar *et al*., 2013).

The PDS induced reduction of rural poverty at the all-India level was around 11 percent based on headcount ratio (HCR) and 18 percent based on poverty gap index (Dreze and Khera, 2013). The situation varied across states where better performing states like Tamil Nadu showed 61 percent of reduction and implicit income transfer of ₹101, poor performing states like Bihar showed poverty reduction of 4.3 percent and income transfer of ₹5 (Table 4).

PDS has been effective in taming nutrition deficiency.

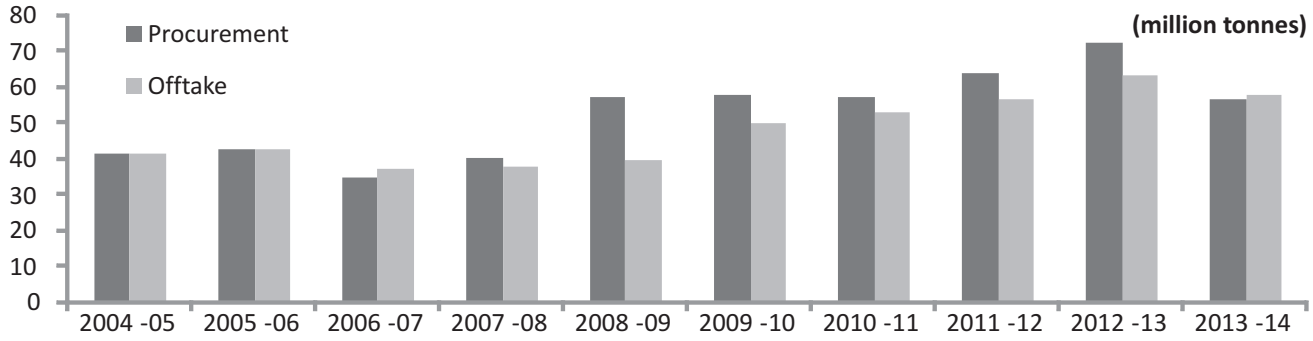
Table 3. Contribution of PDS in household consumption of food grains

(Per cent)

Year	Households accessing PDS for cereals			Share of PDS in cereal consumption		
	Rural	Urban	All	Rural	Urban	All
1993-94	26.6	29.1	27.3	7.7	11.4	8.5
2004-05	26.6	14.7	23.3	10.6	7.3	9.8
2009-10	44.9	26.2	39.4	19.3	13.2	17.8
2011-12	52.1	28.5	44.8	21.7	13.9	19.7

During 1993-94 calorie intake of people from poor quartiles was low but it considerably increased in 2004-05 and 2009-10 due to PDS access (Himanshu & Sen, 2013).

The perusal of Table 5 reveals that 45.2 percent and one-third of BPL card holders could get adequate calorie only because of the PDS in 2011-12. The results show that food transfers through PDS have a considerable impact on improving food security and thus should be further strengthened (Kumar *et al.*, 2013). The poor and weaker sections spend a major portion of their income on food and when the food grains are available at cheap and fair prices it strengthens their income base. Table 6 puts forth that owing to PDS, on an average, an amount of ₹286/person at 2004-05 prices was transferred to a household through PDS in 2011-12. This transfer accounted for only 2.2 percent of the per capita consumption expenditure of a household (Kumar *et al*., 2013).



Source: Economic Survey (2014-15).

Figure 1. Public distribution system: Procurement and offtake

Table 2. Minimum support price and central issue price of food grains

Commodity	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	CIP (₹/kg)		
	Minimum support price (₹/quintal)								BPL	APL	AAY
Paddy common	850	1000	1000	1080	1250	1310	1360	1410	5.65	8.30	3.00
Paddy grade 'A'	880	1030	1030	1110	1280	1345	1400	1450	-	-	-
Wheat	1080	1100	1120	1285	1350	1400	1450	-	4.15	6.10	2.00

Source: Commission for Agricultural Costs and Prices.

Table 4. Implicit income transfer to households

State	Average implicit subsidy (₹/month/capita)		Poverty reduction due to PDS			
			Using the Tendulkar national poverty line		Using CPI-AL based poverty line	
	Rural	Urban	HCR	PGI	HCR	PGI
Andhra Pradesh	61.70	46.60	32.800	40.60	56.1	57.2
Assam	13.70	5.60	9.20	17.90	16.3	27.2
Bihar	5.50	3.80	1.30	4.30	4.2	7.1
Chhattisgarh	70.60	43.40	17.20	39.00	44.4	56.8
Gujarat	14.40	10.00	11.80	15.30	18.7	18.7
Haryana	8.40	4.00	13.80	15.10	15.4	15.1
HP	46.10	28.80	36.10	35.30	37.9	36.9
J & K	41.70	58.90	45.00	35.30	26.4	41.5
Jharkhand	16.20	5.30	3.30	13.20	16.0	21.7
Karnataka	49.40	23.90	22.20	33.10	34.6	45.5
Kerala	37.10	28.50	33.00	36.70	39.6	38.2
MP	25.10	10.0 0	6.0 0	13.40	9.6	25.7
Maharashtra	19.00	6.2 0	18.9 0	30.00	35.5	30.1
Orissa	37.10	19.2 0	9.6 0	23.30	27.7	40.8
Punjab	8.10	5.6 0	15.80	14.40	19.6	14.9
Rajasthan	6.40	5.80	7.60	11.70	15.7	14.2
Tamil Nadu	107.30	86.00	44.40	61.30	80.3	83.4
UP	10.0	5.80	5.170	11.10	11.4	16.7
Uttarakhand	17.80	5.10	17.670	24.10	27.3	26.8
West Bengal	13.00	5.90	9.630	11.50	13.5	14.4
India	**26.2 0**	**20.20**	**10.56**	**17.60**	**16.4**	**22.4**

Table 5. Impact on food security

Year	Sector	Nutrition deficiency with TPDS	Nutrition deficiency without TPDS	Average impact on nutrition deficiency (without-with)	Average normalized nutrition gap with PDS	Average normalized gap without PDS	Average impact on NGI
2004-05	AAY	38.6	65.0	26.4	5.03	17.85	12.81
	BPL	37.0	49.4	12.4	5.20	10.05	4.85
	Other	20.9	22.8	1.9	2.42	3.38	0.96
	All card holder	25.8	31.3	5.5	3.29	5.72	2.43
2011-12	AAY	27.4	72.6	45.2	2.82	20.48	17.66
	BPL	24.5	58.8	34.3	2.61	12.48	9.87
	Other	17.0	22.2	5.2	1.70	3.13	1.43
	Allcard holder	20.4	38.5	18.1	2.11	7.66	5.55

Table 6. Trend in income transfer through PDS at 2004-05 prices

Year	Rural		Urban		All	
	PDS subsidy (₹/person)	Share of subsidy in expenditure (Per cent)	PDS subsidy (₹/person)	Share of subsidy in expenditure (Per cent)	PDS subsidy (₹/person)	Share of subsidy in expenditure (Per cent)
1993-94	86	1.3	146	1.4	101	1.4
2004-05	116	1.6	103	0.8	113	1.3
2009-10	329	3.3	262	1.4	310	2.5
2011-12	313	3.1	217	1.1	286	2.2

Issues and challenges for PDS

PDS faces severe criticism due to several issues and challenges that prevent its efficient functioning. Inaccurate identification of households, leakages, and diversion of food grains, inadequate storage capacity, non-viability of FPS and poor quality of food grains are some of the challenges faced by the system.

Inaccurate identification of households

Inaccurate identification of beneficiaries implies that food grains are not reaching the targeted recipients instead people who are not entitled to the in-kind transfers are enjoying undue benefits. These errors are referred to as an error of inclusion and exclusion. The error of inclusion means including the non-poor in the poor category and the error of exclusion implies including the poor in the non-poor category

A study conducted by Mahamalik & Sahu (2011) brings out the huge extent of targeting errors prevailing in the system. According to the study, out of the total ration cards distributed only 32.2 percent were allotted to the "consumption poor" and the remaining 67.8 percent of the "consumption non-poor" households. Around 68.8 percent of total BPL cards and 58.2 percent of AAY cards were distributed among the non-poor households. Figure 2 shows the targeting errors across different states of the country. High errors of exclusion and inclusion were reported from the majority of Indian states but the proportion of exclusion error was higher comparatively in almost all states. This proves that the eligible poor are being devoid of their due benefits from the PDS. The state of Tamil Nadu shows only inclusion error as it follows a universal PDS, hence no one is excluded from the system.

Leakages

Leakages are the most severe lacuna of PDS that pose a serious threat to the efficient functioning of the system. Leakage is defined as the difference between off-take of grains by the state and actual consumption by the beneficiaries (Gulati & Saini, 2015). Leakages may occur due to the reasons are given below:

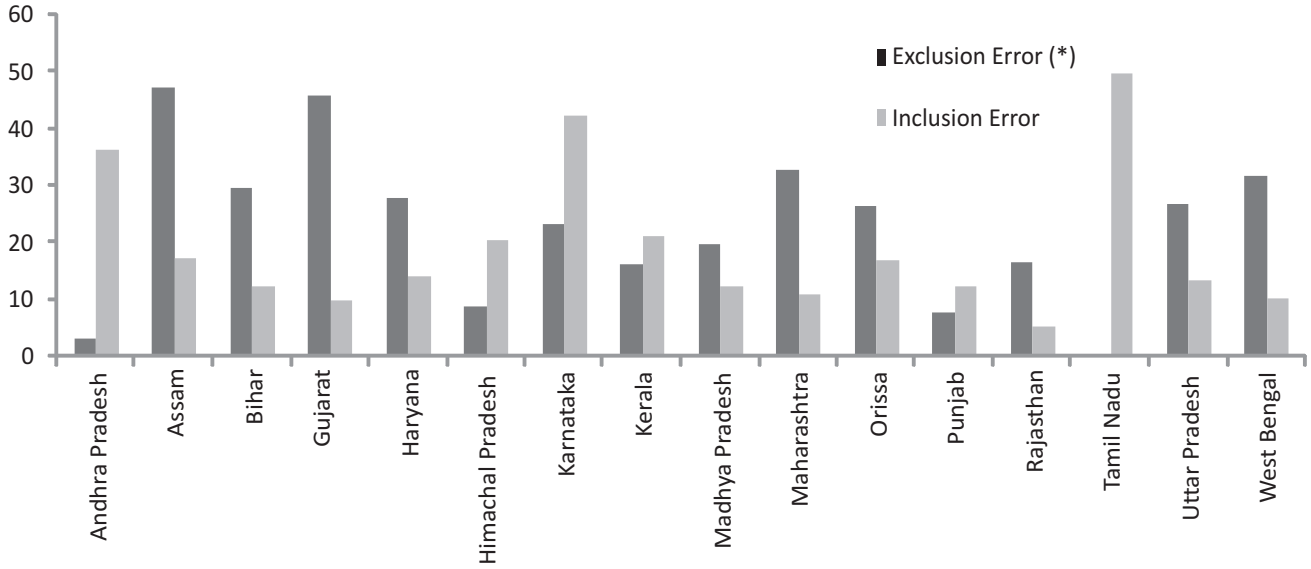
a. Ghost cards: Ration cards are made in the name of people who do not exist and hence grains are diverted for black marketing.
b. Shadow ownership: Ration cards are made for the eligible beneficiaries but the entitlements are received by non-beneficiaries on their behalf without the knowledge of the beneficiaries.
c. Diversion of food grains into open market by FPS owners.

States like Assam, Himachal Pradesh and Madhya Pradesh showed the high percentage (>30 percent) of leakages while states like Andhra Pradesh, Kerala, Haryana, Tamil Nadu showed a lower percentage of leakages (< 10 percent) through ghost cards. In leakage of food grains from FPS Punjab and Bihar ranked highest with more than 75 percent of leakages being reported whereas states like Andhra Pradesh, Kerala, and Tamil Nadu ranked low with less than 25 percent of leakage.

The PDS in the country is highly leaky to the extent that out of every 4 rupees spent on PDS, only 1 rupee reaches the poor. 57 percent of grains do not reach the intended beneficiaries. (Planning Commission, Performance Evaluation of Targeted Public Distribution System, 2005)

Figure 3 puts forth the extent of leakage from various states. 25.9 MMT (46.7 percent) grains leaked from the PDS in 2011-12.Out of the total quantity pilfered, UP stands at the top with almost 4 MMT leakage followed by West Bengal, Bihar, Maharashtra (Gulati & Saini, 2015).

Dreze & Khera (2015) estimated PDS leakages for the years 2004-05 and 2011-12 at all India level. The study



Source: Performance of Evaluation of Targeted Public Distribution System, Planning Commission, 2005.

Figure 2. Targeting errors in different states

showed that there has been a moderate decline in leakages over these years but the sharp decline was observed in states like Chhattisgarh, Odisha, and Bihar that have initiated serious PDS reforms in recent years. At the same time, a large number of states that account for high leakages like Madhya Pradesh, Maharashtra, and Uttar Pradesh showed no progress between all these years (Table 7).

Food Subsidy

Food subsidy is the difference between the economic cost and the central issue price at which the beneficiary buys the food grains. FCI and state agencies are reimbursed by the government with the food subsidy since they are responsible for procurement and selling the procured food grains at CIP. The components of food subsidy are MSP, procurement cost, and distribution cost.

The food subsidy burden has increased manifold on the exchequer which increased from ₹2850 crore in 1991-92 to about ₹107823 crores in 2014-15. This increase in the subsidy can be attributed to hike in MSP over years, accumulation of large stocks of food grains, high economic cost of food grains, high off-take under TPDS and other welfare schemes and constant CIP which has led to widening of the difference between CIP and economic cost causing a huge food subsidy burden on the exchequer (Sharma, 2012). Food subsidy has risen from 3.6 percent to 5.1 percent as a ratio of agricultural GDP from 2001-02 till 2011-12 (Gulati *et al*., 2012).

Storage Capacity

FCI's average annual rate of increase in storage capacity has been a meager 4.5 percent while the growth rate of rice and wheat stocks in the central pool has been more than 18 percent. This has led to acute storage problems. Therefore, huge quantities of grains are stored in the open under covered and plinth (CAP) storage leading to deterioration in grain quality. Overstocking of grains has negative implications on fiscal side as a higher cost is to be borne in maintaining the buffer by the government.

Table 7. State-wise leakage estimates

(Per cent)

States	Estimated leakages		Percentage reduction
	2004-05	2011-12	
Andhra Pradesh	23.2	22.0	5
Assam	88.7	50.7	43
Bihar	91.0	24.4	73
Chhattisgarh	51.7	9.3	82
Gujarat	51.7	67.6	-31
Haryana	82.7	49.0	41
HP	27.0	27.1	0
J & K	23.0	-3.7	116
Jharkhand	85.2	44.4	48
Karnataka	28.7	34.7	-21
Kerala	25.6	37.1	-45
MP	50.1	51.5	-3
Maharashtra	49.3	48.2	2
Orissa	76.3	25.0	67
Punjab	93.2	58.8	37
Rajasthan	93.9	60.9	35
Tamil Nadu	7.3	11.9	-63
UP	58.0	57.6	1
Uttaranchal	59.4	34.9	41
West Bengal	80.6	65.3	19
India	**54.0**	**41.7**	**23**

The public stock of food grains, maintained and operated by the FCI, was close to 65.3 million tonnes at the beginning of 2014, which was more than double the existing buffer stocking norm of 31.9 million tonnes for the quarter. The buffer stock with the FCI has been above the buffer norms over the years (Saini & Kozicka, 2014).

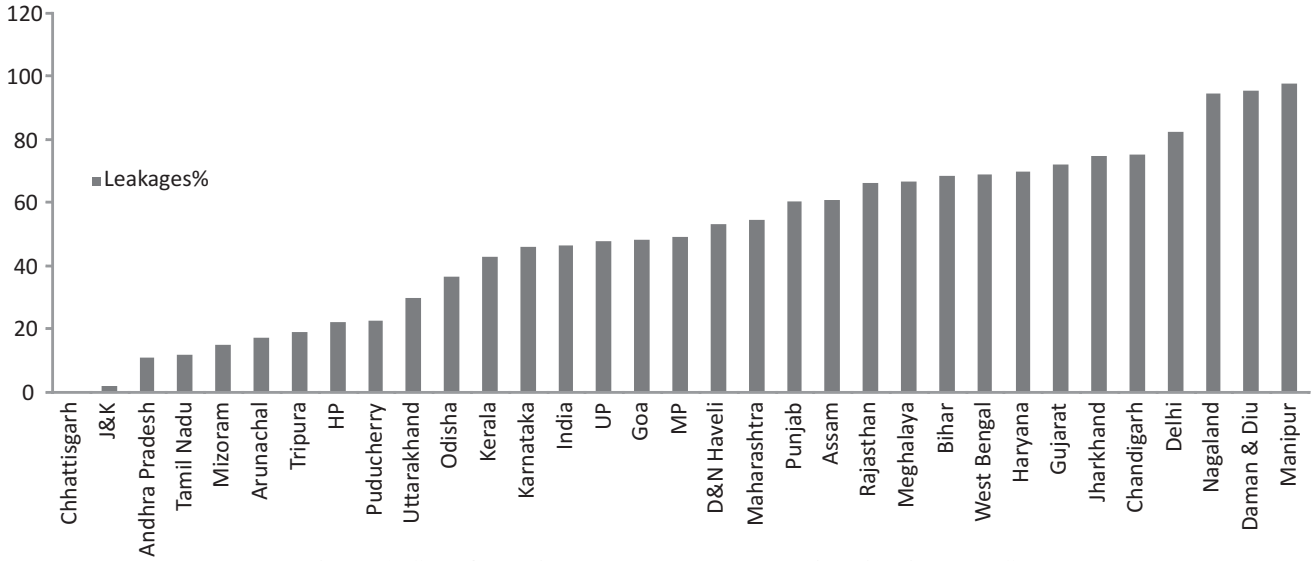


Figure 3. State/UT-wise percentage leakage of grains from PDS

Non-viability of fair price shops

Efficient functioning of Fair Price Shops is a must for the success of PDS. But, in reality, only 39 percent of the FPS around the country generate a positive net income over variable costs and 8.3 percent earn income sufficient enough to run the FPS (Planning Commission, 2005).The problems faced by FPS that lead to their non-viability are: i) dealers get low rates of commission and hence resort to malpractices ii) ration shops do not open on a daily basis, neither they keep regular hours of opening, iii) beneficiaries have to wait for hours in long queues to get their rightful entitlements iv) despite having sufficient stock with them, dealers may declare "No Stock" thus depriving the beneficiaries of their due entitlement. The grains are diverted to the open market often by the dealers to make a profit.

