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Research Article

IMPACT OF SOCIO-ECONOMIC FACTORS ON TECHNICAL EFFICIENCY OF PADDY FARMS IN PUNJAB

N.D.Singh*

ABSTRACT

The present study was undertaken to examine the impact of socio-economic factors on technical efficiency of rice production in Punjab in 2011-12. The technical efficiency on the sample farms was estimated using Cobb-Douglas production function. The production of rice was positively related to the farm size as the regression coefficient of farm size came to be positive and significant statistically. The frontier production function indicated that the use of all the factors of production higher was than frontier level on the sample farms. This indicated that existing level of production could be achieved by reducing the input use. The technical efficiency analysis revealed there is ample scope in improving resource use efficiency. The relationship between technical efficiency and various socio-economic factors revealed that rice production was positively related with farm size, education, age, experience, extension contacts and percentage of good land and negatively related with fragmentation of the land.

Keywords**:** Efficiency, technical efficiency, frontier level, production function, operational area.

INTRODUCTION

Rice is the principal food crop of more than half the population of the world. A large proportion of its area and consumption is in Asian countries like China, India, Indonesia, Pakistan, Bangladesh, Ceylon, Burma, Japan and Taiwan. India is the second largest producer of rice in the world (after China) with an area of 43 million hectares and a production of 95 million tonnes in 2010-11. As far as the rice productivity was concerned it was 2240 kg per ha in India against the world average of 4310 kg per ha, which was 48 and 39 per cent of China and USA respectively

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(Anonymous, 2011). One of the important reasons for low rice productivity in India was due to poor resource use efficiency of farmers (Chamak and Singh, 1979; Muraleedharan, 1987 and Rao *et al.*, 2003). In developing economies like India where resources are meager and opportunity for adopting capital intensive new technologies are limited, the best option to enhance productivity is by efficient use of the production resources as resource use efficiency is an important factor for productivity growth (Naidu and Tirupathaniah, 1992 and Kaur *et al.,* 2010).

Similarly, Punjab state with an area of 1.5 per cent of the total geographical area of the country having 2735 thousand hectares under rice crop and contributing 43.8 per cent of rice in the central pool (Anonymous, 2011a), is facing serious ecological and economic crisis especially due to paddy cultivation like falling water table level, deficiency of macro and micro nutrients in soil resulting in increased cost of production and almost stagnant productivity of rice. Increasing the productivity of rice further without increasing the cost of production is possible by efficient use of resources. Although, several studies on estimation of resource use efficiency were undertaken on all major crops sown in Punjab, but comparatively less work has been done for identifying reasons for poor resource use efficiency of farmers. Keeping in view the above points, the present study was undertaken with following specific objectives:

i. to estimate resource use efficiency of rice growing farms in Gurdaspur district of Punjab and
ii. to estimate the impact of socio-economic factors on the technical efficiency on the rice farms in the study area.

METHODOLOGY

The present study was conducted in Gurdaspur district purposively as this district is one of the leading rice producing districts. In order to reach out the ultimate sampling unit a multistage random sampling technique was used. At the second stage two developmental blocks were selected randomly. Similarly, the villages and farms formed third and fourth stage sampling units. The farms were divided into five categories based on national classification of farmers. As such 30 farms each were randomly selected from each category of farms. In total the sample consisted of 150 paddy farms. The data were collected pertaining to age, education level, farming experience (years), area under rice crop, operational farm area in acres, input structure of rice crop, production, productivity, cash income from the crop, gross return, variable cost, etc. The secondary data were collected from the published sources at the district and state levels and revenue records, newspapers, journals, books, internet, etc.

Analysis of data

In the initial stages of analysis, percentages, averages and frequency distribution technique were used, then comparative analysis of existing resource use pattern with recommended resource use level was made to find out the efficiency gap (if any) for different categories of farms. To work out technical efficiency (TE) on the sample farms, output-based measure by Timmer (1971) was used. Ordinary least square (OLS) method was applied to estimate Cobb-Douglas production function of the following form:

$$Y = a X_1^{b1} X_2^{b2} \ldots\ldots\ldots\ldots\ldots\ldots X_k^{bk} e^U$$

$$LnY = Lna + b_1 LnX_1 + b_2 LnX_2 + \ldots\ldots\ldots\ldots\ldots\ldots + b_k LnX_k + u$$

Where,

Y = Gross output (quintals), computed by aggregating the physical output of the main product and the main product equivalent of by-product, (if any) of a crop enterprise.

X_1 = Farm size in hectares.

X_2 = Seed in kilograms.

X_3 = Nitrogen in kilograms.

X_4 = Phosphorous in kilograms.

X_5 = Micro-nutrients in kilograms.

X_6 = Expenditure on plant protection measures in rupees.

X_7 = Human labour use in hours.

X_8 = Machine use in hours.

X_9 = Irrigation with electric motor in hours.

X_{10} = Irrigation with diesel engine in hours.

a = Technical efficiency parameter, a constant term,

b_{ik} = Regression coefficients of respective independent variable

u = Random term with usual properties.

The frontier production function, which gives the maximum possible output that can be produced from a given set of inputs, was derived by the method called corrected ordinary least squares (COLS). The intercept estimate was then corrected by shifting the function until no residual was positive and one was zero. This resulted in output magnification not only at the particular point, but also over the entire production surface. The frontier production function takes the form:

$$\text{LnY*} = (\text{Ln a} + \text{v}) + \sum_{i=1}^{k} b_1 \, Ln\, X_i$$

Where LnY* = Frontier output (for given level of inputs)

v = maximum positive residual.

This function yielded in the best, linear, unbiased estimates of the b coefficients. The independent variables were tested for their stochastic independence also.

The Timmer Measurer of Technical Efficiency

Technical efficiency of 'j^{th}' farm is the ratio of actual output as observed on the farm to the potential output as given by the frontier production function at a given level of input use on 'j^{th}' farm. It would thus, indicate how much extra output could be obtained if 'j^{th}' farm would have operated on the frontier production surface. Thus, TE for each farm was obtained as:

Timmer $TE_1 = (Y_i / Y^*_i)$

Where,

Y_i = Output of a given crop on 'j^{th}' farm.

Y^*_i = Potential output of the same crop for 'j^{th} farm.

'j' = Number of farms.

To study the effect of socio-economic factors on technical efficiency, the correlation coefficient analysis was undertaken. The socio-economic variables studied were farm size, age of the farmer, experience of the farmer in crop production, education level of farmer, contacts of farmer with extension agencies, number of family members working on farm, fragmentation of land, percentage of good land on farm, caste of farmer.

RESULTS AND DISCUSSION

The results obtained from the analysis of data are discussed here various sub-heads as under:

Resource Use Efficiency in Rice

The analysis of data showed that production of rice was positively related to the farm size as the regression coefficient of farm size came to be positive and significant statistically. The role of seed and machine use was negative on large farms and were non-significant on all other farm size categories.

Table 1: Factors affecting production of rice on different farm size categories

Factors	Unit	Marginal	Small	Semi-Medium	Medium	Large
Constant	-	1.13 (2.16)	4.19 (1.04)	2.50 (1.37)	2.54 (1.52)	6.54 (2.37)
Farm size	ha	0.87** (2.15)	1.71*** (3.89)	0.98*** (3.37)	0.81** (2.45)	1.40** (2.28)
Seed	kg	0.21 NS (0.98)	1.12 NS (1.17)	-0.44 NS (1.24)	-0.40 NS (1.37)	-1.24** (2.14)
Nitrogen	kg	0.34 NS (1.23)	0.44 NS (1.55)	0.29 NS (1.46)	-0.57 NS (0.97)	-0.29 NS (1.22)
Phosphorus	kg	0.10 NS (0.71)	0.05 NS (0.83)	0.08 NS (1.37)	-0.01 NS (1.01)	-0.04 NS (1.13)
Micro-nutrients	kg	0.08 NS (1.12)	0.12 NS (0.97)	0.01 NS (1.63)	-0.01 NS (0.89)	-0.05 NS (1.57)
Plant protection	`	0.61*** (3.18)	0.41** (2.54)	0.29 NS (1.57)	-0.76** (2.19)	-0.82** (2.31)
Human labour	hr	0.25 NS (1.14)	0.40 NS (1.43)	0.24 NS (0.72)	0.27 NS (1.23)	0.17 NS (1.54)
Machine use	hr	0.05 NS (1.21)	0.04 NS (1.09)	0.04 NS (1.11)	-0.02 NS (1.08)	-0.11** (2.26)
Electric motor use	hr	0.41*** (3.68)	0.32*** (4.21)	0.29*** (2.62)	0.29** (2.26)	0.10 NS (1.43)
Diesel engine use	hr	0.03 NS (0.69)	-0.04 NS (0.62)	0.10 NS (1.14)	0.08 NS (0.88)	0.13** (2.39)
R^2		0.7962	0.8154	0.8311	0.8855	0.9057

Figures in parentheses are t-values.
****** and ** Significant at 1 and 5 level respectively.***
NS: Non-significant

The effect of expenditure on plant protection materials was positive and significant statistically on marginal and small farm size categories, non-significant on semi-medium farms and significantly negative on medium and large farms. The use of electric motor came out to be significantly on all the farm size categories except the large farms where it was non-significant statistically. The use of diesel engine contributed positively to rice production on large farms (Table 1). The independent variables included in the equation explained 79.62, 81.54, 83.11, 88.55 and 90.57 per cent of the variation in production of rice on marginal, small, semi-medium, medium and large farms respectively which means the fitted model was powerful in explaining the variability in rice production.

Frontier and Actual Use of Inputs in Rice Production

The differences between the frontier level use and the actual use of different inputs in rice production are shown in Table 2. A perusal of Table 2 indicated that all the factors of production were used at levels higher than frontier level by all the farm size categories. The inputs were being used in excess of the frontier use of inputs in the production of rice which ranged between 29.27 per cent on potassium to 10.96 per cent on seed in the case of marginal farms. The same ranged between 45.45 per cent on potassium to 11.66 per cent on micronutrients in the case of small farms.

The excess use was observed from 53.27 per cent on potassium to 11.27 per cent on electric motor use in the case of semi-medium farms. The actual input use was 55.50 per cent on potassium and 10.09 per cent on electric motor use excess of frontier level in case of medium farms. In the case of large farms, the excess use of inputs ranged between 59.88 per cent on potassium to 7.62 on electric motor use. The analysis showed that the use of potassium on rice was much higher than the frontier level while the use of electric motor was not much higher than the frontier level. Thus, it may be concluded from the above discussion that the existing level of production could be achieved by reducing the input use by 18.24, 20.98, 25.38, 27.06 and 27.99 per cent on marginal, small, semi-medium, medium and large farms respectively (Table 2).