Mechanism to strengthen TPDS

1 Role of AADHAAR- Aadhaar would help in eliminating duplicate and ghost beneficiaries, making identification more accurate.
2 Digitisation of ration cards or issuing smart cards instead of ration cards
3 Use of GPS technology to monitor the trucks transporting food grains from FCI depots to state godowns and from state godowns to fair price shops.
4 States should undertake a campaign for a review of BPL/AAY list annually or once in three years to eliminate bogus ration cards.
5 For sake of transparency, involvement of elected Panchayati Raj Institution (PRI) members in the distribution of food grains; FPS licenses be given to Self Help Groups (SHGs), gram panchayats.
6 Wherever possible, door-step delivery of food grains should be ensured by states instead of letting private transporter/wholesalers to transport goods.
7 Timely availability of food grains at FPS level and fixed dates of distribution to ration card holders should be ensured.

Alternatives to PDS

Universal PDS

Reviving the universal PDS in the country is certainly a step towards food security. TPDS in several states has not only resulted in excluding the needy but has also failed to benefit the targeted beneficiaries. Universalization of the PDS may require an increased outlay of funds but would be a small cost to pay if it ensures food security and reduces hunger and malnourishment in the country. States like Tamil Nadu and Chhattisgarh that have been following universal PDS have the largest percentage of the population accessing PDS and considerably reduced leakages (Himanshu & Sen, 2011).

Cash Transfer

Cash transfer involves payment of cash directly to the beneficiaries by the state governments so that they can meet out their daily expenditure and food requirements. The allotted amount is provided to them through banks or post offices, enabling them to buy the commodities they prefer and thus diversify their food basket. Cash transfers provide beneficiaries with choice but also make them vulnerable to the risk of supply failures. These risks don't pose a threat in areas where there is an efficiently functioning market (Bathla, 2013).

Khera (2013) studied the preference of PDS beneficiaries between cash and in-kind transfers and found that over two-thirds of the respondents favoured in-kind food transfers rather than cash (Table 8). The preferences of the beneficiaries were based on their situation- if they had an efficient functioning PDS in their state they voiced their preference for in-kind transfer, but if the PDS functioned poorly like in Bihar the respondents preferred cash transfers.

Food coupons/ Food stamps

The food coupons are given to beneficiaries instead of direct monetary help and these can be used to purchase food grains from any grocery store. The food grains will not be provided at a subsidized rate instead the

Table 8. Performance of in-kind transfer programme and people's preferences

States	Proportion (percent) of respondents who:				
	Prefer food	Have a 'conditional preference' for food	Prefer cash	Have a 'conditional preference for cash'	Were undecided, unclear or inconsistent
Andhra Pradesh	91.3	0.8	5.6	0	2.4
Bihar	20.8	18.1	54.2	1.4	5.6
Chhattisgarh	90.3	2.1	2.1	0	4.2
Himachal Pradesh	81.4	1.7	9.3	1.4	7.6
Jharkhand	66.0	3.5	22.2	1.4	7.0
Orissa	88.3	0.7	5.8	0	5.0
Rajasthan	59.6	7.4	14.7	8.1	10.2
Tamil Nadu	70.6	8.4	10.5	2.1	8.4
Uttar Pradesh	41.5	6.7	34.1	0	17.7
All States	67.2	5.6	17.9	1.6	7.5

PER refers to the proportion (%) of official grain entitlement that households actually receive.

beneficiaries will buy food grains directly from retailers using food coupons. The retailers will be furnished with remuneration by the local banks against these food coupons. Since the shop owners receive a same and full price from both poor and rich, they will not turn the poor away from their shops. Coupons also ensure decreased corruption as the owner gets the same price from all buyers (Basu, 2010).

CONCLUSIONS AND POLICY IMPLICATIONS

PDS is one of the largest food security programmes in the world which primarily aims to improve food and nutrition security of the socially and economically vulnerable sections of the society. Over the years PDS has managed to survive the innumerable challenges but still, it is intensely scrutinized. The performance of PDS in certain states has been praiseworthy as it has provided assured food supplies to the needy. The PDS has been effective in reducing poverty, hunger as well as has been effective in strengthening income base of weaker sections by increased access to it over the years. However, a lot needs to be done to ensure efficiency in the system because, in various states, the system is still highly leaky and marked by targeting errors. PDS costs the exchequer hugely in the form of food subsidy hence quick and timely reforms are a must for the efficiency of the system. The greater political will at Centre and State level can lead to achieving efficiency in the system.

Governments both at centre and state level have taken a string of measures to strengthen the system right from digitization, incorporating computerization of entire system to the better commission to FPS dealers. Steps are being taken and improvements are being observed in the system over the years, hence, dedicated and organized efforts are required continuously to upgrade the functioning of PDS, so that the largest food security programme in the world maintains its reputation and is able to make India a food secure nation.

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Adoption of Economic and Sustainable Resource Conservation Technology (RCT) in Rice Wheat System: Zero Tillage

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ABSTRACT

The farmers had low to the moderate overall knowledge of zero tillage technology but they had full knowledge of vital aspects like seed placement in most fertile soil zone, phosphorus placement at the right depth, 15-20 litres diesel saving, more saving in comparison to conventional tillage, less population of Phalaris minor and excellent soil erosion control. Farmers had little knowledge on aspects such as ZT builds good soil structure and health, less carbon exposure to environment leading to high organic carbon in the soil. Hardly 40 percent farmers adopted zero tillage with crop residue which attributes to the addition of organic carbon essential for growth of beneficial microbes to maintain soil structure and health. Farmers opined few factors like lack of knowledgeable field functionaries, the high cost of the drill, less amount of subsidy on it, standing (anchored) stubble, inadequate extension facilities by input agencies and no credit facilities to buy new machine were the major reasons for poor or improper adoption of technology by the farmers.

Keywords
Adoption, resource conserving technology**,** rice-wheat system**,** sustainability**,** zero tillage.

JEL Codes
Q01, Q16, Q32, Q55, Q12.

INTRODUCTION

Rice-wheat is one of the predominant and economical cropping systems of Indo- Gangetic plains (IGP) of South Asia covering India, Pakistan, Bangladesh, and Nepal. It is estimated that (Rice-wheat) is followed on more than 14 m ha agricultural lands and nearly two-thirds of existing cereal supplies of the region comes from this system. These crops contribute more than 80 percent of the total cereal production and are critical to employment and food security for hundred millions of rural families (Gupta & Seth, 2007). In this system, wheat is planted with the traditional method by giving 4-6 tillage operations for the preparation of fine seed-bed. Presently, India is the second largest wheat producing country in the world after China contributing 12 percent of the total global wheat.

Haryana contributes 13.3 percent towards the national production of wheat from the 8.9 percent of wheat growing area of the country, with an average productivity of nearly 4 tonnes/ha. The area, production, and productivity averaged over last five years are 2.3 million ha, 9.3 tonnes, and 4 tonnes/ha respectively. The trend during last five years has shown a marginal decline in production and productivity from the nearly stable area of cultivation. Wheat production in the state is constant due to reduced soil organic carbon status, nutrient mining, imbalanced fertilization, crop residue burning leading to nutrient and organic carbon loss and declining water table.

Wheat is generally grown after intensive cultivation involving 6-17 tractor passes with various implements in different parts of the country (Sharma *et al*., 2005). This practice is called conventional tillage. The tillage operations are only raising the cost of production but they have no benefits for increasing the grain yield of wheat. In the years ahead there will be a steep increase in the energy demand for agriculture due to mechanization. Therefore, a need was felt to optimize energy usage by improving tillage practices and development of efficient machines for growing crops. During the past few years, research efforts were focused to reduce the cost of cultivation, increasing productivity and maintaining, rather

improving soil health. The farmers are adopting the zero tillage for planting wheat being a technology for reducing the cost of production (Dhaliwal, 2003), tillage operations, saving fuel (Yaduraju & Mishra, 2002), water, energy, time reduce the weed population, that is, *Phalaris minor*, timely planting of crop (Sen *et al*., 2002) and reduces the wear and tear of tractor (Yadav *et al.,* 2002). By definition, zero tillage seeding is a one-pass operation which places seed and fertilizer into an undisturbed seed-bed, packs the furrow and retains adequate surface residues to prevent soil erosion. The technology is mainly adopted by farmers in wheat crop. The farmers have also started use of one pass operation which places seed and fertilizer into the fine pulverized seed-bed, that is, rotavator for the sowing of wheat which is not recommended by researchers. Hence it becomes necessary to know the adoption status of climate-smart and cost-effective resource conserving technology that is zero tillage (ZT).

However, knowledge, socio-economic conditions, policy decisions, etc. play a pivotal role in the adoption of a technology. Keeping in view the importance of the above facts, the present investigation was undertaken in Haryana with the following objectives:

1. to assess farmers' knowledge level of zero tillage technology,
2. to ascertain the farmer's adoption of zero tillage with residue, and
3. to identify the factors responsible for the poor/improper adoption of zero tillage technology.

MATERIAL AND METHODS

To collect the primary data on "Adoption of Economic and Sustainable Resource Conserving Technology (RCT) in Rice-Wheat System: Zero Tillage", the respondents were selected with the multistage sampling. Zone-6 Trans-Gangetic Plains (comprising the states Punjab, Haryana, Union territories of Chandigarh, Delhi) was purposively selected and from selected zone, Haryana state was selected purposively having direct access of investigator. Further two rice-wheat growing districts of Haryana state where the maximum area was under zero tillage. Kaithal district from the eastern zone and Fatehabad from western zone were selected, purposively. Kalayat block from Kaithal and Tohana block from Fatehabad district were selected. Then from selected blocks villages viz. Kailram, Titram, and parts of Pirthala were selected, respectively. Finally, 25 farmers were randomly selected from each village and a total of 100 farmers were interviewed. The data were collected with the help of well-structured pre-tested interview schedule. The data were analyzed and tabulated after applying the statistical techniques like frequency, percentage, mean, and standard deviation.

RESULTS AND DISCUSSION

The perusal of Table 1 depicts socio-personal attributes of respondent farmers i.e. the majority of farmers belonged to young age (45.00 per cent) followed by 36.00 per cent to old age and middle age group (19.00 per cent) means that about 2/3rd of the respondent farmers belonged to productive age group i.e. young and middle age. Their potential could be utilized to introduce the innovations and modern farm resource conservation technologies essential for the profitable and sustainable development of agriculture. The vast majority of farmers had farming as their main occupation and few farmers adopted the subsidiary occupation. Similarly, majority of farmers had up to 20 years of farming experience, which can also be utilised for promotion of region-specific sustainable farming practices

Majority of farmers had education up to higher secondary (40.00 per cent) followed by primary (29.00 per cent) and even 23.00 percent farmers had done the post-graduation. The higher educational status can be best exploited for the intervention of latest scientific techniques in farming. The vast majority of farmers had no social participation (81.00 percent) followed by 16.00 percent as member Panchayat. Only 3.00 percent were members of Zila Parishad.

Pertaining to farm size, half of the respondents belonged to big farmers category followed by medium category whereas; hardly 10.00 per cent belonged to small farmers' category.

The vast majority of farmers (80.00 per cent) used neighbours, friends, relatives and other farmers as their main source of information for zero tillage followed by

Table 1. Profile of socio-personal attributes of farmers (N=100)

Variable	Category	Percentage
Age (years)	Young (up to 37)	45.00
	Middle (38-55)	19.00
	Old (above 55)	36.00
Occupation	Farming	93.00
	Subsidiary	07.00
Farming experience	<10 years	27.00
	10-20 year	28.00
	> 20 years	45.00
Education	Up to primary	29.00
	Up to higher secondary	44.00
	Graduates	04.00
	Postgraduates	23.00
Social participation	No participation	81.00
	Panchayat members	16.00
	Zila Parishad	03.00
Farm size (including leased in & out)	Up to 5 acres	9.00
	6-10 acres	41.00
	>10 acres	50.00
Information sources used for ZT	Neighbours, Friends, Relatives & other farmers	80.00
	Scientists	05.00
	Extension functionaries	15.00

field functionaries of the agriculture department whereas, hardly 5.00 per cent consulted scientists for ZT information, the most credible source of information to prove the worth since being their limited direct contact. The personal localite channels were the most used by farmers for ZT knowledge.

Farmers' knowledge level pertaining to various aspects of ZT is presented in Table 2. Seed placement in most fertile zone of soil, phosphorus placement at right depth, 15-20 litres diesel saving, more saving in comparison to conventional tillage, successful in heavy soils, less population of *Phalaris minor*, post-emergence herbicides use is necessary, excellent erosion control, no lodging, low termite population, 1-2 days earlier germination than CT and labour saving were the aspects on which farmers had full knowledge whereas, they had less knowledge on aspects such as ZT builds soil structure and health, insect population especially, yellow stem borer does not increase in rice after wheat using ZT technology, less carbon is exposed to environment. Farmers possessed good knowledge on aspects such as no water stagnation problem, stubbles up to 15 inches not a problem, excellent soil moisture conservation, population of rats does not increase, crop vigour is better than CT, etc. but this vigour is visible at alater stage. The findings are in agreement with past study by Singh *et al.* (2009).

Differential overall knowledge of farmers presented in Table 3 clearly shows that the farmers had low to moderate knowledge of zero tillage technology since 78.00 percent of farmers belonged to these categories (Singh *et al.,* 2009). Only 22.00 percent had high knowledge pertaining to zero tillage. The knowledge is a prerequisite to making full use of any technology hence more sincere efforts are required to enhance the farmers' proper technical knowledge to make efficient and best use of this economic as well as sustainable resource conservation technology especially with crop residue to maintain the organic carbon and improving the soil health.

It is obvious from results presented in Table 4 that only 39 percent of the farmers used the zero tillage with crop residue, which is essential for proper adoption of zero tillage in the rice-wheat system. It was also observed that majority of these farmers used either in manual harvesting or using the tractor mounted cutter to spread the residue of paddy (especially in case of Paddy variety PB-1), few farmers had used in combine harvested field since maximum area of paddy was under basmati group like variety Pusa-1121 and CSR-30 attributed to easy sale of straw of these varieties in the field there itself. A very low market price of paddy was the main reason for ZT adoption to reduce the production cost by the vast

Table 2. Farmers' knowledge pertaining to zero tillage technology

(N=100)

Statement	Percentage
Seed is placed in the most fertile soil zone	100.00
Phosphorus is placed at right depth in the soil with ZT drill	100.00
Phalaris minor population is less in ZT than in CT	100.00
Use of post-emergence herbicides is necessary	100.00
The diesel saving is in the range of 15-20 litres/acre	100.00
Zero-tillage is successful only in heavy soils	100.00
Lodging is not a problem in ZT	100.00
Excellent erosion control	100.00
More saving in ZT technology than CT	100.00
The population of termite does not increase.	99.00
Germination of wheat under ZT is 1 - 2 days earlier than CT	96.00
Labour saving in ZT technology	94.00
Ideal soil moisture condition for sowing with ZT reach earlier than CT	92.00
The crop vigour is better than CT	89.00
Water does not remain stagnant in ZT after irrigation	88.00
Standing (anchored) stubbles of rice up to 15" is not a problem	83.00
Excellent soil moisture conservation	83.00
The population of rats does not increase	81.00
The yield in ZT field is more than in CT	73.00
Insect population especially, yellow stem borer does not increase in rice after wheat using ZT technology	46.00
Less carbon is exposed to environment	35.00
Straw burning	35.00
Builds soil structure and health	34.00

Table 3. Distribution of farmers on overall knowledge of zero tillage

(N=100)

Category	Score range	Frequency	Percentage
Low	16-18	29	29.00
Moderate	19-21	49	49.00
High	>21	22	22.00

Mean= 19.81 S.D=1.89

Table 4. Distribution of farmers on the basis of use of residue in zero tillage

(N=100)

Zero tillage method	Percentage
With residue	39.00
Without residue	61.00

majority of farmers. The findings are in consonance with the study (Singh *et al.*, 2009) reported that farmers face problem in seeding wheat crop in full crop residue.

The perusal of Table 5 depicts factors for poor adoption of zero tillage technology by farmers. Lack of knowledgeable field functionaries, high cost of drill, neighbours find the farm untidy, less amount of subsidy on machine, standing (anchored) stubble, inadequate extension facilities by input agencies, lack of illustrated farm literature, no credit facilities to buy new machine was the major reasons perceived by farmers for poor adoption since they highly depend upon field staff for technical advice as well as subsidy matters and for the inputs on input dealers which are primarily concerned with their profits instead of technical advice (Singh *et al.*, 2009).

No ideal moisture condition at the time of sowing due to early harvesting of rice, non-availability of quality drill, appropriate moisture at the time of sowing , no ideal moisture condition at the time of sowing due to late harvesting of rice, more population of weeds at the time of drilling, increased problem of yellow stem borer, access to cover crop seeds requirement, were not perceived any hindrance to adoption of zero tillage method attributed to area being endowed with assured irrigation facilities as per paddy requirement so appropriate moisture not a matter of concern in adoption of ZT and also farmers expressed that access to cover seeds was not any problem but satisfied to place the seeds at most fertile zone due presence of residue in field.

Lack of appropriate loose straw management (Singh *et al.*, 2009), lack of money to purchase the ZT drill, lack of local manufacturer facility, etc. were of moderate concern by the farmers due to straw of manual harvesting is sold by the farmers in the field there itself and they also expressed that Tohana being hub of farm machinery in Fatehabad and similarly Kaithal being in vicinity also fulfilled the requirement of machinery

Table 5. Factors for poor adoption of zero tillage technology by farmers

(N=100)

Statement	Percentage
Lack of knowledgeable field functionaries	100.00
High cost of drill	100.00
Neighbours find the farm untidy	99.00
Less amount of subsidy on machine	95.00
Standing (anchored) stubble	91.00
Inadequate extension facilities by input agencies	90.00
Lack of illustrated farm literature	84.00
No credit facilities to buy new machine	77.00
Lack of appropriate loose straw management	67.00
Lack of money to purchase the ZT drill	63.00
Lack of technical knowledge of ZT	53.00
Hardening of upper layer of soil	52.00
Lack of local manufacturer facility	45.00
Slow soil warming on poorly drained soils	36.00
Straw burning	35.00
Extra cost for herbicides due to no incorporation	23.00
Requires access to cover crop seeds	23.00
Increased problem of yellow stem borer	16.00
More population of weeds at the time of drilling	15.00
No ideal moisture condition at the time of sowing due to late harvesting of rice	14.00
Non-availability of quality drill	12.00
Appropriate moisture at the time of sowing	11.00
No ideal moisture condition at the time of sowing due to early harvesting of rice	05.00

CONCLUSION AND POLICY IMPLICATIONS

Farmers had fairly good overall knowledge of zero tillage technology but they were fully aware of aspects like seed placement in most fertile soil zone, placement of fertilizers at the right depth, more saving, excellent soil erosion control and less weedy population. The proper adoption of zero tillage was very low i.e. only 39 percent farmers adopted ZT with crop residue which is crucial to maintaining the organic carbon, stop nutrient mining and imbalanced fertilization to enhance the productivity and sustainability of rice-wheat cropping system so there is need of concerted efforts such as

a. More educational programmes should be organised to change the attitude of farmers towards untidy fields
b. To build up the confidence of farmers that incorporation of crop residue in the soil not only helps in maintaining soil fertility but also it builds soil structure and health. This is more economical in comparison to sell the loose straw so a number of long-term farmers' field demonstration need to be organized to provide the technical literacy to prove the worth of good soil structure and health issues.
c. There is need to develop a mechanized technology to incorporate residue in the soil in situ in shortest period instead of pallet making which is labour intensive along with time-consuming
d. Farmer participatory validation of the stem borer incidences in ZT fields in comparison to CT
e. Similar in case of rats population, some farmers observation was that the holes remain as such in field

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Economic Analysis and Feasibility of Tractor Operated Cotton Harvesters

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ABSTRACT

India is the first country in having a maximum area under cotton crop, second in yarn production and third in raw cotton production in the world. However, entire cotton is picked by human labour involving about 517 man h/ha. A 3-row finger type cotton stripper and single row cotton picker have been developed indigenously and the cost economics has been calculated as per the standard procedure to determine the feasibility and economic viability of the machines. It has been estimated that the break-even point (BEP) calculated on an area basis for a cotton stripper and cotton picker was 1255 and 1543 ha respectively. The payback period calculated on year basis for the cotton stripper and cotton picker was found 3.17 and 6.43 years respectively. Cost of harvesting done by the cotton stripper and cotton picker can save cost up to 57.48 and 44.42 percent respectively as compared to the hand picking.