Table 2: Frontier and actual use of inputs for rice production on different farms

Factors	Marginal		Small		Semi-Medium		Medium		Large	
	F	**A**	**F**	**A**	**F**	**A**	**F**	**A**	**F**	**A**
Farm size (Ha)	0.13	0.16 (18.75)	0.31	0.38 (18.42)	0.42	0.49 (14.29)	0.87	1.08 (19.44)	1.98	2.14 (7.48)
Seed ($kg\ ha^{-1}$)	17.31	19.44 (10.96)	16.55	19.59 (15.52)	15.23	20.11 (24.27)	13.61	20.40 (33.28)	12.44	20.67 (39.82)
Nitrogen ($kg\ ha^{-1}$)	31.63	35.54 (11.00)	28.39	36.61 (22.45)	23.64	38.45 (38.52)	21.56	40.52 (46.79)	19.65	42.63 (53.91)
Phosphorus ($kg\ ha^{-1}$)	22.54	26.61 (15.30)	20.68	27.13 (23.77)	19.43	28.55 (31.94)	18.55	30.73 (39.64)	18.09	31.98 (43.43)
Potassium ($kg\ ha^{-1}$)	5.34	7.55 (29.27)	4.98	9.13 (45.45)	4.78	10.23 (53.27)	4.61	10.36 (55.50)	4.59	11.44 (59.88)
Micro-nutrients ($kg\ ha^{-1}$)	3.37	4.13 (18.40)	4.62	5.23 (11.66)	3.22	4.37 (26.32)	2.79	3.45 (19.13)	3.44	4.67 (26.34)
Human labour ($hr\ ha^{-1}$)	528.59	678.76 (22.12)	534.13	666.90 (19.91)	549.61	659.49 (16.66)	546.18	642.20 (14.95)	531.68	605.15 (12.14)
Machine use ($hr\ ha^{-1}$)	29.16	35.49 (17.84)	29.41	36.61 (19.67)	30.45	37.12 (17.97)	31.15	36.23 (14.02)	32.47	37.94 (14.42)
Electric motor use ($hr\ ha^{-1}$)	319.14	374.22 (14.72)	309.28	351.98 (12.13)	307.44	346.49 (11.27)	303.34	337.39 (10.09)	301.49	326.37 (7.62)
Diesel engine use ($hr\ ha^{-1}$)	32.19	42.37 (24.03)	30.98	39.14 (20.85)	29.37	36.41 (19.34)	29.16	35.44 (17.72)	28.41	33.38 (14.89)
Average percentage change		18.24		20.98		25.38		27.06		27.99

Figures in parentheses are the percentage differences between actual and frontier level of input use.

F= Frontier and A = Actual

Frontier and Observed Output of Rice

Frontier output of rice for individual farms was obtained by substituting the quantity of inputs, actually employed for raising rice on these farms, in the corresponding frontier production functions. It was observed from the Table 3 that the using the similar level of inputs as were observed on the sample farms, the output of rice at the frontier was higher than actual realized on different categories of farms. The figures for the frontier output were 44.68, 41.13, 39.62, 39.71 and 37.53 quintal per ha against the realized output of 31.39, 30.54, 30.82, 32.16 and 31.83 quintal per ha which showed an increase of 42.34, 34.68, 28.55, 23.48 and 17.91 per cent on marginal, small, semi-medium, medium, medium and large farms respectively (Table 3).

Table 3: Frontier and observed output of rice crop on different farm size categories

(Qha^{-1})

Output	**Marginal**	**Small**	**Semi-Medium**	**Medium**	**Large**
Frontier	44.68	41.13	39.62	39.71	37.53
Observed	31.39	30.54	30.82	32.16	31.83
Difference	13.29	10.59	8.80	7.55	5.70
Percentage difference	42.34	34.68	28.55	23.48	17.91

Though, in absolute terms, the realized output was highest on medium farms and large farms, the deviation in output between the frontier and the actual output was observed to be the highest in the case of marginal, small and semi-medium farms. Thus, there existed a great scope to increase rice output smaller farms as compared to the larger farms. This showed that none of the farm size category was fully exploiting the scarce resources at the existing level of technology.

Technical Efficiency of Rice Farms

Technical efficiency of farms in utilizing farm resources for production of rice crop on different farm size categories in Gurdaspur district was estimated. It can be seen from the Table 4 that only 10 per cent of the marginal farms achieved the technical efficiency of more than 80 per cent in rice production, while the 43.33 percent of the farmers achieved the efficiency level of 40-60 per cent. Similarly, 40 per cent of the small farms achieved the technical efficiency of 40-60 per cent in rice productivity, and only 13.33 per cent of them could attain the technical efficiency above 80 per cent.

Table 4: Technical efficiency in rice production using Timmer Approach on different farm size categories

(Percent)

Technical efficiency	Marginal	Small	Semi-Medium	Medium	Large
20-40	8 (26.67)	8 (26.67)	4 (13.33)	-	-
40-60	13 (43.33)	12 (40.00)	11 (36.67)	8 (26.67)	7 (23.33)
60-80	6 (20.00)	6 (20.00)	8 (26.67)	11 (36.67)	12 (40.00)
80-100	3 (10.00)	4 (13.33)	7 (20.83)	11 (36.67)	11 (36.67)
Average TE	53.33	55.00	60.00	72.50	73.33

Figures in parentheses are percentages to total number of farms.

The highesttechnical efficiency in rice cultivation was observed to be 36.67 per cent each in the case of medium and large farms respectively were operating at 80-100 per cent, indicating direct relationship between technical efficiency and farm size. The overall mean level of technical efficiency in utilizing farm resources came to be 53.33 per cent on marginal farms, 55 per cent on small farms, 60.00 per cent on semi-medium farms, 72.50 per cent on medium farms and 73.33 per cent on large farms which means that there is still scope of improving resource use efficiency by 46.67 per cent, 45 per cent, 40 per cent, 27.5 per cent and 26.67 per cent on respective farm categories in Punjab.

Role of Socio-Economic Factors

The results pertaining to the effect of socio-economic factor on technical efficiency are given in Tables 5 and 6 and discussed under various sub-heads here under:

Farm size: The technical efficiency in rice production increased with increase in farm size. The average technical efficiency was highest on large farms (73.33 %) followed by medium farms (72.50%) and minimum average technical inefficiency was observed on marginal (53.33%) and small farmers (55.0%). Analysis of variance revealed that the difference in technical efficiency among various size-groups was significant at one per cent level. The positive correlation coefficient between farm size and technical efficiency also indicated that the farm size increases efficiency of the farm. This result clearly indicates that bigger farms provide opportunity for better utilization of inputs and machinery making them more efficient than the marginal and small farms whose farm size was less than two hectares As there is no scope to increase farm size as such, co-operative type of farming, where farmers bring their resources together including land should be encouraged to increase the farm size.

Age of the farmer: To study the effect of age, the farmers were grouped into three categories, such as below 35, 35-50 and 50 years and above, and their average technical inefficiency was compared. The farmers belonging to age group of below 35 years showed lowest technical efficiency in the production of rice followed by the farmers belonging to 36-50 years age group. The technical inefficiency of the farmers belonging to 50 years and above age group was comparatively higher than that of younger age groups. The analysis of variance revealed that the difference in technical inefficiency was significant and the efficiency level of the farmers below 50 years of age was comparatively lower than that of farmers above 50 years. The age variable was positively and significantly correlated with technical efficiency indicating that with the age of the fanner, his experience and knowledge level also increases, making him more efficient (Table 5).

Education of the farmer: The technical efficiency increased significantly with the increase in the level of education. The correlation coefficient between education and technical efficiency was also positive and significant. Highest technical efficiency in rice production was found with the college educated farmers (72.23%) followed by secondary educated farmers (69.54%). The technical efficiency of illiterate and primary educated farmers was 61.33 and 62.29 per cent respectively, which was comparatively lower. So, primary level education had no effect on efficiency. Hence, at least secondary level education is needed to carry out production in an efficient manner. The well-educated farmers can understand production technology better, can get information from various sources and can maintain meaningful contacts with extension agencies resulting in better technical efficiency.

Experience in rice production: The sample farmers based on their experience in production of rice, were classified into four groups having experience up to 10, 11-20, 21-30 and 31 years and above. The farmers having up to 10 year experience recorded lowest technical efficiency (59.26%) followed by the farmers with experience 11-20 years (64.34%). The farmers with experience of 31 years and above recorded the highest technical efficiency (68.12%). The analysis of variance revealed that these differences were significant statistically. This clearly indicated that experience was positively correlated with efficiency of rice production showing that as experience increases efficiency also increases.

Table 5: Relationship of socio-economic factors with technical efficiency of rice farms

Particulars	Technical Efficiency	F-ratio	Particulars	Technical Efficiency	F-ratio
Farm size		8.281	**Caste**		1.618
Marginal	53.33		Higher	73.62	
Small	55.00		Lower	72.89	
Semi-medium	60.00		**Farm workers (No.)**		2.49
Medium	72.50		1-2	68.35	
Large	73.33		3-4	66.98	
Age (Years)		6.894	5 and above	63.47	
Less than 35	58.23		**Extension contacts**		4.983
36-50	63.67		Yes	66.59	
51and above	71.0		No	61.10	
Educational level		6.977	**Good Farm Land (%)**		7.139
Illiterate	61.33		Up to 50	57.56	
Primary	62.29		51-75	61.23	
Secondary	69.54		76 and above	65.48	
Graduate and above	72.23		**Fragmentation index**		5.328
Farming Experience (Years)		7.567	Low	69.43	
			Medium	63.31	
Upto 10	59.26		High	56.00	
11- 20	64.34		**Type of Family**		
21-30	65.51		Nuclear	66.99	1.23
31and above	68.12		Joint	65.99	

Type of family: The technical efficiency of farmers was 66.37 and 65.99 per cent in case of nuclear and joint families respectively which was non-significant statistically.This showed that there was no relationship between family type and technical efficiency.

Caste of the farmer: Farmers based on the social order of their cast were grouped into lower (SC, ST, BC) and higher (OC) caste groups and their average efficiency was compared. The analysis of variance revealed that there was no significant difference between efficiency levels of lower and higher caste farmers in the production of rice. But, the lower caste farmers registered slightly lower technical efficiency compared to the higher caste farmers in rice production. The correlation coefficient was negative but non-significant statistically indicating that inefficient farmers are distributed in both higher as well as lower castes.