Keywords
Break-even point, cost economics, cotton stripper, payback period.

JEL Codes
C82, L64, O13, Q16.

INTRODUCTION

Cotton fabric alone accounts for half of the fiber worn in the world. It is estimated that the world demand for all fibres is expected to rise in volume terms from 74 million tonnes in 2010 to 95 million tonnes in 2020 (Barik, 2010). Cotton is an important commercial crop in India, having 11.7 Mha cultivated area which is the largest in the world. India is the largest producer of cotton in the world but the yield is much less than as compared to the world average yield. In India, the average yield of cotton is only 540 kg/ha as compared to 2151 kg/ha in Australia and as against the Worlds average of 766 kg/ha (India Stat, 2014). Cotton picking is one of the major labour-intensive operations in cotton cultivation consuming the major share of the expenditure. The labour requirement for cotton picking is reported to be about 517 man h/ha (Kohli *et al.,* 2015). It was not only tedious but also ten times costlier than irrigation and about twice costlier than the weeding operation (Sharma *et al.,* 2015). A grown-up person can pick about 15-20 kg seed cotton/day, compared to an average pick of 870-2180 kg seed cotton/day by a single row spindle type picker (Sandhar, 1999).

Cotton has a continuous flowering and fruit formation order depends on its genotypes and environmental conditions which makes field operations especially harvesting/picking of cotton very difficult. Thus, for picking the cotton, it becomes necessary to control the vegetative growth of plants by using plant growth regulator or cotton harvesting aid materials. Since the varieties used in our country require cotton picking at several stages, the feasibility of using mechanical cotton pickers is remote as in the case of defoliated picking method (Singh *et al.,* 2017).

Due to the impending scarcity of labour, mechanization of cotton harvesting is considered to be of vital importance. But, there are some reasons due to which cotton harvesters are not popular in India. Cotton varieties grown in India are the determinate and bushy type. The holdings are small and fragmented. High initial cost of cotton pickers and their higher

capacity, made their use uneconomical or impossible for small or medium-sized farms. Keeping all these factors in view, a tractor operated cotton stripper has been developed in collaboration with Punjab Agricultural University, Ludhiana and Mahindra Applitrac, Mohali (Mishra, 2017). Such development would pave the work for mechanization of cotton cultivation. Besides, the majority of our farmers cannot economically afford to go for mechanical harvesting and at the same time, they cannot depend entirely upon the conventional methods of cotton harvesting (manual harvesting) which suffer from acute inadequacy in the critical period and also it is becoming costlier day by day. The main objectives of this paper were to analyze total cost of the machine and to determine the feasibility and economic viability of the tractor operated cotton stripper in Indian farms.

MATERIAL AND METHODS

Tractor Operated Cotton Stripper

The tractor operated cotton stripper is mounted on Swaraj 855 tractors (55 hp). This cotton stripper having four major assembly names are header unit, feeder unit, cleaning unit and storage unit. Header unit is three-row finger type with reel and conveying auger unit. The designed cotton header works on the principle that when the header moves through the cotton field due to its forward motion, inclined fingers will strip the cotton bolls with burs including green bolls, sticks, and leaves from the plants. Cotton bolls with shells/burs are stripped from the plants with the help of a series of stationery inclined fingers having a narrow gap between the fingers. The stripped materials displace upward to the inclined fingers with the force of next group of plants being stripped. A reel/paddle/kicker mounted at the rear-side of the fingers assist to convey the stripped materials to the conveying auger. The materials are conveyed through the feeder to cleaner unit. Here, burs including green bolls, sticks, and leaves were removed with the help of cleaner. After cleaning, seed cotton depot into the storage tank. The main specifications and operational view of developed tractor operated cotton stripper is given in Table 1 and Figure 1.

Tractor Operated Cotton Picker

The tractor operated cotton picker (Make John Deere) is mounted on John Deere 5050 E tractor (55 hp). The machine was single row spindle type cotton picker having three major assemblies i.e. header unit, conveyor unit, and storage unit. Spindle machines, use prongs to push into the cotton bolls and then twist to cleanly remove the cotton, leaving behind the burr attached to the stem. The machine has doffers unit with lugs that pull the cotton from the prongs and drop it into the machine's conveyor system, which then uses air to transport the cotton into a basket on the machine. The main specifications and operational view of developed tractor operated cotton stripper is given in Table 1 and Figure 1.

Performance of the Machines

The picking efficiency of the tractor operated cotton stripper was between 90-95 percent, at the ground and stalk loss of 0-10 percent, trash content 20-25 percent (on seed cotton basis) and the field capacity of the machine was 0.5-1.0 ha/hr observed. The operating speed of cotton picker was about 5.0 km/hr. The picking efficiency of cotton picker was 75 -80 percent. Ground and stalk loss was 20-30 percent. Trash content (crushed leaves, small sticks, dust particles, etc.) of mechanically picked cotton was 26.86 percent (on seed cotton basis). The rest of trash content would be clean at ginnery using pre-cleaner.

The efficiency of the cotton stripper was observed as 90-95 percent whereas for cotton picker it was quite lesser (75-80 percent). The trash content (crushed leaves, small sticks, dust particles, etc.) of harvested seed cotton in case of cotton picker was ranged from

Figure 1. Operational view of tractor operated cotton stripper (A) and cotton picker (B)

Table 1. Main specifications of the tractor operated cotton stripper and cotton picker

Description	Tractor operated cotton stripper	Tractor operated cotton picker
Tractor Power, hp	55	55
No of rows	3	1
Picking mechanism and Header unit		
Type	Finger type	Spindle type
Number of fingers/spindles	39	600 (20 spindle per bar)
Number of drum	-	2 (each drum have 15 bar)
Harvesting width, mm	2050	800
Reel/Paddle/doffer		
Type	Paddle type	Lugs type
Number of paddle	18	40 (20 for each drum)
Rotational speed, rpm	40	60
Conveying mechanism		
Type	Auger type (Screw Conveyor)	Pneumatic conveyor
Rotational speed, rpm	162	
Feeder unit		
Type	Belt and flight type	Pneumatic conveyor
Length, mm	4080	
Storage Tank		
Type	Perforated sheet and nest type	Perforated sheet and nest type
Capacity, kg	300	300
Power transmission	Chain-sprockets and V- Belts	Gear and V- Belts
Overall dimensions, mm	2050 X 2530 X 6235	-
Cleaning Unit		
Type	Chanel saw band cylinder type	-
Capacity, kg/h	2000	-

20-30 percent and for the cotton stripper, it was about 20-25 percent.

Economic cost of Tractor Operated Cotton Stripper and Cotton Picker

Cost of operation of tractor operated cotton stripper was estimated assuming that cotton stripper is attached to a new tractor and it is compared with commercially available tractor operated, spindle type cotton picker made by John Deere India Pvt. Ltd. It was assumed that harvesting window of the cotton crop for north, central and south parts of India was 25 days. Hence, the total working day per year was cumulatively 75 days. Similarly, the total working hour in one year was 600 hr. Total wear out the life for both of machines was considered 10 years or 6000 hr. The assembling and dismantling charges were included in maintenance cost for both of machine. Break-even point (BEP) area wise as well as year wise (Payback period) was also calculated as per standard cost estimation methods (BIS: 9164-1979) which is shown in.

Table 2. Mathematical formulas for cost calculation

Parameter	Formula	
Depericiation	$D = \frac{C - S}{L}$	Where D = Depriciation (₹/year) C = Capital cost (₹) S = Solvage Value (₹) L = Useful machine life (year)
Solvage value	$S = C\ \ 10\ percent$	
Intrest	$I = \frac{(C + S)}{2} \times r\%$	r = rate of intrest
Break even point (area wise)	$BEP = \frac{P}{H - V}$	BEP = Break even point (ha) P = Total cost per year H = Harvesting rate (₹/ha) V = Running cost (₹/ha)
Break even point/Pay Back Period (year wise)	$PBP = \frac{A}{BEP}$	A = Total area covered (ha/year)

RESULTS AND DISCUSSION

The cost of operation of tractor operated cotton stripper was estimated on the basis of cotton stripper using a new tractor and compare with the cotton picker.The cost of ownership of tractor operated cotton stripper and cotton picker are depicted in Table 3. The total fixed cost per year of cotton stripper and cotton pickers were ₹279900 and ₹578500 respectively. The total variable cost per year of cotton stripper and picker were ₹292000 and ₹377000, respectively. The total cost per year cotton stripper and cotton pickers were ₹571900 and ₹955500, respectively. The total area covered annually was calculated 396 ha by assuming

Table 3. Cost of ownership of tractor operated cotton stripper

Description	Cotton stripper with tractor (₹)		John deere picker with tractor	
	Value	Cost per year	Value (₹)	Cost per year
Cost of machine	800000		2500000	
Cost of tractor	750000		750000	
Total capital cost	1550000		3250000	
Depreciation	139500	139500	139500	139500
Total interest	106562.5	106563	106563	106563
Insurance + Tax	17050	17050	35750	35750
Housing cost	16788	16788	30813	30813
Total fixed cost		**279900**		**578500**
Maintenance cost	77500	77500	162500	162500
Operator's charges (per day)	800	60000	800	60000
Fuel and lubrication cost per year	154500	154500	154500	154500
Total variable cost		**292000**		**377000**
Total cost per year (8+12)		**571900**		**955500**
Total area covered per year	396		240	
Harvesting rate (₹/ha)	2500		4500	
Total earning (Annual)		990000		1080000
Profit / Loss (annual)		418100		124500
Running cost (per ha)		1444		3981
Profit / Loss (per ha)		1056		519
Break-even point (Area-wise)		1255		1543
Payback period years (Year-wise)		3.17		6.43

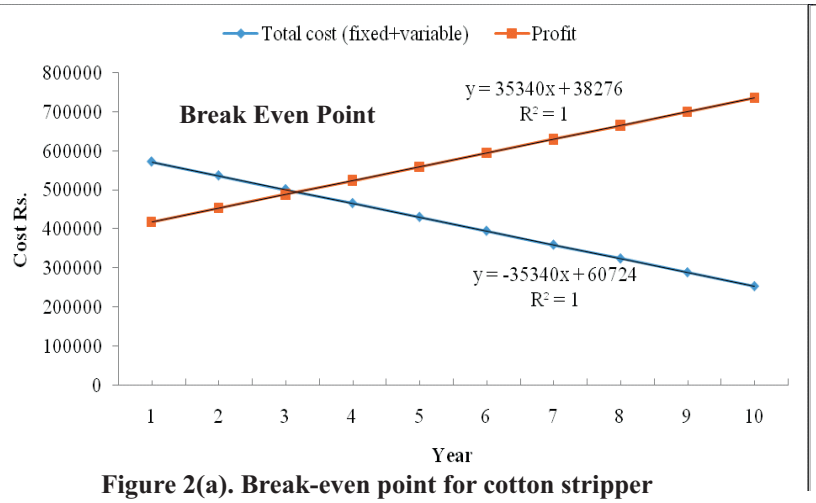

Figure 2(a). Break-even point for cotton stripper

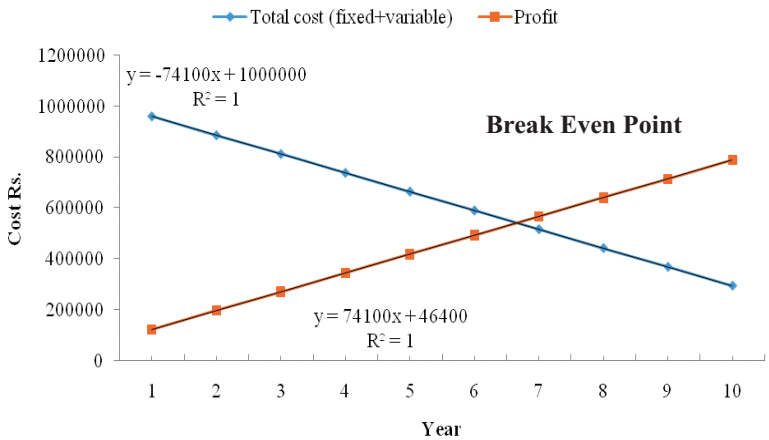

Figure 2(b). Break-even point for cotton picker

Table 4. Economic analysis for cotton harvesting

(₹)

Cost terms	Cotton stripper with tractor	John Deere Picker with tractor	Manual
Cost of operation	953.17	1592.50	-
Operating time (h/ha)	1.52	2.50	517*
Operational cost (₹/ha)	1449	3981	19386**
Defoliation cost	6793	6793	-
Total operating cost	8241.81	10774.25	-
Cost saving over manual	11144.20	8611.75	-
Cost saving (Per cent)	57.48	44.42	-

Prasad et al., 2004.

**** 64.62 man - days/ha, wages @₹ 300 per day (8 h) per man day***

cotton harvesting period of 75 days and field capacity of the 0.6 ha/h for the cotton stripper. Similarly, The total area covered annually was calculated 240 ha by assuming cotton harvesting period of 75 days and field capacity of the 0.4 ha/h for the cotton picker. The cost of harvesting calculated for the cotton stripper and cotton picker was ₹1 and ₹2 per kg. Material harvested by the header having trash (leaves, sticks, and cotton with outer burs) need to be removed and separated to obtain clean seed-cotton. To separate the trash from the harvested material additional cleaning charge was employed. The cost of cleaning calculated for the cotton stripper and cotton picker was ₹1.5 and ₹1 per kg.

The break-even point for the cotton stripper and cotton picker is depicted in Figure 2(a) and (b). The break-even point (BEP) calculated on the area basis for the cotton stripper and cotton picker was 1255 and 1543 ha respectively. The payback period calculated on year basis for the cotton stripper and cotton picker was 3.17 and 6.43 year respectively.

The estimated operating cost of cotton stripper and cotton picker was ₹1066.08 and ₹1592.50 per h. The machine took an estimated time of 1.52 hour for the cotton stripper and 2.50 hour for the cotton picker to harvest in one hectare. While manually it requires about 517 hours to pick the seed cotton in one hectare (Prasad *et al*., 2004). The economics comparison between the manual picking and harvesting by the tractor operated cotton stripper and cotton picker are given in Table 4.

Since the hand picking of cotton involves a huge amount of labour. Hence, harvesting done by cotton stripper can save cost up to 57.48 percent as compared to the hand picking. While cotton picker can save 44.42 percent.

CONCLUSIONS

1. The break-even point (BEP) calculated on the area basis for the cotton stripper and cotton picker was 1255 and 1543 ha respectively.
2. The payback period calculated on year basis for the cotton stripper and cotton picker was 3.17 and 6.43 years respectively.
3. Cost of harvesting done by the cotton stripper and cotton picker can save cost up to 56.13 and 42.65 percent respectively as compared to the hand picking.

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Effect of Working Capital Management Practices on Working Capital Efficiency-A Case from Agribusiness Sector

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ABSTRACT

Working capital is an important part in firm's financial management decision. Inefficient management of working capital suffers firms, so an optimum level of working capital and its efficient utilization is the key to a smooth inflow of profit. In the present study, the various components of working capital which includes cash management, receivables management, and inventory management were analyzed and the relationship between Working Capital Efficiency Index (WCEI) and working capital management practices. The study sample consisted of 40 coconut oil mills in Western Tamil Nadu and the data collected for the five-year period from 2009-10 to 2013-14. The overall working capital efficiency index indicated that the oil mills inefficient category had efficiently managed their working capital and generated sales. The multiple regression analysis revealed that 31.3 per cent of the variations in working capital efficiency was explained by the independent variables included in the model. Among the three independent variables, the effect of Working Capital Cash Management (WIM) practices was the highest on working capital efficiency. Effective cash management reduces the length of the cash conversion cycle which improves the financial performance of coconut oil mills.

Keywords:
Regression analysis, working capital, working capital efficiency, working capital efficiency index, working capital management, working capital management practices .

JEL Codes
M13, L26, Q13, Q14.

INTRODUCTION

According to Atrill (2006), working capital management involves the planning and controlling of current assets and liabilities in a manner that eliminates the risk of inability to meet short-term obligations and avoid excessive investments in those assets. Working capital management involves the relationship between a firm's short-term assets and its short-term liabilities. The goal of working capital management is to ensure that a firm is able to continue its operations and that it has sufficient ability to satisfy both maturing short-term debt and upcoming operational expenses. The management of working capital involves managing inventories, accounts receivable and payable and cash.

Working capital management is an integral part of the financial management of an undertaking. There have been instances when major giants have fallen down due to an inefficient working capital management. Thus, the working capital management should aim at having balanced; optimal proportions of the working capital management components to achieve maximum profit and cash flow. While an excessive working capital leads to an inefficient use of funds; inadequate working capital interrupts the smooth flow of business activity and in result profitability. Thus, the need to have an adequate amount of working capital in a firm cannot be ignored in any respect. Its efficient utilization is equally important, as the level of utilization is the key to profitability in the longer run.

DATA BASE AND METHODOLOGY

Guthmann & Kunze (1953) defined working capital as the portion of a firm's current assets, which are financed from long-term funds. Chiou *et al.* (2006) explained working capital as the investment by the organization on its current assets and debts. Afza & Nazir (2011)

evaluated the working capital performance and utilization as well as the total efficiency of the working capital management of cement sector of Pakistan for the period of 21 years, i.e. 1988-2008. They measured the working capital efficiency in terms of utilization index, performance index and total efficiency index as suggested by Bhattacharya (1997). They also tested the speed of achieving the target level of efficiency by an individual firm during the period of study with that of industry norms as the target level of efficiency. Findings of the study indicated that the cement sector as a whole did perform well during the study period. They also found that there existed a very high degree of inconsistency, which pointed out the need for adoption of sound working capital policies by those firms. Bieniasz and Golas (2011) presented the results of working capital management efficiency in the food industry in Poland and selected countries of the Eurozone. The research was conducted on the basis of the unpublished data by the Polish Central Statistical Office in the trade structure and dimension of food industry enterprises in Poland in the period of 2005-2009, and comparatively, in respect of the food sector in selected Eurozone countries. The working capital management efficiency was assessed by means of the inventory, accounts receivables, current liabilities turnover cycles, cash conversion cycle, and in respect of the obtained rates of return from non-financial assets. The research proved that in the food industry sectors with the shortest working capital cycles, relatively higher rates of profitability were obtained. A favorable influence of working capital cycles reduction of the profitability was also verified by means of a multiple regression analysis. Goel (2013) analyzed the working capital efficiency in the Indian retail industry. He collected the secondary data from the annual reports and other related documents of selected retail firms. He evaluated the various components of working capital; appraised the utilization of current assets and found out the relationship between working capital efficiency and profitability. The research results showed that proper working capital management helped inefficient utilization of resources.

Sampling Design and Data Collection

The list of coconut oil mill was collected from Coconut Oil Mill Association and District Industries Centre (DIC) for Western Zone (Tiruppur and Coimbatore) of Tamil Nadu. The list comprised of 126 coconut oil mills in Tiruppur and 15 oil mills in Coimbatore districts. From that list, 40 coconut oil mills were selected by simple random sampling method.

Five year period from 2009-10 to 2013-14 was considered for evaluating the financial performance and efficiency of coconut oil mills in Western Tamil Nadu. The entire study profoundly relied on the interview schedule (financial management practices) and secondary data (balance sheet, income statement and cash flow statement) from the annual reports of the coconut oil mills.

RESULTS AND DISCUSSION

Overall Working Capital Efficiency Index of Coconut Oil Mills

Based on the Overall Working Capital Management Efficiency Index (EI_{WCM}), the coconut oil mills were classified as efficient and inefficient category (Afza and Nazir, 2011). Oil mills having EI_{WCM} more than one ($EI_{WCM} > 1$) were classified as an efficient category and less than one ($EI_{WCM} < 1$) were under the inefficient category. The results are presented in Table 1.

The working capital efficiency index was greater than unity for all the years, which showed that the working capital position was satisfactory. For the year 2013-14, the index was at a lower level when compared to previous years. It was due to increase in the price level of raw materials, which led to the huge accumulation of funds in inventory and resulted in poor working capital position. Inefficient use of various components of working capital leads to increase of current liabilities proportionately at a faster rate than current assets and results in worsening of working capital position. Thus, there is a need for managing either the individual components of current assets or the current assets as a whole for generating more sales revenue. The overall performance of selected samples was efficient as evident from EI_{WCM} of 1.63.

Working Capital Management Practices of Coconut Oil Mills in Western Tamil Nadu

Working capital management practices comprised of cash management practices, receivables management practices, and inventory management practices of coconut oil mills in Western Tamil Nadu.

Cash Management Practices of Coconut Oil Mills in Western Tamil Nadu

Cash management practices focused on the frequency of cash budgeting, determination of target cash balance and occurrence of cash surplus or shortages. The score reflecting the frequency of adoption of cash management practices, t-test results, and coefficient of variation (CV) inefficient and inefficient category oil mills are presented in Table 2.

Table 1. Overall working capital efficiency index of coconut oil mills

Categories / Year	2009-10	2010-11	2011-12	2012-13	2013-14	Average EI_{WCM}
Efficient category (N_1=28)	2.09	2.80	3.31	2.62	1.71	2.51
Inefficient category (N_2=12)	0.54	0.55	0.72	1.27	0.72	0.76
Annual average	1.32	1.67	2.02	1.95	1.21	1.63

The results of t-test from the Table 2 revealed that there was a significant difference in mean score for preparation of cash budgets between efficient and inefficient category. The mean scores for determination of target balance and occurrence of cash shortage/surplus between the efficient and inefficient category of oil mills did not differ significantly. Hence, it is concluded that the preparation of cash budgets significantly influenced the efficiency.

The mean score of the efficient category was higher (3.93) than the inefficient category (3.42). The score indicated that inefficient category was not concentrating on the preparation of cash budgets, hence faced the problem of occurrence of cash shortage/surplus. They did not invest temporary cash surpluses for profit and most of them had problems on how to invest temporary cash for profitable purposes. Scarborough & Zimmerer (2003) reported that small businesses reserve cash and maintain relatively high current ratios to ensure that they do not run out of cash hence the conclusion that the management of cash surpluses rather than cash shortages was a problem for Small Scale Enterprises (SSEs).

Receivables Management Practices of Coconut Oil Mills in Western Tamil Nadu

Regarding receivables management practices, respondents were asked, whether they made credit sales, had credit guidelines for the customers and frequency of review of the levels of receivables and bad debts. The data were analyzed and the mean score of receivables management practices, the coefficient of variation (CV) and t-test results of efficient and inefficient category oil mills are presented in Table 3.

It could be inferred from the Table 3 that there was a significant difference in mean score of selling products on credit and setting up credit guidelines for customers between the efficient and inefficient category oil mills. Review of the level of receivables and review of the level of bad debts were not significant. Setting up credit guidelines for customers in efficient category got the score of 3.57 followed by selling products on credit (3.39). Hence, it is concluded that selection of creditworthy customers would increase the credit sales, which in turn improved the profitability of oil mills. Review of the level of receivables got the highest score of 4.0 in the inefficient category. The other three practices got the lowest score of less than three. The coefficient of variation of all the receivables management practices except a review of the level of receivables in both the categories was high, which indicated higher inconsistency in receivables management practices followed by coconut oil mills in Western Tamil Nadu.

In the inefficient category, setting credit guidelines for their customers were not practiced at the required level, which affected the receivables and ended with an accumulation of bad debts. Consequently, the practice of selling product on credit was at lower level, which ultimately affected the financial performance.

Inventory Management Practices of Coconut Oil Mills in Western Tamil Nadu

On inventory management, respondents were asked how frequently they prepared inventory budgets and reviewed their inventory levels. The results on the mean score of receivables management practices, the coefficient of variation (CV) and t-test of inventory management practices for the efficient and inefficient category are presented in Table 4.

The t-test revealed that the mean score preparation of inventory budget of efficient (3.46) and inefficient (2.42)

Table 2. Cash management practices of oil mills in Western Tamil Nadu

Cash management practices	Efficient category (N_1=28)		Inefficient category (N_2=12)		t-test
	Score	CV	Score	CV	
Preparation of cash budgets	3.36**	32.64	2.50	46.71	2.166
Determination of target balance	3.04	41.55	3.25	44.74	-0.467
Occurrence of cash shortage / Surplus	3.93	26.77	3.42	31.72	1.381

***** Significant at 0.05 level.***

Table 3. Receivables management practices of oil mills in Western Tamil Nadu

Receivables management practices	Efficient category (N_1=28)		Inefficient category (N_2=12)		t-test
	Score	CV	Score	CV	
Selling products on credit	3.39**	41.94	2.25	65.99	2.258
Setting up credit guidelines for customers	3.57**	39.57	2.67	41.22	2.545
Review of level of receivables	3.61	29.55	4.00	23.84	-1.152
Review of level of bad debts	2.61	46.79	2.50	42.64	0.307

***** Significant at 0.05 level.***

category oil mills was statistically different. Hence, it could be concluded that the preparation of inventory budget might be significantly associated with efficiency. Inefficient category, preparation of inventory budgets got the highest score of 3.46 compared to the review of the level of inventory (3.29), which helped them to avoid accumulation of funds as idle. Oil mills in the inefficient category had the lowest score of less than three for the preparation of inventory budgets and review of inventory levels.

Thus, it is concluded that preparation of inventory budgets and review of inventory levels would help the oil millers to keep their short-term liquidity position at the required level, which would increase the financial performance.

Relationship between Working Capital Management Practices and Working Capital Efficiency Index

Spearman's rho correlation coefficient was estimated to analyze the relationship between working capital management practices and working capital efficiency index. The results are presented in Table 5.

The correlation results presented in Table 5 revealed that there was a strong positive correlation (r = 0.482 **) between Working Capital Efficiency Index (WCEI) and Working Capital Cash Management practices (WIM); Working Capital Efficiency Index and Working Capital Inventory Management practices (0.348*); It indicated that WCM and WIM are significantly different with WCEI.

Effect of Working Capital Management Practices and Working Capital Efficiency Index - Multiple Regression Analysis

The effect of working capital management practices on working capital efficiency index was analyzed using multiple regression analysis. The results are presented in Table 6.

Table 4. Inventory management practices of oil mills in Western Tamil Nadu

Inventory management practices	Efficient category (N_1=28)		Inefficient category (N_2=12)		t-test
	Score	CV	Score	CV	
Preparation of inventory budgets	3.46 **	28.57	2.42	62.67	2.248
Review of inventory level	3.29	38.49	2.50	44.72	1.495

*** Significant at 0.05 level.*

Table 5. Relationship between working capital management practices and working capital efficiency index

(N=40)

Particulars		WCEI	WCM	WRM	WIM
WCEI	Correlation coefficient	1.000	0.482***	-0.064	0.348**
	Sig. (2-tailed)	.	.002	.696	.028
WCM	Correlation coefficient		1.000	-0.087	0.140
	Sig. (2-tailed)		.	.594	.388
WRM	Correlation coefficient			1.000	-0.036
	Sig. (2-tailed)			.	.824
WIM	Correlation coefficient				1.000
	Sig. (2-tailed)				

Table 6. Effect of working capital management practices on working capital efficiency index

(N= 40)

Variables	Unstandardized coefficients		t-value	Sig.	Collinearity statistics (VIF)
	b	Standard error			
Constant	-1.151	1.095	-.516	0.609	
WCM	0.571***	.154	2.939	0.006	1.016
WRM	-0.111	.200	-0.556	0.582	1.006
WIM	0.434**	.203	2.136	0.040	1.013
	R Square : 0.313;		Durbin-Watson: 2.099		

Dependent Variable: WCEI.
*** and ** Significant at 0.01 and 0.05 level.*

The R square (0.313) indicated that 31.3 percent of the variations in working capital efficiency was explained by the independent variables included in the model. Value of Durbin-Watson (2.099) revealed that there was no autocorrelation in the sample.

Among the three independent variables, the effect of Working Capital Cash Management (WIM) practices was the highest on working capital efficiency. The Variable Inflation Factor (VIF) was adequately low hence; the possibility of multicollinearity did not exist.

Efficiency in cash management had the greatest effect on working capital efficiency, with a unit change in the WCM, holding WIM and WRM constant resulted in 0.571 times increase in overall working capital efficiency. Effective cash management reduces the length of the cash conversion cycle which in turn improve the financial performance of the coconut oil mills. Whereas practices on inventory management had comparatively less effect on working capital efficiency index, with a unit change in WIM holding WCM and WRM constant, resulted in 0.434 times increase in working capital efficiency. Effective inventory management reduces the accumulation of funds as idle. Most researchers have established a positive relationship between efficiency in working capital management practices and business performance (Marfo-Yiadom & Agyei, 2012; Kwame, 2007; Peel & Wilson, 1996).

The findings also reinforced the establishment by Deloof (2003) which showed that the way working capital managed had a significant effect on the overall performance of businesses.

CONCLUSIONS

The overall working capital efficiency index of the efficient category was 2.51. It indicated that the oil mills in those categories had efficiently managed their working capital and generated sales whereas inefficient category (0.76) were not at the desired level of more than one. Thus, there is a need for managing either the individual components of current assets or the current assets as a whole for generating more sales revenue. The correlation results revealed that there was a strong positive correlation ($r = 0.482^{**}$) between Working Capital Efficiency Index (WCEI) and Working Capital Cash Management practices (WIM); Working Capital Efficiency Index and Working Capital Inventory Management practices (0.348^{*}); It indicated that WCM and WIM are significantly different with WCEI.

The effect of working capital management practices on working capital efficiency index was analyzed using multiple regression analysis. The R^2 (0.313) indicated that 31.3 percent of the variations in working capital efficiency was explained by the independent variables included in the model. Among the three independent variables, the effect of Working Capital Cash Management (WIM) practices was the highest on working capital efficiency. Effective cash management reduces the length of the cash conversion cycle which in turn improves the financial performance of the coconut oil mills.

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Study of Market Concentration and Inequality Measures in Non-timber Forest Products (NTFPs): A Case of *Harar (Terminalia chebula)*

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ABSTRACT
Non-timber forest products (NTFPs) provide employment for tens of millions of rural Indians who would otherwise be forced to migrate in search of jobs as agricultural labourers or marginal urban job seekers. The present investigation aims to examine, the study of market concentration and inequality measures in Non-timber forest products (NTFPs): A case of Harar (Terminalia chebula). A sample of 50 farmers each from Sirmour and Kangra districts of Himachal Pradesh and; besides this, 20 other market functionaries from the Amritsar market were also selected for the study. The Gini Concentration Ratios for green Harar and dried Harar was 0.40 and 0.16 respectively and relative mean deviation (RMD) was found 0.183 and 0.20 in case of green and dried Harar respectively and indicating that there exists a high degree of competitiveness for dried Harar as well as for green Harar in Amritsar market which means market for both types of the products is competitive. The coefficient of variation (CV) in the case of green Harar was found 0.43 as compared to 0.51 in case of dried Harar. The value of entropy index for green Harar was found 0.97 and for dried Harar 0.94.

Keywords
Gini concentration ratio, Harar, Lorenz curve, non-timber forest products.

JEL Codes
C81, Q13, Q18.

INTRODUCTION

Rural poverty in India is generally considered to be linked with the lack of access to cultivable land, or with its low productivity. Changes in the collection of gathered items from common property resources such as forests go largely unnoticed and are not even presented in the national accounts. However, about 100 million people living in and around forests in India derive their livelihood support from the collection and marketing of non-timber forest products (NTFPs). Thus the issue of rights and access to, and income from, NTFPs is basic to sustenance and livelihood for the forest dwellers (Sexena, 2003).

Non-timber forest products (NTFPs) are estimated to generate 70 percent of all employment in the Indian forestry sector. Commercial NTFPs alone are estimated to generate ₹3 billion ($ 100 million) annually. NTFPs provide employment for tens of millions of rural Indians who would otherwise be forced to migrate in search of jobs as agricultural labourers or marginal urban job seekers. One study estimated that NTFP collection generates over 2 million person-years of work annually and that this could be increased to 4.5 million person-years. In addition, millions of individuals are employed in NTFP processing and marketing. Yet, NTFPs generate some of the lowest wages of the rural employment sector. While the minimum wage in most states ranges from ₹30 to 40 per day ($1 to $1.30), most NTFP collectors earn from ₹5 to 15 ($0.25 to $0.50) per day. Low wages reflect the low productivity of the forest arising from poor management, and depressed prices imposed by state trading monopolies and private buyers (Poffenberger, 1994).

The market potential that exists can only be achieved through a sound knowledge base on markets and marketing. However, information on marketing of native fruits is still scanty (Chilimampunga, 2001; Mumba *et al*., 1996). Commercialisation promoted by an organization

such as the World Agroforestry Centre (ICRAF) is based on a narrow and imperfect knowledge of markets (Simmons, 1998). It is important for understanding the main factors influencing supply and demand of a product, developing relevant strategies for the commercialization of NTFPs to meet market demand, building capacity among farming communities, disseminating technology by creating market-based incentives for the production and improving the effectiveness and efficiency of production and marketing (Hyman, 1996; Kaaria, 1998 and Mwanza & Kwesiga, 1994).

Terminalia chebula Gertn. is an important herbal drug in Ayurvedic pharmacopeia. It is called the "king of medicines". It is always listed first in the Ayurvedic material media because of its extraordinary potential of healing. In Ayurveda, it is thought to destroy all diseases and remove all waste from the body. At the same time, it is known to help tissue growth and health. It is known by its local name as Haritaki, *Harar,* Harida, Black myrobalan, Chebulic myrobalan, and Harada. *Terminalia chebula* Gertn is reported to be antimicrobial (Malekzadeh *et al*., 2001; Bonjar, 2004; Aqil & Ahmad, 2007), hepatoprotective (Tasaduq *et al*., 2006), anti-inflammatory (Pratibha *et al*., 2004), immunomodulatory (Srikumar *et al*., 2005), antioxidant (Lee *et al*., 2007; Tejesvi *et al*., 2008, Lee *et al*., 2005; Cheng *et al*., 2003) and adaptogenic (Rege *et al*., 1999).

Both fresh and dried fruit of *Harar* has a ready market. The important markets are Amritsar, Hoshiarpur, and Delhi. The fruit is also exported to Pakistan and other Gulf countries. Presently, *Harar* is cultivated in Sirmour, Kangra, Bilaspur Hamirpur, Una and Mandi districts of the state. Mostly, it is collected from the trees grown in the *ghasnis* or common village lands. However, with the development of budding and grafting techniques in *Harar,* farmers have started planting grafted *Harar*, because it comes into bearing after 4 to 5 years. The total export of chebulic myrobalan fruit extract is 1,127 MT of value Rs. 249.39 lakh in 1996–97 (Gupta, 1994).

Objectives of the study

- To determine the market concentration of green and dried *Harar*
- To estimate different inequality measures of green and dried *Harar*

METHODOLOGY

The material and methods of the study have been described in the following sections:

Selection of Study Area

Harar is cultivated in Sirmour, Kangra, Bilaspur, Hamirpur, Una and Mandi districts of the state. Mostly it is collected from the trees grown in the *ghasnis* or common village lands. Purposive sampling has been adopted to select two districts namely Sirmaur and Kangra districts out of 6 districts. Besides this, Amritsar market was selected for the present study, because major produce of selected districts sold in that market.

Sampling Design and Sampling Size

A Simple random sampling design was used for the selection of the respondents. Production areas in the selected districts were identified through the pilot survey and a sample of 50 farmers each from the selected areas from the selected districts. Besides, 20 market functionaries from the Amritsar market were also selected for the study.

Primary Data

The primary data on yield, marketable or marketed surplus were collected on well-designed pre-tested schedules by adopting a personal interview method from the selected households and traders in the study area and markets respectively during the year 2014-15.

Inequality Measure

Inequality can be defined as the dispersion of the distribution of income or some other welfare indicator (Litchfield, 1999).