Table 6: Correlation of socio-economic factors with technical efficiency of rice farms

Socio-economic factors	Correlation coefficient	Significant at
Farm size	+ 0.398	0.01
Age	+ 0.314	0.01
Experience	+ 0.268	0.05
Education	+ 0.423	0.01
Type of family	+ 0.411	NS
Caste	- 0.076	NS
Farm workers (No.)	- 0.098	0.01
Extension contacts	+ 0.411	0.01
Good Farm Land	+ 0.528	0.01
Fragmentation index	- 0.369	0.01

Extension contacts: In order to examine the influence of extension contacts on technical efficiency of rice production the efficiency of the farmers who have contacts with extension agencies were compared with those who do not have contacts with extension agencies. The technical efficiency in rice production was significantly lower (61.10%) with the farmers who did not have contacts with extension agencies in comparison with farmers who had contacts with extension agencies (66.59%). The contact of the farmers with extension agencies was found to be positively correlated with efficiency in rice production. This happened primarily due the reason that the farmers who had contacts with extension workers agencies will get the technical guidance at the right time and thus, making them more efficient.

Level of fragmentation: To study the effect of fragmentation, the fragmentation index was developed which considers the number of fragments into which the farm land was divided and the area of the farm. The fragmentation index was computed with the following formula:

$$\text{Fragmentation index} = \frac{\text{Number of fragments}}{\text{Area}}$$

The sample farms were classified into low, medium and highly fragmented categories based on this index. The technical efficiency of rice production was lowest in high fragmented farms while it was the highest in very low fragmented farms. The efficiency increased significantly with the decrease in fragmentation level which exhibited negative correlation of fragmentation level with efficiency in rice production. This may be due to the fact that highly fragmented and inhibits the use of improved technologies, making farms more inefficient.

Number of farm workers in the family: The lowest technical efficiency was found on the farms where there were 5 and more farm workers in the family and highest efficiency was observed on the farms having 1-2 farm labourers in the family. This showed that an increase in family farm workers decreases the technical efficiency in rice production. This may be due to the reason that farmers are already using excess human labour in rice production which increases the inefficiency of the farm.

Quality of farm land: This variable was subjective in nature as it was based on the judgment of the respondents. The percentage of good quality land influenced efficiency in rice production significantly. The farms having high percentage of good quality land have higher efficiency as compared to the farms having lower percentage of good quality land. The results revealed that quality of land do determine the production efficiency of rice. The percentage of good quality land on the farm showed negative and significant relationship with inefficiency in rice production indicating that increase in good quality land reduces inefficiency significantly. The good quality land due to its inherent capacity gave higher yields than the inferior land and thereby increasing the efficiency level

CONCLUSIONS

The results showed that production resources such as phosphatic, potassic fertilizers and micro-nutrients were underutilized whereas labour, irrigation and machinery over utilized than the recommended level on the sample farms. The existing level of production could be achieved by reducing the existing input use significantly. This showed that none of the sample farm was exploiting the scarce resources to optimum level at the existing level of technology. The productivity of rice was positively related to the farm size. It was noticed that large sized farms were more efficient than the small farms in utilizing farm resources in rice production. The relationship between technical efficiency and various socio-economic factors revealed that rice production was positively related with farm size, education, age, experience, extension contacts and percentage of good land and negatively related with fragmentation of the land.

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Research Article

AN ECONOMIC VALUATION OF SHIFTING CULTIVATION AND ITS ALTERNATIVE LAND USE SYSTEM IN MANIPUR

Jenny Kapngaihlian and D.V. Subba Rao*

ABSTRACT

Environmental problems related to agriculture and rural developments have been a major public concern in India in recent years. The policies and programs aiming at promoting alternative land use practices of shifting cultivation have failed largely to achieve the desired goal. The present study aims to examine the economic valuation of shifting cultivation and its alternative land use system in Manipur. The study was based on primary data from 70 respondents practicing shifting cultivation and following several studies. The financial analysis under the three land-use systems demonstrated that the highest annual gross benefit per hectare was obtained from horticulture followed by annual cash crop and lowest benefit by shifting cultivation. In terms of net present value, annual cash crops appear to be the best performer followed by horticulture and shifting cultivation. When the environmental costs were taken into account, annual cash crops appear to be the most costly land-use system, with horticulture becoming most profitable. Shifting cultivation lies in between these two land use systems.

Key words: Net present value, shifting cultivation (Jhuming), replacement-cost method, biodiversity, carbon séquestration.

INTRODUCTION

Manipur is a small landlocked, hilly and mountainous state in the North Eastern India. It has 22327 square km of area, which constitutes 0.7 per cent of the total land surface of India. It is a hill girt state with 90 per cent of the area, that is 2.05 lakhs ha is characterized by hilly regions and surrounding a flat valley, which constitutes 10 per cent that is 0.184 lakhs ha of the total geographical area. Out of the total hill area of 2.05 lakhs ha, only 31.22 per cent was cultivated, whereas in the valley, out of the total land area of 0.184 lakhs ha, 47 per cent was under rice

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cultivation. Manipur agriculture in general could be classified as permanent agricultural systems, shifting cultivation and terrace cultivation. Permanent system includes smallholder plantation which is multi-strata arrangement, paddy systems, annual vegetable crop system and animal husbandry and fisheries