Different inequality measures are described below:

Lorenz Curve

The Lorenz curve is the important measure of variability of the statistical series. This curve was first used by Max Lorenz, Hence, it is called Lorenz curve. These curves are generally used to measure variability in the distribution of income and wealth.

The Lorenz curve is a measure of the deviation of actual distribution from the line of equal distribution. This is a cumulative percentage curve. Greater the distance of Lorenz curve from the line of equal distribution more is the inequality or the variability in its series. On the other hand, closer is the Lorenz curve to the line of equal distribution, lower will be the variability or the degree of equality (Todaro, 1997).

Gini Concentration Ratio (GCR)

The Gini coefficient is an increasing function of inequality and equals zero when the distribution is perfectly equal. It is defined numerically (Kakwani and Podder, 1976) as:

$$G = 1 - \sum_{i=1}^{n-1} (Y_{i-1} + Y_i)(X_{i+1} + X_i)$$

Where,

G = Gini coefficient

n = Sample size of wholesalers

Xi = Cumulative percent of quantity of *Harar* transacted in i^{th} interval of the quantity transacted

Yi = Cumulative percent of number of wholesalers in i^{th} interval of the quantity transacted

Relative Mean Deviation

RMD is a dimensionless number which is computed using the following formula (Sen, 1997):

$$RMD = \frac{1}{2 \times n \times \bar{X}} \sum_{i=1}^{n} | X_i - \bar{X} |$$

Here, X_i refers to quantity of *Harar* transacted of the i^{th} wholesaler, $\bar{x}$ to average quantity of *Harar* transacted, and n for number of wholesales in the market. The

measure captures the extent to which quantity of *Harar* transacted by individual wholesaler differs from the average quantity transacted by the market. Higher the RMD, greater is the inequality in quantity transaction, and hence lesser is the extent of market competition.

Coefficient of Variation

CV is a standard measure of the dispersion. It is the standard deviation of the quantity of *Harar* transacted by the wholesales normalized by its average. Mathematically, CV is computed as,

$$CV = \sqrt{\frac{1}{\bar{X}} \times \sum_{i=1}^{n} (X_i - \bar{X})^2}$$

Here, x_i stands for size of the i^{th} wholesaler, $\bar{x}$ to average quantity of *harar* transacted, and n for number of wholesales in the market. A higher CV indicates lesser competition in the market.

Relative Entropy Index

The entropy index is a measure of uncertainty in information theory. In its basic form, the value of the index lies between 0 and *ln(n),* where n stands for the number of wholesalers in the market. This makes the index incomparable across wholesales. In order to make the index comparable, the entropy index is divided by *ln(n)* so that it is restricted to the interval [0,1]. Mathematically, the relative entropy index is compared as follows:

$$REI = \frac{1}{In(n)} \sum_{i=1}^{n} s_i \times In \frac{1}{s_i}$$

Here, s_i refers to the share of the i^{th} wholesaler in total quantity transacted in the market.

RESULTS AND DISCUSSION

The result and discussion is divided into two sections *viz.* market concentration and inequality measure

Market Concentration

Market concentration is the number of marketing agents operating in a market and their respective share in the overall business. In general market, concentration reflects the organizational characteristics of the market where the focus is mainly on the characteristics that affect the degree of competition among the firms, both for a number of sales and pricing decisions. It is often the case that more the number of effective marketing agents in the market, the more distributive would be their share in the market. However it is also noted that markets do not often behave in this fashion and the functioning is generally lopsided; resulting into imperfect competition in the market. One of the ways to analyze the structural characteristics of the market is to estimate the concentration ratio, which reflects the proportion of the total sale/business in the market that is controlled by a few market functionaries.

In the present study, the market concentration for Amritsar market was studied by analyzing the share of wholesalers in total *Harar* sale. In order to analyze this situation, quantity transacted (quintals per month) was grouped together into seven different categories based on the volume of transactions made in a market during a month. A share of wholesalers in the total quantity transacted and the proportion of wholesalers handling the respective volume of sales for the selected market is presented in Table 1. The degree of business concentration of wholesalers for the *Harar* in the selected market was assessed by estimating the Gini concentration ratio.

It can be observed from the table that 28.58 percent of the total wholesalers dealing in green *Harar* were in the size group of 1000-1500 quintals per season, and their share in total transactions was just 18.99 percent. About 21.94 percent of the total quantity transacted was handled by the 13.94 percent of the total green *Harar* wholesalers of the size group 2500–3000 quintals per season. In case of dried *Harar*, 23.16 percent of the total quantity sold in the market was handled by the 11.12 percent of the total wholesalers of the size group of 2500–3000 quintals per season, while 22.22 percent of the total wholesalers of dried *Harar* of the size group 1500-2000 quintals per

Table 1. Market concentration of market share among wholesalers in Amritsar market

Class intervals of quantity transacted (Q/month)	Green Harar		Dried Harar	
	Percent of wholesalers (Y)	Percent of quantity of transacted (X)	Percent of Wholesalers (Y)	Percent of quantity of transacted (X)
0-500	-	-	11.11	3.47
500-1000	14.28	6.75	22.22	12.36
1000-1500	28.58	18.99	22.22	19.31
1500-2000	21.44	20.25	22.22	24.71
2000-2500	14.28	18.57	11.11	16.99
2500-3000	14.28	21.94	11.12	23.16
3000<	07.14	13.50	-	-
Total	14	23700	**9**	**12950**
Gini concentration ratio	**0.49**		**0.16**	

Table 2. Inequality measure for market *Harar*

Inequality measure	Green *Harar*	Dried *Harar*
Gini coefficient ratio (GCR)	0.40	0.16
Relative mean deviation (RMD)	0.18	0.20
Coefficient of variation (CV)	0.43	0.51
Relative entropy index (REI)	0.97	0.94

season were handling 24.71 percent of the total dried *Harar* transacted. In the present study Gini concentration ratios for green *Harar* and dried *Harar* worked out to be 0.40 and 0.16 respectively. The situation revealed that there exists a high degree of competitiveness for dried *Harar* as well as for green *Harar* in Amritsar market.

Inequality Measures

The Lorenz curve was also estimated for green and dried *Harar*. It was found that for both green and dried Harar, the Lorenz curve was closer to the line of equal distribution which indicates lower variability in the market concentration. It is also concluded that for both green and dried *Harar*, near perfect competition like situation exist in the Amritsar Market.

In addition to Lorenz curve, four measures of dispersion, viz., Gini concentration ratio, relative mean deviation (RMD), the coefficient of variation (CV), and

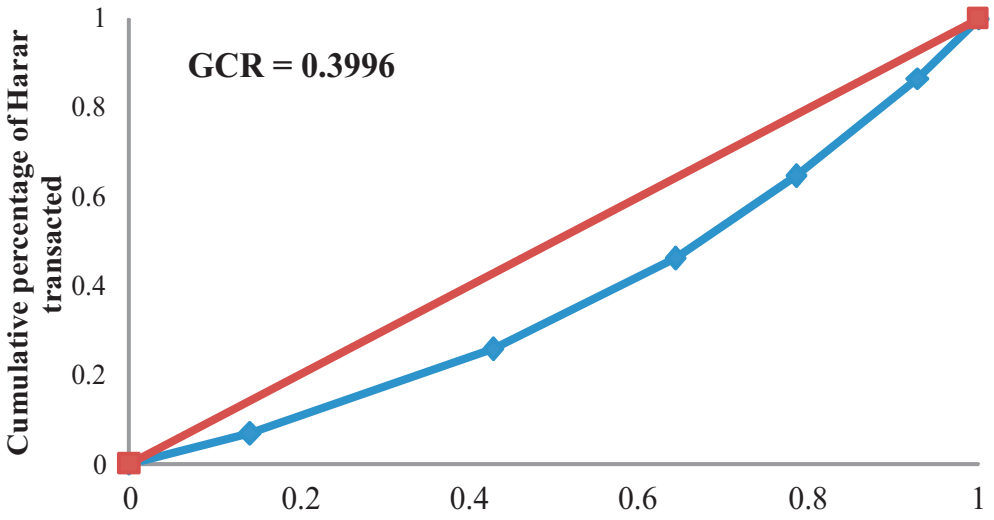

Figure 1. Lorenz curve for green Harar

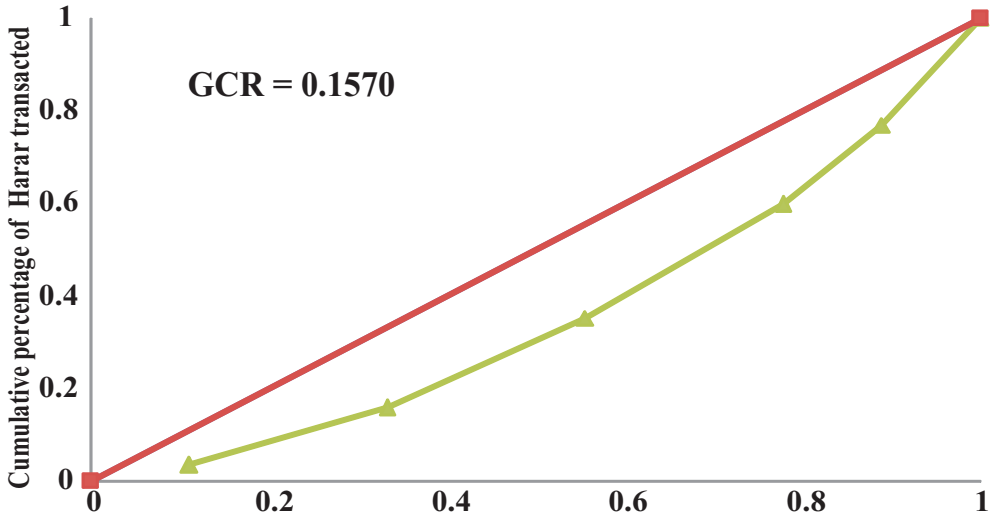

Figure 2. Lorenz curve for dried Harar

relative entropy coefficient (REC) were also estimated to examine the inequality in the market and the results have been presented in Table 2. Although these inequality measures are generally used to measure income equality, they have often been applied to understand market inequality as well. GCR for green *Harar* was estimated 0.40 and for dried *Harar* 0.16.

Relative mean deviation (RMD) was found 0.18 and 0.20 in case of green and dried *Harar* respectively which means the market for both types of the products is competitive. The coefficient of variation is a unit free standard measure of dispersion and is comparable to the product. The CV in the case of green *Harar* was found 0.43 as compared to 0.51 in case of dried *Harar*. A lower value is indicative of higher completion in the market. The value of entropy index lies between 0 and 1and higher value implies higher competition. The value of entropy index for green Harar was found 0.97 and for dried *Harar* 0.94.

CONCLUSIONS

Millions of individuals are employed in NTFP processing and marketing. Yet, NTFPs generate some of the lowest wages of the rural employment sector. This study was hope of light to forest dwellers living in the Lower Himalayas to provide a new mean of rural employment and increase their income. *Harar* was sold in both green and dried form. It is concluded from the study that there was a higher demand for the *Harar* in both forms. Also, there was perfect competition in the market which indicates less fluctuation in market prices, no delay in payments, no irrational deductions and ultimately the profitability of crop becomes higher than other crops.

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Cost Benefit Analysis of Milk Production in Ballia district of Uttar Pradesh

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ABSTRACT

Dairy farming emerged as an important source of livelihood, particularly on small holder households. An attempt was made to analyze the cost and returns from milk production in Ballia district of Uttar Pradesh. The study covered 150 households which were then post stratified into small, medium and large categories of households based on the herd size. The study revealed that per day maintenance cost, as well as net return, was highest in case of buffaloes as compare to cross bred and local cow. The returns from local cow were positive for all categories of households but insignificant in small category households.

Keywords
Cost, herd size, milk production, returns.

JEL Codes
E21, M31, Q13.

INTRODUCTION

Dairying in India over the years has witnessed a sea change from a largely unorganized activity into a blooming organized industry. Dairy Industry is one of the fastest expanding industries in the world. India ranks first in world milk production, its production having increased from 17 million tonnes in 1950-51 to 155.5 million tonnes by 2015-16 (Government of India, 2015). The demand for milk is projected to be 181 million tonnes by 2020 (India Vision, 2002) which shall be further propelled due to increasing middle class population with high disposable income along with fast changing socioeconomic and cultural values and health consciousness.

In India, milk production offers great opportunities for increasing farm income, employment and provides subsidiary occupation in semi-urban areas and people living in hilly, tribal and drought prone areas (Rao *et al.,* 2004). Thus the cost and returns in dairy enterprise are important concern for milk producers, consumers and policy makers to provide an effective linkage among them to make rational economic decisions (Kumar & Pandian, 2003). Generally, a milk producer can increase his dairy income in two ways either by increasing the milk production or by reducing cost of milk production. Cost of milk production often becomes a policy issue, when milk producers complain that the price of milk they are getting does not the cover cost of milk production. Keeping the above background in mind, the present study was conducted in Ballia district of Uttar Pradesh. The specific objective of the study was to compare the cost and return of milk production among different herd size categories of households.

REVIEW OF LITERATURE

Attempts have been made to review briefly the specific and relevant literature, which has direct or indirect bearing on the objectives of the present study. Accordingly, relevant literature has been reviewed and presented in chronological order as follows.

Bardhan *et al.* (2005) analyzed the economics of buffalo milk production for different categories of farmers in different seasons in the Tarai area of the newly created state of Uttaranchal. Large farmers incurred the highest annual expenditure (₹21,054) in maintenance of their animals. The lowest expenditure were found to be made by the marginal category of farmers (₹17,071). Net returns over total costs were negative for all the categories of farmers except marginal farmers. Average net loss in the study area was ₹795. Family labour income was however found to be positive for all categories of farmers. The findings indicated that rearing of buffaloes for milk

purpose was a non-remunerative and unprofitable proposition in the study area.

Singh (2008) in his study on economic analysis of milk production in Varanasi District of Uttar Pradesh reported that overall daily net maintenance cost per milch buffalo per day was ₹47.37 and per milch cow was ₹36.00 and the feed cost constituted about 79 per cent of gross cost. Overall net cost of milk production for milch buffalo was ₹13.27 per litre and it was ₹15.78 per litre for milch cows. Net return from milking buffalo was ₹1.05 which was highest (₹9.60) for large and lowest (₹0.73) for landless, whereas negative return was incurred in small and medium category. The net returns per milch buffalo were found negative for all the categories except for marginal category.

Suresh *et al.* (2009) conducted a study in Karnal district of Haryana and revealed that milk production by rearing buffalo was more profitable as compared to that of cow. The gross income (₹22249.52) and net income (₹3720.28) per buffalo per annum was significantly higher as compared to (₹17498) and (₹2028) per cow per annum respectively. Similar pattern was observed in case of family labour income realized from buffalo and cow. The improved breed of the animals and better feeding might be helpful for increasing income and employment opportunities.

Singh *et al.* (2012) in a study in Bihar showed that Per litre cost of milk production varied from Rs.10.12 for crossbred cows to ₹13.90 and ₹13.57 for buffalo and local cows, respectively. Herd size and type of milch animal along with parity had significant influence on cost of milk production. Production cost was likely to decrease with increase in size of unit and in production of crossbred cows in herd. Dairy farmers should also be advised for meeting the requirements of feed by providing desired nutrients through feeding of green fodder which not only reduces intake of concentrates but also helps in reducing the cost of production.

METHODOLOGY

Ballia district was purposively selected from Uttar

Table 1. Cost of milk production and returns from buffalo

(₹/animal/day)

Cost components	Category of households			Overall
	Small	Medium	Large	
Green fodder	30.75 (17.98)	32.85 (18.11)	37.60 (19.88)	32.07 (18.00)
Dry fodder	21.58 (12.62)	23.49 (12.95)	24.31 (12.85)	23.67 (13.28)
Concentrates	65.19 (38.14)	68.34 (37.68)	66.86 (35.35)	66.16 (37.14)
Total fodder cost	117.52 (68.74)	124.68 (68.74)	128.77 (68.08)	121.90 (68.42)
Labour cost	25.24 (14.76)	25.19 (13.89)	27.65 (14.63)	26.14 (14.67)
Miscellaneous expenses	8.05 (4.71)	9.11 (5.02)	9.75 (5.15)	8.48 (4.76)
Total variable cost (TVC)	150.81 (88.21)	158.98 (87.65)	166.17 (87.86)	156.52 (87.85)
Depreciation on fixed cost	11.02	11.86	12.01	11.96
Interest on fixed cost	9.14	10.53	10.94	9.68
Total fixed cost (TFC)	20.16 (11.79)	22.39 (12.35)	22.95 (12.14)	21.64 (12.15)
Gross cost (TVC+TFC)	170.97 (100.00)	181.37 (100.00)	189.12 (100.00)	178.16 (100.00)
Value of dung	3.12	4.17	3.84	3.76
Net cost (Gross cost-Value of dung)	167.85	177.20	185.28	174.40
Sale price of milk (₹/*l*)	36	35.65	35.87	35.74
Milk production (*l*/day)	5.03	5.97	6.02	5.47
Gross returns	181.08	212.83	215.94	195.5
Net returns	13.23	35.63	30.65	21.09
Cost (₹/*l*)	33.37	29.68	30.78	31.88
Net return (₹/*l*)	2.63	5.97	5.09	3.86

Figures in parentheses indicate percentage of the respective total.

Pradesh state. Then from Ballia district five blocks and ten villages from these blocks were randomly selected. At the next stage 150 households were randomly selected based on probability proportional to the number of households in the area. Then a complete enumeration of all the milk producing households was carried out. All the milk producing households were then classified on the basis of milch animals into three herd size categories, viz., small (1-4 milch animals), medium (5-6 milch animals) and large (7 and above milch animals) through cumulative frequency square root technique. The primary data were collected with the help of a well-structured pre-tested schedule by personal interview method for the year 2016. To work out cost and returns of milk production tabular analysis was done and cost per litre of cattle as well as buffalo milk was find out. Similarly, the net return per litre of milk had been also calculated.

Cost and Return concept

Fixed Cost: It includes interest on the fixed capital and depreciation on animals, cattle shed, machinery and equipments. The interest on the fixed capital was worked out at the prevailing rate i.e. a 13 per cent per annum. Depreciation was worked out separately on milch animals, cattle shed, machinery and equipments keeping in view its present value and life time.

Depreciation rate on milch animals was as follows:

Local Cows - 10 per cent (productive life 10 years)

CB Cows – 8 per cent (productive life 12.5 years)

Buffaloes -10 per cent (productive life 10 years)

And depreciation rate on cattle shed and dairy equipments were as under:

Particulars	Percent
Pucca building	2
Semi-pucca building	5
Bullock cart	10
Chaff cutter	10
Milk can	20
Buckets	20

Table 2. Cost of milk production and returns from cross bred

(₹/animal/day)

Cost components	Category of households			Overall
	Small	Medium	Large	
Green fodder	24.65 (14.82)	27.25 (15.97)	29.42 (16.56)	25.76 (15.29)
Dry fodder	22.1 (13.29)	22.33 (13.09)	22.57 (12.70)	22.20 (13.19)
Concentrates	62.09 (37.34)	59.93 (35.12)	64.08 (36.07)	61.66 (36.60)
Total Fodder Cost	108.84 (65.45)	109.51 (64.18)	116.07 (65.33)	109.62 (65.08)
Labour cost	26.15 (15.72)	27.52 (16.13)	26.92 (15.15)	26.59 (15.79)
Miscellaneous expenses	7.59 (4.56)	8.67 (5.08)	8.37 (4.71)	7.95 (4.72)
Total variable cost (TVC)	142.58 (85.74)	145.70 (85.38)	151.36 (85.19)	144.16 (85.59)
Depreciation on FC	13.43	14.05	14.71	13.71
Interest on FC	10.29	10.89	11.60	10.56
Total fixed cost (TFC)	23.72 (14.26)	24.94 (14.62)	26.31 (14.81)	24.27 (14.41)
Gross Cost (TVC+TFC)	166.30 (100.00)	170.64 (100.00)	177.67 (100.00)	168.43 (100.00)
Value of dung	4.10	3.83	4.75	4.08
Net cost (Gross cost-Value of dung)	162.20	166.81	172.92	164.35
Sale price of milk (₹/*l*)	26.65	26.75	27.15	26.72
Milk production (*l*/day)	6.70	7.20	7.39	6.93
Gross returns	178.55	192.60	200.64	185.17
Net returns	16.36	25.79	27.71	26.72
Cost (₹/*l*)	24.21	23.17	23.40	23.71
Net Return (₹/*l*)	2.44	3.58	3.75	3.00

Figures in parentheses indicate percentage of the respective total.

Variable Cost: These costs include feed cost, labour cost, veterinary cost and other miscellaneous cost.

Feed Cost: The cost incurred on green fodder, dry fodder and concentrate to feed the animals constituted feed cost. It was worked out by multiplying quantities of feeds and fodder consumed by animals with their respective prevailing prices in the study area.

Labour Cost: It included family as well as paid hired labour. The hired labour was calculated considering time utilised in various dairy activities and wages paid. In case of family labour, the imputed value was taken as per the prevailing wage rate of casual labour in the study area.

Veterinary Cost: It included the cost incurred on natural service, artificial insemination (A.I.), vaccination, medicines and other charges/fees of veterinary doctors.

Miscellaneous Cost: The cost of repairs, electricity, water charges, bucket, rope, etc formed this group.

Other Cost Concepts Used

Gross cost: It was obtained by adding all the cost components including fixed and variable costs, i.e.

Gross Cost = Total Variable Cost + Total Fixed Cost

Net cost: The net cost was worked out by deducting the imputed income earned through dung, from the gross cost.

Net Cost = Gross Cost - Value of Dung

Gross returns: Gross returns were obtained by multiplying milk yield of an individual milch animal with respective prevailing prices in the study area.

Gross returns = Quantity of milk × Market price of milk

Net Returns: Net return was calculated by subtracting net cost from gross returns.

Net returns = Gross Returns -Net Cost

Price of Milk: The price of milk differs for different type of milk, that is, buffalo, crossbred cow, and local cow

Table 3. Cost of milk production and returns from local cow

(₹/animal/day)

Cost components	Category of households			Overall
	Small	Medium	Large	
Green fodder	13.75 (13.89)	16.95 (15.27)	24.06 (19.77)	15.49 (14.87)
Dry fodder	13.32 (13.46)	13.96 (12.58)	14.35 (11.79)	13.58 (13.04)
Concentrates	29.52 (29.83)	35.95 (32.38)	37.5 (30.83)	31.95 (30.67)
Total fodder cost	56.59 (57.18)	66.86 (60.23)	75.91 (62.39)	61.02 (58.58)
Labour cost	16.09 (16.26)	17.16 (15.46)	18.54 (15.24)	16.59 (15.93)
Miscellaneous expenses	5.96 (6.03)	5.83 (5.25)	6.02 (4.95)	5.93 (5.69)
Total variable cost (TVC)	78.64 (79.47)	89.85 (80.94)	100.47 (82.58)	83.54 (80.20)
Depreciation on fixed cost	11.08	11.46	11.59	11.23
Interest on fixed cost	9.24	9.70	9.61	9.40
Total fixed cost (TFC)	20.32 (20.53)	21.16 (19.06)	21.20 (17.42)	20.63 (19.80)
Gross Cost (TVC+TFC)	98.96 (100.00)	111.01 (100.00)	121.67 (100.00)	104.17 (100.00)
Value of dung	4.50	4.40	4.35	4.46
Net cost (Gross cost-Value of dung)	94.46	106.61	117.32	99.71
Sale price of milk (₹/*l*)	28.5	30.00	29.45	28.72
Milk production (*l*/day)	3.36	3.71	4.14	3.52
Gross returns	95.76	111.30	121.92	101.09
Net returns	1.3	4.69	4.60	1.38
Cost (₹/*l*)	28.11	28.73	28.34	28.32
Net Return (₹/*l*)	0.38	1.26	1.11	0.39

Figures in parentheses indicate percentage of the respective total.

milk. Weighted average price of milk was calculated for each household by using the following formula

$$\text{Weighted Average Price} = \frac{\sum_{i=1}^{n} P_i W_i}{\sum_{i=1}^{n} W_i}$$

Where,

P_i = Price per litre of the i^{th} type of milk (₹)

W_i = Total quantity of i^{th} type of milk sold by the household

Cost of milk production

In order to estimate the cost per litre of milk, the average net maintenance cost per animal per day was divided by average milk of animal per day:

$$\text{Cost of Milk Production (₹/l)} = \frac{\text{Net Cost per animal}}{\text{Average Milk Yield of the animal}}$$

RESULTS AND DISCUSSION

The perusal of Table 1 reveals that for buffalo, the overall feed cost was ₹121.90 which accounts for 68.42 per cent share of gross cost. The feed cost constituted a major share in the variable cost. Overall cost of milk production per litre of milk was worked out to be ₹31.88 per day. Highest cost per litre of milk was found in case of small herd size category (₹33.37) followed by large category (₹30.78) and least in medium category (₹29.68). The net return per litre of milk was found to be positive for all categories of households and it was highest for medium category (₹5.97) followed by large category (₹5.90) and small category of households (₹2.63).

The results presented in Table 2 show that for cross bred, the overall feed cost was ₹109.62 which accounts for 65.08 per cent share of gross cost. Overall cost of milk production per litre of milk was worked out to be ₹23.71 per day. Highest cost per litre of milk was found in the case of small herd size category (₹24.21) followed by large category (₹23.40) and lowest in medium category (₹23.17). The net return per litre of milk was found to be positive for all the categories and it was highest for large category (₹3.75) followed by medium category (₹3.58) and small category (₹2.44) of households which were in conformity with the findings of earlier studies (Das, 2004).

The perusal of Table 3 shows that in the case of local cows the overall feed cost was ₹61.02 which accounts for 58.58 per cent share of gross cost. Overall cost of milk production per litre of milk was worked out to be ₹28.32 per day. Highest cost per litre of milk was found in the case of medium herd size category (₹28.73) followed by large category (₹28.34) and lowest in small category (₹28.11). Net return per litre of milk was found to be positive for all categories of households but is insignificant in small category households. Highest returns were incurred by medium category (₹1.26) followed by large category (₹1.11) of households.

CONCLUSIONS

The cost and return measure of milk production obtained in the present study suggests that buffalo milk production is relatively more profitable than cow in the study area. Although maintenance cost is higher in case of buffalo (₹178.16) as compare to cross bred (₹168.43) and local cow (₹104.17), the net return is highest in buffalo (₹3.86 per litre) than cross bred (₹3.00 per litre) and local cow (₹0.39 per litre). Thus, sound economic logic exists for persuading households to continue buffalo rearing to enhance their income. Hence, adequate attention should be paid to promote buffalo upgradation programme.

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Water Productivity and Profitability of Spring Maize Hybrids

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ABSTRACT

The study was conducted in districts Kapurthala and Jalandhar during Kharif 2016 season. A total of 110 farmers were randomly selected and interviewed 4 times during the crop season and the information was collected as per questionnaire. The results revealed that majority of farmers were opting for recommended input application with more than 90 per cent farmers using seed treatment of insecticide and more than 60 per cent applying urea and DAP at recommended levels. Four spring maize hybrids prominent in the region were found to be DKC 9108, P 1844, 31Y45 and P 1855. Among these hybrids, 31Y45 is of longer duration as compared to other 3 hybrids, so its water requirement is more. For growing spring maize hybrids, irrigation water used was 9840 m^3/ha with water productivity of 0.95 kg/m^3 and grain productivity of 79.3 kg/ha/day. Contrary to last two years, farmers shifted area from 31Y45 to new hybrids such as P 1844 due to its higher yield. The gross income of Rs 90,093/-ha obtained by the farmers seems to be very profitable but on the other hand, if the cost of irrigation water is taken into consideration then net returns reduce from Rs 59,293/-ha to Rs 49,453/-ha. Hence, farmers must adopt some other short duration, low water requiring crops like summer moong, musk melon, and watermelon, groundnut, etc.

Keywords

Grain productivity, hybrids, irrigation water, net returns, profitability, spring maize, water productivity.

JEL Codes

Q01, Q15, Q25, Q32.

INTRODUCTION

Maize (*Zea mays* L.) is a cereal crop and is grown in a wide range of agro ecological environments. Maize grain has rich nutritive value and known as king of grain crops because it is not only used by human beings as a food grain but also consumed as feed for livestock and poultry. It is also a major source of raw material for various industries, where it is used for the preparation of starch, corn oil, corn syrup, corn flakes, cosmetics, ethanol, wax and tanning material for leather industry. Maize can be grown thrice a year (*kharif, rabi,* and spring season), both for grain and fodder purpose in the plains of the country. In Punjab and UP, spring season maize is gaining popularity because firstly, it gives more productivity as compared to *kharif* season due to longer duration and safer from insect-pests and secondly, it fits in the cropping system with potato. The only constraint in its cultivation is that it can only be grown in areas with adequate irrigation facilities.

Maize crop sown during spring season has to face high temperature at the reproductive phase which affects pollination and thus, seed setting resulting in reduced grain filling and ultimately lowering the final yield. To avoid heat stress, farmers were giving irrigation on every alternate day during the month of May. Hence, farmers are trying to avoid this heat stress during the flowering stage by early sowing of maize. Under early spring sowing maize low soil temperatures delay and reduce seedling emergence (Afzal *et al.,* 2008).In spring season as maize is generally sown during the month of February, when the temperature is very low (17/10 ± 3°C, day/night) for maize seed germination, and as a result crop stand is hampered (Farooq *et al.,* 2008). The optimum temperature for maize germination is between 25°C and 28°C. Poor and erratic germination at suboptimal temperature is the most important hindrance in its early sowing. Effect of low temperature also can be reduced with the application of irrigation that farmers generally apply for proper germination, if sown early.

Maize is a typical C_4 photosynthesis plant grown in

warm climates and has developed mechanisms to conserve water under dry conditions. It has a very low water coefficient (around 300 kg of water per kg of dry product). On average, water consumption is estimated at about 5000-6000 m^3/ha during *Kharif* season (90-100 d)for maximum production levels. This figure obviously varies according to water availability in the area, climatic conditions, and growing methods. The irrigation schedule should meet all the crop's water requirements during the period between the appearance of the tassel (around 2 weeks before flowering) and the milk-wax stage (around 5-6 weeks after flowering), a total of approximately 50-60 days.

Sharma *et al.* (2014) reported that farmers in the central plain zone of Punjab were cultivating maize hybrids developed from various private organizations and earning high net profits. Contrary to the fact that farmers were not calculating the cost of irrigation water applied in raising the spring season crop because state government is providing electricity free of cost to run the tubewell. Therefore, this study was conducted to calculate water productivity and profitability of spring maize hybrids grown by the farmers in the Kapurthala and Jalandhar districts.

METHODOLOGY

The study was conducted in districts Kapurthala and Jalandhar during *Kharif* 2016 season. A well-developed questionnaire was prepared to take into account all the package of practices followed by farmers from sowing to harvesting. The questionnaire included the name of the hybrid sown, date of sowing and harvesting, fertilizers applied, seed treatment, irrigations applied, the yield obtained, selling price etc. A total of 110 farmers have randomly selected from 3 spring maize growing blocks of Kapurthala district, namely, Kapurthala, Sultanpur Lodhi and Dhilwan and one block of Jalandhar district namely Nakodar. The selected farmers were regularly interviewed 4 times during the crop season and the information was collected as per questionnaire. The data regarding grain yield and selling price was recorded in the grain market at the time of selling the produce. The values obtained from the questionnaire were interpreted in the form of percentage, mean and standard deviation. Based on the data, calculations were made in order to draw the inference about the comparative performance of spring maize.

The economical parameters were calculated using following formulae:

a. $\text{Mean}(\mu) = X1 + X2 + \ldots + Xn / n$

b. $\text{Standard deviation}(\sigma) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$

Where, X = Dependent variable under study, N = Number of samples

c. Irrigation water applied (m^3/ha) = Number of irrigations x depth of irrigation (5cm) x 10x 10

d. Water productivity (kg/m^3/ha) = Yield (kg/ha) / Total irrigation water used (m^3)

e. Grain productivity (kg/ha/day) = Yield (kg/ha)/Number of days taken to maturity (days)

f. Gross income (₹/ha) = Yield (q/ha) X Selling price (₹s/q)

g. Net returns (₹/ha) = Gross returns (Rs) – Cost of production (₹)

h. B:C ratio = Net returns (₹)/ Cost of cultivation (₹)

The data were analyzed using mean values.

RESULTS AND DISCUSSION

Input Pattern and its Effect on Yield

The recommended dose of urea is 225 kg/ha but the packing size of urea is 50 kg, so farmers find it convenient to add urea in multiple of 50 kg, therefore a figure of 250kg urea/ha was used in the questionnaire. From the Table 1, it can be inferred that 63.6 per cent of farmers apply urea up to 250 kg/ha and 36.4 per cent farmers apply higher doses of urea but the yield obtained under both the situations was same. Therefore, farmers were advised through extension programmes to apply urea as per the recommendations made by the research institutes. The higher quantity of urea application results in an economic loss on one hand and increase soil and water pollution through ammonia volatilization or leaching in the form of nitrate on the other hand. The standard deviation of 109.5 kg/ha suggested the wide range (211.5 to 430.5 kg/ha) of urea application due to wrong farmers' perception based on previous years' experience.

In case of di-ammonium phosphate (DAP), the recommendation is 137.5 kg/ha but the packing size of DAP is 50 kg, so farmers find it convenient to add 125 kg/ha, therefore a figure of 125 kg DAP/ha was used in the questionnaire. From the Table 1, it was observed that 59 per cent of farmers were applying DAP up to 125 kg/ha and 41 per cent were applying higher doses of DAP. On comparing yields under both the situations, an increase of 50 kg/ha was observed with the application of higher doses of DAP. These results were in agreement with Manan *et al.* (2016).

On comparing values for Muriate of potash (MOP) from Table 1, 59 per cent of farmers do not apply potash

Table 1. Use of inputs and grain yield of spring maize obtained by farmers during 2016

Parameter	Farmers (Percent)	Yield (q/ha)	Mean ± S.D. (kg/ha)
Urea applied	63.6	94.0	321.0 ± 109.5
>250 kg/ha	36.4	94.0	
DAP applied	59	93.8	176.3 ± 63.0
>125 kg/ha	41	94.3	
MOP applied	59	92.8	48.3 ± 63.8
Not applied >50 kg/ha	41	94.8	
Seed treatment	95.5	94.3	N.A.
Yes/No	4.5	90.0	

fertilizer due to the fact that spring maize is generally grown after the harvesting of potato and the farmers apply MOP at higher rates than the recommended dose (100 kg/ha) to the potato crop. Further, it was also observed that 41 per cent of the farmers apply MOP to the spring maize crop and obtained an increase in yield by 2.0 q/ha. This increase was probably due to low potassium level in the soil.

It was further noticed that available packed hybrid seed of maize produced by private companies is treated with fungicides and thus farmers do the seed treatment with insecticide only in order to control shoot fly and stem borer. The data (Table 1) revealed that 95.5 per cent of the farmers were treating the seed with Gaucho (Imidacloprid 600FS) and obtained 4.5 per cent higher grain yield than untreated seed.

Productivity of Spring Maize Hybrids

Four spring maize hybrids viz., DKC 9108 (Monsanto), 31Y45, P 1844 and P 1855 (Pioneer) were found to be grown by the farmers. DKC 9108 dominated the region as 52 per cent of farmers preferred this hybrid because it has been recommended by Punjab Agricultural University(PAU), Ludhiana (Table 2). Hybrids 31Y45 and P 1844 were grown by 21.7 per cent of farmers each and P 1855 by 4.5 per cent of farmers under study. All the 4 hybrids matured in 115-125 d and shortest duration was observed for P 1844.

On an average, 19.7 irrigations (10125 m^3/ha water) were applied to spring maize hybrids during spring 2016 (Table 2). Hybrid 31Y45 received the highest number of irrigations (20.25) due to its longer duration as compared to other hybrids.

145 water blocks that Punjab has been divided into, 110 have already been declared as dark zones (India in grip of severe water crisis, 2016). Water productivity of all the hybrids was calculated and found to be highest for hybrid P 1855 (0.99kg/m^3) followed by DKC 9108 (0.97kg/m^3), P 1844 (0.94kg/m^3). The lowest water productivity value (0.91kg/m^3) was recorded for spring maize hybrid 31Y45 due to its higher water requirement and longer duration. The grain productivity followed similar trends as water productivity with maximum values for P 1855 and minimum for 31Y45.

Comparative Performance of Spring Maize Hybrids

It was interested to note that maize hybrid DKC 9108 was recommended by the PAU, Ludhiana during 2015 and thereafter it showed an increasing trend at the farmers' field from 46.4 per cent during 2014 to 52.2 per cent in 2016 (Table 3). Maize hybrid namely P 1864 was taken back by the company due to performance issues and new hybrids replaced older hybrids such as P 1844 and P 1855. A decrease in area under hybrid 31Y45 was observed from 48.0 per cent during 2014 to 21.7 per cent area during 2016.

Consistently higher levels of yield were obtained with DKC 9108 might be the reason for its wider adaption. New hybrids namely, P 1844 and P 1855 were giving better yields than older hybrids as 31Y45.The selling rate of all the spring maize hybrids varied from₹940.5 to ₹988.3, with a maximum for DKC 9108 and minimum for 31Y45 (Table 3).