Shifting cultivation, also known as *slash-and-burn agriculture*, *swidden* or rotational bush fallow agriculture, and as '*Jhum*' (Paamlou in Manipuri) cultivation; in Northeast India is still being practiced in the Northeastern Hill Region (Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura) and other parts of the country (Orissa, Andhra Pradesh, Madhya Pradesh, etc.). The shifting cultivation is a traditional agricultural system, where a patch of forest is cleared, burnt and cultivated for a few seasons, then abandoned for several years following soil fertility decline and weed proliferation, and allowed for natural vegetation regeneration before being cleared and used again (Anonymous, 1984, Gil, 1985 and Gupta, 1993). The shifting cultivation (*Jhuming*) is not, a single stage in the evolution of agricultural production, but a variable element within a wide variety of farming systems encompassing stable rotational systems, extensive forest fallow cultivation and also forest mining.

The *Jhuming* is an age-old practice in the hills of Manipur. The hills are confronted with problems of land degradation, deforestation and poverty. Wider environmental impacts also occur in the form of reduced biodiversity, reduced ability of the ecosystem to regulate the stream flow and reduced carbon sequestration. The problems caused by traditional agriculture and environmental degradation in the district need policies and programs for environmentally compatible and economically viable agricultural systems (Rasul, 2005). However, policies and programs aimed at promoting alternative land use systems have failed to achieve expected goals because of inadequate understanding of the evolution of the existing land use systems and forces driving the changes (Rasul *et al*., 2004).

In order to plan a better environmental decision-making policy, the economic valuation of environmental problems is important. Accelerated land degradation, stemming from inappropriate agricultural practices, and associated environmental and social effects, has underlined the importance of measurement of environmental costs and benefits associated with agricultural practices in order to improve decision making in public policy in regard to land use and agriculture. In the backdrop of this, the present study was under taken with the following objectives:

i. to estimate the environmental benefits and damages of shifting cultivation, and

ii. to suggest policy measures on the basis of results emerging from the study of shifting cultivation.

METHODOLOGY

The study was carried out in Manipur with special emphasis on Churachandpur district to fulfill the stated objectives. The highest percentage (45.00) of geographical area of the state of Manipur where shifting cultivation was practiced was recorded in Tamenglong and Churachandpur district. The combination of purposive and random sampling techniques was used for the selection of the district, blocks, villages and farmers.

Churachandpur district was selected purposively as it has the highest areas under shifting cultivation. At the next stage four blocks were selected where the shifting cultivation was done extensively. At the third stage six villages were selected keeping in view the concentration of farmers practicing the *Jhuming*. At the last stage 70 farmers were selected randomly who were practicing shifting cultivation. The requisite data were collected through personal interview on well-structured schedule. The reference year of the study was 2009-10.

Analysis of Data

The environment benefits and damages and its environmental services such as soil erosion, biodiversity and carbon sequestration were valuated following several case studies (Pagiola, 2004, Pagiola *et al.*, 2007, Rasul and Thapa, 2007, Rasul, 2009 and Salzer, 1993). For Estimation of Returns to Land, Net Present Value (NPV) was adopted to evaluate each land-use system.Benefit cost analysis was adopted to indicate the performance of each land use. Replacement-cost method was adopted for valuation of on soil erosion.

Valuation of Environmental Services

Jhum (*shifting cultivation*) is a dominant type of agriculture in the Churachandpur region. But more financially attractive alternative land use systems have gained importance in the shifting cultivated area, as the environmental benefits of alternative land use systems includes reduced soil erosion, improved biodiversity and carbon sequestration. Thus, valuation of environmental services was adopted where shifting cultivation was considered as Land Use I, the alternative land use system: annual cash crop was considered as Land Use II and horticulture was taken as Land Use III. Although these land-use systems are distinct economic activities, farmers variously engage in several of them on a concurrent basis.

The various land-use systems each have different production cycles. For annual crops, (Land Use I and II), the production cycle is one year and horticulture (Land Use III) is five to six years. To compare the costs and benefits of land-use systems, a five-year time horizon was considered. The analysis is based on inputs, outputs, and farm-gate prices of produce. To facilitate the comparison, all costs and benefits were brought to present value by using a discounting method. In view of this, the value of carbon sequestration, biodiversity conservation and the cost of soil erosion attached to each land use system are estimated. This will eventually enable the policymakers to promote land uses which are environmentally and economically sustainable.

Estimation of Returns to Land

The returns to land were a criterion to evaluate each land-use system. It was expressed by NPV which discounts the streams of benefits and costs over a period of time. In calculating the NPV the difference between the present value of the benefit streams and present value of cost streams at discount rate of 12 per cent was considered.

$$\sum_{j=1}^{n} \frac{B_j - C_j}{(1+i)^j}$$

Where,

B_j = Benefits in j^{th} year

C_j= Costs in j^{th} year

i = Discount rate

n = Number of years

Valuation of Soil Erosion

Soil erosion has both onsite and offsite effects. Lack of data required for all sorts of on-site and off-site effects of soil erosion and inability of farmers to respond to environment related problems poses estimation problems. Besides, lack of markets and the presence of market imperfections and distortions will display a higher rate of discount by the society. Long-term data are essential; however, the effects of erosion on productivity will change throughout the soil profile. Land in Manipur was also not cadastrally surveyed to obtain this type of information. Even supposing that collecting vast quantities of location-specific data presented no problems, it would be still extremely difficult to determine the influence of any single factor on crop yields. Hence, following several studies (Rasul and Thapa, 2007 and Rasul, 2009) the replacement-cost method for valuation of soil erosion was employed.

Salzer (1993) and Rasul (2009) estimated that the rate of soil formation was 15 tonnes per ha per yr. Since their study area lies in tropical climate to which was similar to Churachandpur in terms of climatic condition and topography. It was assumed that the annual soil formation rate was 15 tonnes per hectare per year for the present study. To estimate the reliable value of soil loss, it was necessary to deduct the natural rate of soil formation from the rate of erosion.

Valuation of Biodiversity

In addition to soil conservation, the different land uses have varying impacts on many other environmental and social services. The monetary value of biodiversity services and carbon sequestration associated with each land-use system was estimated following Pagiola, 2003, Pagiola *et al*., 2004 and Pagiola *et al*., 2007. While estimation of carbon sequestration was relatively straightforward, approximating the economic value of biodiversity was extremely difficult.

On realizing the difficulties, Pagiola *et al*., 2004 developed an index of biodiversity for different land uses that ranges from 0 to 1, with 0 for annual crops like grains, tubers and 1 for primary forest. Other land uses reside between these two extremes. Although this index was a proxy measure and may vary considerably depending on biophysical conditions, it was used to estimate the value of biodiversity services and carbon sequestration as no other precise method were available within the confines of this study. Following the work of Pagiola and his colleagues, the values of carbon sequestration and biodiversity services were estimated with the following formulae.

$ICSS = PCS \times PC$

$IBS = PBS \times PBC$

Where,

ICSS = Index of carbon sequestration services

PCS = Point of carbon sequestration in specific land use

PC = Price of carbon (tonnes per year).

IBS = Index of biodiversity services

PBS = Point of biodiversity in specific land use

PBC = Price of biodiversity services (ha per year).

Although these indices have been used in several studies to value environmental services, the rate of payment has varied. While Pagiola *et al*., 2004 estimated US$75 point per year payment for environmental services, Costa Rica's *pagos por servicios ambientales* (payments for environmental services) program pays US$45 hectare per year for environmental services (Zbinden and Lee, 2005) and Rasul, 2009 pays US$33.75 ha per year for environmental services. In the present study, we assume that value adopted by Zbinden and Lee (2005) and Rasul (2009) that is US$33.75 point per hectare for environmental services, reflecting the sum of the carbon-sequestration and biodiversity-protection services. The sum, in fact, was equivalent to farmers' willingness to accept to manage/supply environmental services in exchange for a given amount of remuneration (Rasul and Thapa, 2007 and Rasul *et al.*, 2009).

RESULTS AND DISCUSSIONS

Farmers in Churachandpur have started adopting ginger cultivation as cash crop and pineapple as horticultural crops. Therefore, the environment cost and benefits with this changing system are compared with *Jhum* system. Since horticulture crop is for five years, to compare the costs and benefits of land-use systems, a five year time horizon was considered in an analysis based on inputs and outputs. A discount rate of 12 percent was taken into consideration. Shifting system and annual ginger crops were cultivated only once during the five year time horizon and the remaining years were left fallow. Pine apple was harvested thrice during the span of five years, as the crop period ranges from 15-18 months during five year period.

Financial Performance of Alternative Land-Use Systems vis-à-vis Shifting Cultivation: Private Perspective

The financial analysis (excluding environmental costs) which estimate the discounted costs and benefits of products produced under the three land-use systems demonstrates that the highest gross benefit (` per hectare per year) was realized from horticulture (Land Use III) followed by annual cash crop (Land Use II) as compared to shifting cultivation (Land Use I) as shown in Table 1.

But, the cultivation of annual cash crops provides relatively quick returns and horticulture requires the longer time period to convert it into income for the farmers. The small landholders, who have limited or no other source of income, may not be able to alter current cultivation patterns without external support. Since, cultivation of annual cash crop is more profitable than traditional methods of shifting cultivation. Hence, it is advisable for the farmers to cultivate annual cash crop from the financial point of view. In terms of NPV, annual cash crops appear to be the best performer followed by horticulture and shifting cultivation. Thus, estimation of NPV by incorporating the environmental cost assumes importance from the society point of view.

Table 1: Comparison of financial performance of alternative land use systems with shifting cultivation

(` ha^{-1})

Particulars	**Shifting cultivation (Land Use I)**	**Annual crops[1] (Ginger) (Land Use II)**	**Horticultural crops[2] (Pineapple) (Land Use III)**
Costs	37580	33756	140625
Labour costs[3]	29830	17688	76781
	(79.38)	(52.40)	(54.60)
Non-labour costs[4]	7750	16068	63844
	(20.62)	(47.60)	(45.40)
Initial establishment cost	-	-	31680
Benefits Net Revenue	45198	126000	225000
Financial performance	7618	92245	84375
Net Present Value (NPV)	6802	82365	75338
Benefit Cost Ratio (BCR)	1.2	3.73	1.6

Figures in the parentheses indicate the percentages.

Economic Performance of Alternative Land-Use Systems vis-à-vis Shifting Cultivation: Social Perspective

Soil erosion/losses are considerably higher than the soil formation rates under annual cash crop, jhum system and horticulture. Net soil loss under annual cash crops and jhum system is 84 tonnes per ha per year. However, it is 28 tonnes per ha per year under horticultural system (Table 2).