Profitability of spring maize hybrids

The cost of production was taken as ₹30,800 per ha, as a number of inputs used by the farmers. An average gross

Table 2. Productivity of different spring maize hybrids grown by the farmers during 2016

Hybrid	Farmers (Percent)	Days took to maturity	Number of irrigations	Irrigation water used (m^3/ha)	Water productivity (kg/m^3)	Grain productivity (kg/ha/day)
DKC9108	52.2	118	19.67	9835	0.97	81.1
31Y45	21.7	125	20.25	10125	0.91	74.0
P 1844	21.7	115	19.8	9900	0.94	80.9
P 1855	4.4	116	19.0	9500	0.99	81.7
Average	100.0	118.5	19.7	9840	0.95	79.3

Table 3. Comparative performance of spring maize hybrids at the farmers' field during last 3 years

Hybrid	Farmers (Percent)			Yield (q/ha)			Selling rate (₹/q)		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
P 1864	4.8	-	-	100.8	-	-	953.3	-	-
PMH 1	0.8	-	-	70.0	-	-	1100.0	-	-
31 Y 45	48.0	19.8	21.7	96.0	79.3	92.5	851.8	884.6	940.5
DKC 9108	46.4	47.0	52.2	96.2	90.0	95.8	855.0	854.0	988.3
Dow 2244	-	19.3	-	-	85.3	-	-	833.3	-
P 1844	-	13.9	21.7	-	73.8	93.0	-	935.0	950.0
P 1855	-	-	4.4	-	-	94.8	-	-	954.0

Table 4. Profitability of spring maize hybrids during 2016

Hybrid	Gross income (₹/ha)	Net returns (₹/ha)	B:C ratio
DKC9108	94,630	63,830	2.07
31Y45	86,995	56,195	1.82
P 1844	88,350	57,550	1.87
P 1855	90,393	59,593	1.93
Average	90,093	59,293	1.93

Table 5. Profitability of spring maize hybrids after addition of irrigation water cost during 2016

Hybrid	Cost of production with irrigation water cost (₹/ha)	Net returns with irrigation cost (₹/ha)	B: C ratio with irrigation water cost
DKC 9108	40,635.00	53,995.00	1.33
31Y45	40,925.00	46,070.00	1.13
P 1844	40,700.00	47,650.00	1.17
P 1855	40,300.00	50,093.00	1.24
Average	40,640.00	49,453.00	1.22

income of ₹90,093/ha, net returns of ₹59,293 per ha and B: C ratio of 1.93 was obtained. The values of gross income, net returns, and B: C ratio was higher for DKC 9108 followed by P 1855, P 1844 and least with 31Y45.

The above values were obtained without considering any cost of irrigation applied or electricity consumed for irrigation. Now, if we consider irrigation as a costly measure during reproductive phase of spring maize (May-June), the irrigation needs to be seen in terms of monetary values. If we consider, ₹1m^3/ha (1000 litre of water) of water used, the cost of production, net returns, and B: C ratio values varied (Table 5).

The cost of production increased from ₹30,800 per ha to an average of ₹40,640 per ha with the addition of irrigation water cost @ ₹1 per m^3, resulting in decreased net profit and B: C ratio from ₹59,293 per ha to ₹49,453 per ha and 1.93 to 1.22, respectively (Table 4, 5).

With the decreasing trend in ground water reservoir, the natural resource needs to be used precisely for its longer and sustained availability.

CONCLUSIONS

On an average, 60 per cent of farmers were following urea and DAP recommendations, whereas, more than 90 per cent opting for seed treatment with insecticide. Farmers were not adding MOP due to heavy application to the preceding crop (Potato), but an increase in grain yield was observed with the application of MOP to spring maize grown under low potassium status soils. Spring maize hybrids showed irrigation water use of 9840 m^3/ha with the water productivity of 0.95 kg/m^3 and grain productivity of 79.3 kg/ha/day, showing high water consumption and low grain productivity. In comparison to previous 2 consecutive years, farmers shifted from 31Y45 to new hybrids such as P 1844 due to higher yield levels. The average net returns of ₹59,293 per ha was decreased to ₹49,453 per ha with the addition of irrigation cost while calculating the total cost of production. The gross income of ₹90,093 per ha seems to be very profitable for spring maize but on the other hand, with the addition of irrigation water cost, net returns reduced to ₹49,453 per ha. Hence, farmers must adopt some other short duration, low water requiring crops like summer moong, musk melon, and water melon, groundnut, etc.

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Spatial Price Integration of Okra in Selected Markets of Gujarat

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ABSTRACT
*Spatial price behaviour in regional markets may be used as a measure of overall market performance. If food markets are properly integrated they will give correct price signals through the marketing channels, which is beneficial to the farmers. Hence the study was undertaken to test spatial market integration of wholesale prices of okra in selected markets of Gujarat. The data used consist of monthly wholesale prices of five okra markets namely, Surat, Bharuch, Surendra Nagar, Navsari, and Vadodara of Gujarat for the period from 2004-2014.To test the null hypothesis of non-stationary against an alternative of stationary, we have applied Augmented Dickey-Fuller (ADF) test. Integration was tested by calculating bivariate correlation coefficient and multivariate cointegration method developed by Johansen and Johansen and Juselius. The analysis was done by using SAS 9.3 software. The results revealed that **a**ll the price series were non-stationary at the level and became stationary after first differentiation and they were integrated with the same order. From market integration results, we can say that all the okra markets were co-integrated and converge to long-run equilibrium. Five co-integration equations were found, which reveals good cointegration among okra price.*

Keywords
ADF, cointegration, market, spatial price integration.

JEL Codes
C12, Q02, Q11, Q12, Q13.

INTRODUCTION

Spatial price behaviour in regional markets may be used as a measure of overall market performance. In spatially integrated markets; competition among arbitragers will ensure that a unique equilibrium is achieved where local prices in regional markets differ by no more than transportation and another transfer cost. Information of spatial market integration thus provides an indication of competitiveness, the effectiveness of arbitrage and the efficiency of pricing (Sexton *et al*., 1991).The study on integration can suggest to the producer as to where, when and how much to sell, which in turn will have bearing on their production strategies and resource allocation.

DATA AND METHODOLOGY

The frequency of data from daily to weekly or monthly of sampled observations does not significantly change the power of the test of cointegration (Hakkio & Rush, 1991). Hence, monthly wholesale price data from January 2004 to December 2014 [132 observations] were used to study the market integration among major market of the state. The price of okra was recorded in rupees per quintal. The markets selected for the study purpose were Surat, Bharuch, Surendra Nagar, Navsari, and Vadodara of Gujarat. These are the major markets of okra on arrivals basis.

Spatial market integration refers to a situation in which prices of a commodity in spatially separated markets move together and price signals or information are transmitted smoothly across the markets. Two markets are considered to be spatially integrated if, in the presence of trade between them, the price in the importing markets (P_t^i) is equal to the prices in the exporting market (P_t^e) plus the transport and other transfer costs involved in moving goods between them (T_t^e). This happens because of spatial arbitrage condition is given by

$(P_t^i) = (P_t^e) + (T_t^e)$

The approaches that are generally used for testing market integration may be classified into two broad categories i.e. the law of one price and cointegration. The law of one price test for perfect price co-movement and assumes that markets are integrated. Price changes in the exporting market will be transmitted to the importing market on one for one basis. Whereas, when the co-movement of prices is lower than perfect, then the cointegration test can be used in such a situation. Prices are simultaneously determined and there are seasonal variations in the transfer costs.

The most common methodology used in the past for testing market integration involves estimation of the bivariate correlation coefficient between price changes in different selected markets. This method was criticised by Blyn (1973); Granger & Newbold (1974); Harriss (1979), Heytens (1986); Ravallion (1986)in spite of its simplicity. The studies based on bivariate correlation were found to have involved methodological flaws, the most serious one seems to have occurred due to their failure to recognize the possibility of spurious integration in the presence of common exogenous trend (e.g. general inflation), common periodicity (agricultural seasonality) or auto-correlated and heteroscedastic residuals in the regression with non-stationary price data(Barrett, 1996; Palaskas & Harriss-White, 1993).Secondly, the value of 'r' will be reduced if transfer costs are high or there are seasonal reversals in trade flows (Blyn, 1973).

The bivariate correlation coefficient for the prices in each pair of selected markets can be tested by the following formula (Acharya & Agarwal, 1994).

$$r = \frac{\Sigma (P_{11} - P_1)(P_{21} - P_2)}{\sqrt{\Sigma (P_{11} - P_1)^2 (P_{21} - P_2)^2}}$$

r = Simple correlation coefficient

P_{11} = Price of the commodity in the first market

P_{21} = Price of the commodity in the second market

P_1 = Mean of prices in the first market

P_2 = Mean of prices in the secondary market

The estimates of correlation coefficient are tested for their significance against zero by using't' test. Many empirical studies showed that time series may contain a unit root which has spurred the development of the theory of non-stationary time series analysis. Therefore, the traditional approach to looking for market integration through estimation of the correlation coefficient is not adequate.

For Unit Roots

Before proceed to test the cointegration, we need to examine the univariate time series properties of the data and confirm that all the price series are non-stationary and integrated of same order [A stationary series is one whose parameter (mean, variance and autocorrelation) are independent of time]. To test the null hypothesis of non-stationary against an alternative of stationary, we have applied Augmented Dickey-Fuller (ADF) test

Johansen Cointegration Test

We used the multivariate cointegration method developed by Johansen (1988) and Johansen & Juselius (1990). This method treats all the variables as explicitly endogenous and takes care of the endogeneity problem by providing an estimation procedure that does not require an arbitrary choice of a variable for normalization. It also allows tests for multiple cointegrating vectors.

Following Johansen &Juselius (1990), the ML method of cointegration may be briefly outlined here. If P_t denotes a (n×1) vector of I(1) prices, then the k-the order vector autoregressive (VAR) representation of P_t may be written as :

$$P_t = \sum_{i=1}^{k} \prod Pt + \mu + \beta t + \varepsilon t \ (t=1,2,3,\ldots\ldots\ldots\ldots,T)$$

The procedure for testing cointegration is based on the error correction representation of $P_t$given by

$\Delta P_t = \Sigma_{i=1}^{k=1} \Gamma_i \Delta P_{t-1} + \Pi P_{t-k} + \mu + \beta t + \varepsilon_t$

Where $\Gamma_i = -(I - \Pi_1 - \ldots\ldots - \Pi_i)$; $i = 1,2,\ldots,k-1$; $\Pi = -(I - \Pi_1 - \ldots\ldots - \Pi_k)$; Each of Π_1 is a n× n matrix of parameters; ε_t is an identically and independently distributed n-dimensional vector of residuals with zero mean and variance matrix, ? ε,μ is a constant term and t is a trend. Since P_{t-k} is I(1),but ΔP_t and ΔP_{t-1} variables are I (0), equation (2) will be balanced if ΠP_{t-k} is I(0). So, it is the Π matrix that conveys information about the long run relationship among the variables in P_t. The rank of Π, r, determines the number of cointegrating vectors, as it determines how many linear combinations of P_t are stationary. If r=n, the prices are stationary in level. If r=0, no linear combination of P_t are stationary. If $0 <$ rank (Π) $= r < n$, and there are n ×r matrices α and β such that $\Pi = \alpha\beta`$, then it can be said that there are r cointegrating relations among the elements of $P_t$. The cointegrating vector β has the property that $\beta` P_t$ is stationary even though P_t itself is non-stationary. The matrix α measures the strength of the cointegrating vectors in the ECM, as it represents the speed of adjustment parameters. Two likelihood ratio test statistics are proposed. The null hypothesis of at most r cointegrating vector against a general alternative hypothesis of more than r cointegrating vectors are tested by the Trace statistics $(\lambda\text{-trace}) = -T(1-\lambda_i)$

The null of r cointegrating vector against the alternative of r+1 is tested by the Maximum Eigen Value statistics $(\lambda\text{-max}) = -T \ln(1-\lambda_{r+1})$.

λ_is are the estimated Eigen Values (characteristic roots) obtained from the Π matrix; T is the number of usable observations (Johansen &Juselius, 1990), The number of cointegrating vectors indicated by the tests is an important indicator of the extent of co-movement of the prices. An increase in the number of cointegrating vectors implies an increase in the strength and stability of price linkages.

RESULTS AND DISCUSSION

Table 1 presents the descriptive statistics of price data of selected markets of okra. The total 132 observations were used for analysis. The average prices of okra were ranged in between ₹1524 to ₹1567 per quintal in different geographically separated okra markets. Price series in all the market were volatile; the coefficient of variation appeared to be 32 percent [Lowest] in Bharuch to 44 percent [Highest] in Navsari market. The bivariate correlation coefficient among the price series of the selected market pairs in the state was reported in Table 2. The bivariate correlation coefficients were calculated using nominal price series for okra in major markets, the correlation coefficients range 0.79 to 0.92.The strong associations were observed for many market pairs namely, Vadodara-Bharuch, and Surat-Navsari. The weak association was observed for the market pairs Surendra Nagar-Navsari and Surat-Surendra Nagar. Unfortunately, as it has been pointed out by a number of the authors, bivariate correlation coefficient has several problems [as discussed in methodology] to use for testing market integration, thus it is not adequate to report correlation coefficient only. Hence the degree of price integration between major okra markets of Gujarat State was determined by using Johansson co-integration method and presented subsequent sections.

Test for Unit Roots

Before conducting cointegration tests, we need to examine the univariate time series property of data and confirm that all the price series are non-stationary and integrated of the same order. This is confirmed by correlogram as well as by using the Augmented Dickey-Fuller [ADF] test developed by Dickey & Fuller (1979). Table 3 reports the unit root results using ADF and for three equations i.e. no intercept, intercept and intercept and trend for level and first differenced price series. The null hypothesis is that the variable observed has a unit root against the alternative hypothesis that it does not have a unit root. All the three equations indicated that null hypothesis of a unit root cannot be rejected for all price series as the absolute value of ADF statistics were well below the 95 percent critical value of the statistics. Hence, we can say that all the price series are non-stationary at the level and become stationary after first differentiation and they are integrated with the same order.

Table 1. Descriptive statistics of price data for major okra markets

Variable	N	Mean	CV [%]	Minimum	Maximum
Surat	132	1528	43	559	3582
Vadodara	132	1524	39	428	3334
Surendra Nagar	132	1567	42	557	3496
Navsari	132	1528	44	287	3671
Bharuch	132	1449	32	569	2628

N= Number of Observation; CV=Coefficient of Variation.

Table 2. Estimates of correlation coefficient for prices of okra between pairs of selected markets in Gujarat

Market	Surat	Vadodara	Surendra Nagar	Bharuch	Navsari
Surat	1.000	0.897***	0.812***	0.827***	0.909***
Vadodar		1.000	.873***	0.921***	0.869***
Surendra Nagar			1.000	0.859***	0.792***
Bharuch				1.000	0.814***
Navsari					1.000

**** Significant at the 1 percent level.*

Table 3. Results of augmented Dickey-Fuller test for stationary and order of integration

Market	ADF TEST [τ]		
	Equation I constant only	Equation II trend and constant	Equation III No trend and no constant
At level			
Surat	-3.53**	-6.50**	-0.94NS
Vadodara	-3.81**	-6.62***	-0.97 NS
Surendra Nagar	-4.46***	-6.50***	-0.33 NS
Bharuch	-4.52***	-6.27***	-1.04 NS
Navsari	-3.71***	-5.66***	-1.11 NS
At first difference			
Surat	-13.62***	-13.57***	-13.64***
Vadodara	-9.11***	-9.06***	-9.11***
Surendra Nagar	-10.90***	-10.85***	-10.92***
Bharuch	-13.70***	-13.64***	-13.74***
Navsari	-9.68***	-9.60***	-4.70***
Critical value at 5%	-2.88	-2.88	-2.88
Critical value at 1%	-3.48	-3.48	-3.48

**** and ** Significant at the 1 and 5 per cent level.*
NS: Non-significant.

Johansen Co-integration Test

After testing for unit root and order of integration, next step is to test for cointegration. Johansen's procedure has been applied [As it has merit over Engel- Granger method] to okra prices. The first step in Johansen procedure is the selection of the order of the vector autoregression [VAR] model. We use Akaike Information Criterion to select the order of VAR model. The second step is the Johansen test for the presence of integration and number of cointegrating vectors among the series in each model. Table 4 presents Johansen cointegration results. It reveals that all the Okra markets were co-integrated and converges to long-run equilibrium, as trace statistics value for each null hypothesis was greater than the critical value. Five co-integration equations were found, which reveals good cointegration among okra price.

Table 4. Johansen Co-Integration test for integration - Trace statistics

Equation tested	Null	Alter -native	Trace statistics	Critical value @ 5 per cent level
Surat	r=0	r=1	215.1336	88.8038
Vadodara	r≤1	r=2	149.9797	63.8761
Surendra Nagar	r≤2	r=3	97.88135	42.91525
Bharuch	r≤3	r=4	50.47297	25.87211
Navsari	r≤4	r=5	21.87692	12.51798

Trace test indicates 5 cointegrating equation(s) at the 0.05 level.

CONCLUSIONS

We can conclude from above results, that all the price series are non-stationary at the level and become stationary after the first differentiation, confirms that all the price series are integrated of same order [I(1)]. From market integration results, we can say that all the okra markets are co-integrated and converge to long-run equilibrium. The pair-wise co-integration results indicate the markets are integrated strongly. In order to improve integration situation among the markets, the government should disseminate arrival and price information effectively and develop communication means within markets.

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Major Advisor: Dr. B.S. Chandel
JEL Codes: Y40

To improve milk production and nutritional status, the Government of Jharkhand (GoJ) has started number of schemes for dairy development in the state. The present study was primarily focused on a scheme that was launched in 2015-16 to distribute two crossbred cattle to the BPL women farmers at 90 per cent subsidy. Keeping in mind the agro-climatic situations of the state and poor economic conditions of farmers, various questions arise about success of the crossbred technology. In this context, the present investigation entitled "Decomposing the effect of technological change in milk production: A study of crossbreeding programme in Jharkhand" was undertaken with the objectives of (1) to estimate the yield differentials and economics of milk production from crossbred and other dairy animals, (2) to decompose the effect of crossbred technology in milk production, and (3) to identify and prioritize the constraints in crossbreeding program and technology in the study area. Two districts of Jharkhand namely Khunti and Hazaribagh were selected purposively on the bases of more number of beneficiaries. A multi-stage simple sampling was followed to select blocks, villages and farmer beneficiaries. The study was based on primary data collected from 130 farmer respondents using well-structured interview schedules. The sample households were post-stratified into two groups, households having less than or equal to two lactating animals (Group 1 abbreviated as G1) and households having more than two lactating animals (Group 2 abbreviated as G2). The proportion of G1 households was about 79 per cent. The average size of land holding of sample household was 1.69 acres, varying from 1.24 acres for G1 households to 2.04 acres for G2 households. Overall, there was 72 per cent literacy among heads of sample households. The techniques used for data analysis were yield gap analysis, economics of milk production and Bisaliah's decomposition model. The results of data analysis shows that milk yield gap between potential yield and actual yield (YGII) was higher than yield gap between experimental yield and potential yield (YGI) for both household groups across all the type of dairy animals. The YG II in crossbred cow was more than two times higher on G1 farm as comparison to G2 farm while it was more than five times in comparison to higher in local cow. Overall value of total yield gap (TYG) implies that if all the constraints related with milk production were addressed, milk yield in the study area could be increased by about 43 per cent. The average productivity of crossbred (9.23 litres/day) was much higher than the average productivity of buffalo (6.09 litres) and local cow (4.98 litres/day). But buffalo was providing higher net returns per day per animal (₹7.39) in comparison to crossbred (₹5.19). Net returns both for per day and per litre were negative in case of local cow. Therefore, both neutral and non-neutral technological contributions were estimated for crossbred cow as well as local cow. The total gain in milk production from crossbred was 80.59 per cent in comparison to local cow. It was further decomposed into technological change (73.31 per cent) and change in level of input use (7.13 per cent). The contribution of neutral technological change was substantially high which was reduced by the negative effect of non-neutral technology. It indicates that crossbred technology has high yield potential but due to inefficient use of inputs, the farmers were not able to harness its full benefit. The most serious constraints faced by the farmers were the biased selection of beneficiaries followed by lack of interest of staff in imparting training on management of a crossbred cow. The major constraints in implementation of the programme were the frequent transfer of programme personnel, poorly conducted trainings to the farmers, inadequate coordination among the line department and the lack of transport facilities for project personnel to visit the study area. There was strong inter linkages among these constraints as one constraint lead to another. Hence, they all need to be attended simultaneously for the success of the programme.

Anupam Anand. (2016). ***Stakeholders opinion on agricultural subsidies and their impact in Punjab.*** Department of Extension Education, Punjab Agricultural University, Ludhiana, Punjab.

Major Subject: Extension Education
Major Advisor: Dr Manmeet Kaur
JEL Codes: C82, Q13

The study entitled "Stakeholders opinion on agricultural subsidies and their impact in Punjab" was undertaken with the objectives to study the awareness of farmers regarding various aspects of agricultural subsidies, opinion of different stakeholders regarding agricultural subsidies, problems faced by the farmers concerning agricultural subsidies and socio-economic and environmental impact of agricultural subsidies in Punjab. Ninety beneficiary and ninety non-beneficiary farmers were selected from the three agro-climatic zones of Punjab through multistage sampling method along with random selection of twenty economists and twenty extension personnel. Thus a total of two hundred and twenty respondents were selected for this study. The data were collected with the help of interview schedule. Findings of the study revealed that very less farmers were aware about the agriculture schemes providing subsidies whereas all the farmers were aware of the subsidies being

provided in the areas of seeds, plant protection materials, machinery, micro-irrigation, power and price (MSP). Input dealers and fellow farmers were found to be the most utilized sources by the farmers to get information regarding agricultural schemes/subsidies. Group meetings, informal personal contacts, farm and home visits and office call were the most employed methods by the extension personnel for dissemination of the information regarding the schemes/subsidies. The level of satisfaction of the beneficiary farmers was found to be low regarding various aspects of the agricultural subsidies. Majority of the respondents in all the categories agreed that subsidies help to increase production but at the same time were making the farmers more dependent on the government. The respondents in all categories except the beneficiary farmers agreed that subsidies are biased towards large farmers. Lengthy documentation procedure, lesser quantity and sub-standard quality of subsidized inputs were found to be the biggest problem faced by the farmers regarding agricultural subsidies. A considerable section of farmers also reported the lack of awareness about the time of availability of subsidy and misallocation of subsidies. Lack of proper infrastructure, less funds, lack of staff and information facilities were the major problems reported by the extension personnel in the disbursement of agricultural subsidies. Difference of opinion was noticed between the farmers and other two stakeholders regarding the increase of rice area in Punjab as an impact of the power subsidy and the impact overuse of urea by the farmers as an impact of fertiliser subsidy. A significant difference was found in the variables viz. operational land holding, annual income and mass media exposure of the beneficiary and non-beneficiary farmers. Tobit regression analysis showed that farmers' operational holding, lack of awareness of time of availability of subsidy, delay in release of subsidies and misallocation of the subsidies significantly affected the receipt of subsidy by a farmer.

Ashu (2017). ***An economic analysis of potato seed production under contract farming in Haryana.*** Department of Agricultural Economics, CCS Haryana Agricultural University, Hisar

Major Subject: Agricultural Economics
Major Advisor: Dr. Dalip Kumar Bishnoi
JEL Codes: Y40

The study on "an economic analysis of potato seed production under contact farming in Haryana" was undertaken with the following specific objectives; (i) To work out cost and return from potato seed production in Haryana (ii) To examine the resource use efficiency of important inputs and their impact on yield. (iii) To identify constraints faced by potato seed growers.

The study was based on primary as well as secondary data. The primary data was collected from the 90 (45 contact farmers and 45 non-contract farmers) selected farmers of Karnal district of Haryana while, the secondary data was collected from the National Horticulture Research Development Foundation (New Delhi), Directorate of Horticulture research (Panchkula), National Horticulture Board (Gurugram) and AGMARKET online source in regarding of area, productivity, production and market price, respectively. The cost of cultivation analysis for potato seed production revealed that rental value of land and seed were higher in contract as well as non-contract farming while; cost of plant protection chemicals was higher in contract farming as compare to non-contract farming. However, cost of fertilizer was observed higher in non-contract farming. It was observed that per acre yield, gross return and net return was almost double in contract farming as compare on non-contract farming.

From the study it has been revealed that in contract farming, the regression coefficients for the variables namely human labour, seed and plant protection charges were significantly negative whereas the for fertilizer and organic manure significant positive regression coefficient was reported. The price uncertainty ratio for non-contract and contract farming reveals that there is higher price risk under non-contract farming. The main reason for higher price uncertainty ratio for non-contract farming may be due to much variation in price of potato seeds in the market depending upon its quality and quantity marketed, place and location of sale, marketing channel and means of transportation etc. Results indicate that yield risk is higher in non-contract farming than that of contract farming. The lower yield risk in contract farming may be due to the fact that the contract farmers had used good quality seeds. These results further advocate the superiority of contact farming system over the non-contract faming in yield and price uncertainty of potato seed production. To achieve higher productivity of potato seeds, there is vast scope for the contract farming in the study area. Farmers has adopted contract farming mainly due to gain of higher income and good quality of inputs supplied by contractual agency. Moreover, the main reason for non-adoption of contract farming was mainly pertained to gap in communication delivery system in regards of the benefits of contract farming.

Harparteet Singh. (2017). ***Examining the profitability and marketing pattern of green fodder for sustainable dairy development in Punjab.*** College of Dairy Science and Technology, GADVASU, Ludhiana- 141 004

Major Subject	**:**	Dairy Economics
Major Advisor	**:**	Dr. Varinder Pal Singh
JEL Codes	**:**	Q12, Q13

The dairy sector is an important sub-sector of Punjab agriculture providing regular income, nutritional security

and employment especially to small and marginal farmers. For determining the productivity and profitability from dairy farming, green fodder plays an important role. The present study has been conducted to examine the availability, costs, returns and marketing of green fodder in three agro-climatic zones of Punjab state during 2016-17. The results of the study revealed that the green fodder deficiency in Punjab state was 22.99 million tonnes which was 28.57 per cent of the total green fodder requirement. The area under fodder crops will have to be increased by 3.58 lakh ha at existing yield level to meet the green fodder requirement. Regarding the cost and returns of fodder crops, among the *kharif* fodder crops, bajra was the most profitable fodder crop with overall profit of ₹19,645/acre followed by sorghum and maize with ₹19,159/acre and ₹13,933/acre, respectively. Among *rabi* season crops, the profit was observed to be the highest in berseem (₹31,568/acre) followed by oats with ₹19,756/acre. The share of green fodder, considering market prices, in variable cost of milk production was to the extent of about 25-27 per cent. There was significant positive correlation between quantity of green fodder fed and milk yield of milch animals. The processing of green fodder was not much popular among the sample farmers. Further, it was found that out of the total sample size of 120 farmers, twenty farmers were involved in marketing of green fodder. The marketing, Producer-Dairy owner (User) was found to be the most efficient channel for green fodder marketing. High price of seed and high cost of labour were the main production problems and lack of proper market followed by price fluctuations and low output prices were the major marketing problems being faced by the fodder growers. The study clearly indicates the need to enhance the green fodder availability which will go a long way for the sustainable dairy development in Punjab.

Manish Kumar. (2017). ***An economic analysis of onion cultivation in Giridih district of Jharkhand*****.** Department of Agriculture, Rural and Tribal Development, Ramakrishna Mission Vivekananda University, Morabadi, Ranchi-834008

Subject: Agricultural Economics
Major Advisor: Dr. Punit Kumar Agarwal
JEL Codes: Y40

This study was carried out in Giridih district of Jharkhand during the year 2016-17. The study investigated the productivity and profitability of onion cultivation in Birni and Dhanwar block of Giridih. The other objectives were to analyze the socioeconomic condition of the farmers and to identify the major constraints faced by the farmers in onion cultivation. From each block five villages were purposively selected and a primary survey was done. From each village 12 farmers were randomly selected for further detail studies and thus making a sample size of 120. It was revealed from the study that in all aspects farmers of Dhanwar were much advance than the farmers of Birni. About 25 per cent of respondents in Birni were labour and Dhanwar had more respondents with business as a main occupation. The average cost of cultivation of onionin dhanwar block was ₹57687.95 per acreage which was higher than ₹50374.3 in case of Birni. The total variable cost per acre in Dhanwar was ₹45325.16 and in Birni it was ₹41691.40. The output per acre in Dhanwar was 65.52 quintal and in Birni it was 46.00 quintal/acre. The return per rupee investment was around ₹1.71 and ₹1.34 over variable and total cost respectively in case of Dhanwar block. In Birni block it was ₹1.65 over variable cost and ₹1.37 over fixed cost. The major problems in cultivation of onion were lack of water for irrigation, high cost of seeds, pest and diseases, awareness on optimum use of fertilizers, high cost of labour etc.

Sakthi Parthiban. R (2012). ***Tamil Nadu mango growers federation (TAMAFED): A stakeholder analysis.*** Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-12.

Subject: Agricultural Extension
Major Advisor: Dr. M.S.Nain
JEL Codes: Y40

With the growing commercialization of agriculture and increasing dominance of supply chains characterized by the requirement of rigid adherence to strict grades and standards, small farmers in India face both an opportunity for access to valuable markets and the risk that they will be excluded from them. Creation of platform for farmers for better production and elaborate documentation of the process can lead to precision farming for successful marketing. Such models can manage to consolidate the activities both at input level by internalizing the production and at output by strategy of targeted marketing. The present study to analyze the stakeholders of Mango growers federation (TAMAFED) was undertaken in three districts of Tamil Nadu state in order to study the process of organization, extension services provided by TAMAFED, motivational factors of the stakeholders, socio-economic gains of the members and the constraints faced by the TAMAFED stake holders is an attempt to verify the expectation of effective and efficient supply chain through farmer's forums. A set of sixty members and sixty nonmember farmers were selected randomly from the six villages of the three districts from Tamil Nadu for study.

Tamil Nadu Mango Growers Federation (TAMAFED) was formed on February 21st. 2006, with assumption of charge by sixty-five office bearers from seventeen mango growers associations of Tamil Nadu and subsequent registration on 10th March, 2006 to facilitate better team work among the farmers to face the various

challenges in supply chain management. Various extension services included starting from arranging buyer and seller meet, providing market information and providing guidelines to form district mango growers association.

The analysis of motivational factors of TAMAFED members showed that the members having 28.33 per cent high innovativeness and 56.66 per cent medium level of innovativeness. It was found that 61.66 per cent of members of TAMAFED having higher achievement motivation when compared to non-members majority of whom having medium level of achievement motivation with 51.66 per cent. About 36.66 and 48.33 per cent members of TAMAFED had higher and medium level of risk orientation respectively. In terms of economic motivation about 40 per cent of member having higher level and 48.33 per cent having medium level of economic motivation. From the results of Logit analysis it was evident that education, economic benefits and area under mango are the major predictors of motivation to join TAMAFED with the odds ratio of 15.087, 10.635 and 2.995 respectively. Since these odds ratios are significant we can conclude that these factors significantly explain the motivation to join TAMAFED.

The major dimensions of socio-economic gains namely, change in input and output transaction cost, social participations and cosmopoliteness were analysed. Analysis revealed that, TAMAFED members were having significantly lesser input transaction costs as compared to non-members. This reduction in input transaction costs may be due to group basis operation leading to sharing of input transaction costs among the TAMAFED members. Similar results were found in case of output transaction costs. Member farmers were not having output transaction costs like, transportation cost, travelling cost, weighing charges and commission charges. This reduction in cost is due to the fact that member farmers were selling their product at their farm itself by having contract with whole-sale, retail dealers and processing industries. All this charges borne by the buying agencies and hence member farmers could be able to save this output transaction costs as compared to non-members, who used to sell their produce in block or district level markets.

Analysis of social aspects viz., social participation and cosmopoliteness revealed that majority of the non-member farmers were having no membership in none of the organization. Whereas, majority of the TAMAFED members were having membership in atleast one organization. This may be due to the fact that joining in TAMAFED gives exposure to external environment and newer social dimensions. In case of cosmopoliteness there was no significant difference between member and non-member growers of TAMAFED. The cosmopoliteness of farmers was not influenced by the membership to TAMAFED. It can be concluded from the study that input and output transaction costs and social participation were seen positive changes as a result of TAMAFED membership.

Since the study area is potential belt for export of mango the major constraints faced by growers need to be addressed in a long term perspective. Regarding the constraints faced by the members of TAMAFED, non availability of labour was given the first rank followed by pest and disease occurrence while the procurement of disease free saplings was given the last rank. Whereas the timely availability of inputs and market price was given the first rank by the non members followed by non availability of labour and procurement of disease free sapling was given the last rank.So the efforts should be focused on viable research and policy solutions to the above said problem.

On the basis of the findings it was concluded that the members of TAMAFED harvested social and economic benefits and the costs incurred on input and output transaction were quite low ultimately adding to the benefit. As such it may be recommended that organization of farmers on commodity basis in the form of similar federations may be promoted for socio economic gain of the farmers.

Jagjeet Singh. (2017) ***Pattern of agricultural land lease market in central zone of Punjab.*** Department of Economics and Sociology, Punjab Agricultural University, Ludhiana

Major Subject: Agricultural Economics
Major Advisor: Dr. M K Sekhon
JEL Codes: Y40

This paper deals with the pattern of agricultural land lease market in central zone of Punjab with the objective to study the extent and magnitude, analyse the determinants of agricultural land lease market and to work out economic rent of agricultural land. So, two districts were selected on the basis of comparative ranking of productivity i.e. Moga as high productivity and Amritsar as low productivity district. Primary data were collected during the year 2015-16. A total number of 120 farmers were purposely selected. About 10 per cent farmers were still illiterate and none of the family head had passed out post-graduation in the sample. The majority of household's heads (63.33 per cent) came under the age group of 36-50 years and the average family size was 4.73 members. Out of 120 sampled farmers 62 (51.66 percent) farmers were involved in leased-in land and 58 (48.33 percent) were involved in leased-out land transactions. There were four pure tenant farmers (3.33 percent) in the sample. The proportion of farmers who leased-in land was the highest among semi-medium (25.80 percent) farmers and the lowest among pure tenant farmers (6.45 percent). The proportion of farmers who leased-out land was the highest among semi-medium

(25.86 percent) farmers and lowest among large farmers (12.06 percent). Average leased-in and leased-out area was 11.24 and 9.25 acre respectively. The proportion of leased-in area to own area was 106.33 and proportion of leased-out area to own land was 87.51 per cent. The paddy-wheat rotation is dominated in this zone and area under paddy crop was 79.36 per cent of total area whereas it was 79.66 per cent for wheat crop.

Economic rent which includes cost A1, management cost, and interest on fixed capital, a part of family expenditure work out for Moga and Amritsar district was ₹33539 and 24844 per acre respectively. But the actual rent paid in Moga and Amritsar districts was ₹47466 and ₹41091 respectively. According to law of tenancy the rent should be ₹27640 for Moga district and ₹26026 for Amritsar district. The oral agreement with the schedule of half amount advance and half after kharif crop for payment of rent was common feature of tenancy system. Lack of non-farming employment opportunities was emerges as the major reasons for acquiring leased-in land and lack of resources was emerged as the major reasons for leased-out land. The surplus resources available on the farm, non-viability of small farm, lack of opportunity than agriculture had effected land leased-in market significantly. However, in lease-out land market the factors like high land rent, regular service, residing abroad were highly affective and significant. Government must in explore the possibilities to generate non-farm employment, fixation of fair land rent, limits on land area to be leased-in to improve the land lease market in Punjab.

5th National Seminar 2018
on
Towards Sustainable Agriculture: Role of Technology, Policy Planning and Implementation
(April 05, 2018)

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Towards Sustainable Agriculture: Role of Technology, Policy Planning and Implementation

Agriculture in India is facing several challenges which together manifests into sustainability issues. The symptoms of agricultural instability are sub-optimal growth, the absence of desirable profits and distraction or movement of farmers away from the sector. The cause lies in the depleting status of natural resources and socio-economic conditions of the farmers. Sustainable agriculture is the efficient production of safe, high-quality agricultural products in a way that protects and improves the natural environment, the social and economic conditions of the farmers, their employees and local communities, and safeguards the health and welfare of all interest-groups. Several frameworks and models on measuring agricultural sustainability have been proposed under various production ecosystems. Sustainable agriculture development integrates three main goals viz., environmental health, economic prosperity and livelihood sustainability. In other words, sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Therefore, stewardship of both natural and human resources is of prime importance. The human resources includes consideration of social responsibilities such as working and living conditions of farm families, the needs of rural communities, and consumer health and safety both of present and in future. The agricultural technologies need to move from production oriented to profit oriented sustainable farming. This calls for the identification and prioritization of constraints, and schematize strategic action plans, for conservation of natural resources, enhancement of agricultural, production, promotion of traditional food crops, value addition and marketing of produce.

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Indian Journal of Economics and Development
Contents

Volume 13 No. 1, January-March, 2017

Research Article

Volume 13 No. 1a, April, 2017

Volume 13 No. 2, April-June, 2017

Volume 13 No. 3, July-September, 2017

List of Referees
Indian Journal of Economics and Development
Volume 13, 2017

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