The economic value of soil nutrient depletion is therefore as high as `18,323 hectare per year under annual cash cropping system and that of jhum is `17,471 hectare per year. Such cost would substantially increase farmers' production costs in order to replenish soil fertility. However, under horticulture system farmers have lower nutrient depletion in monetary terms to the tune of `621 hectare per year (Table 2). When these external costs and benefits are taken into account, the profitability of different land use systems is changed substantially. Due to high rates of soil erosion, profitability under cash crops decreases substantially as compared to horticulture. As a result, differences in profitability between cash crop and horticulture shrink.

Table 2: Economic valuation of soil loss in Manipur

Particulars		Shifting cultivation (Land use I)	Annual cash crops (Land use II)	Horticulture crops (Land use III)
Soil loss (t/ha/year)		99.05[a]	99.15[b]	43.03[c]
Natural rate of soil formation		15.00	15.00	15.00
(t/ha/year)		84.05	84.15	28.03
Net soil loss (t/ha/year)				
	N	566	594	20
	P	10	10	0.34
Loss equivalent to	K	29	31	1
inorganic fertilizer	OM	5364	5625	191
(kg/t/eroded material)[5]	Ca	186	195	7
Total		6155	6455	219.34
	N	4419	4635	156
	P	90	94	3
Economic loss or gain	K	197	206	7
(`/ha)[6]	OM	12337	12939	439
	Ca	427	448	16
Total		17470	18322	621

***Source:** [a]Yadav et al., 2006, [b] Chowdury (2001) and [c] Ghosh (1976).*

The economic performance of alternative land use systems vis-à-vis shifting cultivation is shown in Table 3.

Table 3: Economic Performance of alternative land use systems vis-à-vis shifting cultivation

(` ha^{-1})

Particulars	Shifting cultivation (Land Use I)	Annual cash crops (Land Use II)	Horticulture (Land Use III)
Gross Benefit	45198	126000	225000
Net Financial Benefit	6802	82365	75338
Net soil loss or gain(t/ha/yr)	84	84	28
Economic loss or gain due to soil loss	17470	18322	621
Net Economic Benefits (NEB)	10669	64043	74717

Thus, from environment point of view horticulture gives the highest performance followed by shifting cultivation and annual cash crop occupies the lowest position. But, when both soil erosion effects and financial performance are taken into account, it indicate that highest benefit is obtained from horticulture that is, its Net economic benefits accounts to ` 74717 per hectare which is followed by annual cash crop amounting to ` 64043 per hectare. The perusal of Table 3 shows that the lowest economic performance was found in shifting cultivation `10669 per hectare.

Carbon Sequestration and Biodiversity Benefits

Manipur consist of one of the hot spot for gene pool. *Jhuming* affects the plant and tree species. The animal species are too deprived of their habitat as well. Further since the hill tops, particularly the catchment area were source of water, deforestation in the hills has led to elimination of water due to consequent inability of the soil to retain the water. Thus, there exist undesirable changes in *Jhum* area due to large scale deforestation.

It have been reported that there are more than 104 species of animals (fauna) used as age old medicine and more than 5000 Sacred Groves in Manipur. Many of these animals of ethno zoological importance are in threat due to over exploitation. Loss of biodiversity, deforestation and encroachment on forest lands has a number of impacts on the environment. But, unfortunately no authentic data were available in this regard. However, details concerning environmental benefits are presented in Table 4.

Table 4: Performance of alternative land use system vis-à-vis shifting cultivation with biodiversity and carbon sequestration

(` ha^{-1})

Particulars	**Jhum (Land Use-I)**	**Annual cash crop (Land Use-II)**	**Horticulture (Land Use-III)**
Net Financial Benefit	6802	82365	75338
Net soil loss or gain (tonne	84	84	28
per ha per year)	10669	64043	74717
Net Economic Benefit	0	0	0.30
Biodiversity Index	0	0	5645
Biodiversity services	0	0	0.4
Carbon séquestration			
Carbon séquestration	0	0	7533
services	10669	64043	87900
Total Economic benefit			

*Indices from Pagiola, 2003, Pagiola *et al.*, 2004 and Pagiola *et al.*, 2007.

The value of biodiversity services varies considerably across the land-use systems. In terms of species conservation, *Jhum* do not provide any positive environmental services. Horticulture generates the largest environmental services such as biodiversity services, carbon sequestration services and other benefits.

When the benefits of environmental services are taken into account along with the economic performance, *Jhum* become the least profitable land-use practice. The analysis reveals a tradeoff between short-term profitability in terms of net financial benefit. For the individual farmer who wants to maximize his returns, the cultivation of annual cash crops is the preferable option. Since the tradeoff is lowest in horticulture and cash crops, a combination of horticulture and annual cropping system is preferred option from the society as well as individual point of view.

CONCLUSIONS

The shifting cultivation is an age old system with traditional and low level of technology resulting in low yields. The practice cannot be improved overnight but they can, however, be spontaneously modified with persuasion of the farmer to minimize the ecological ill effects. When financial analysis is taken into account, annual cash crop is the best performer followed by horticulture. The shifting cultivation was the poorest performer. The higher financial benefits associated with annual cash crops, however, are offset by high environmental costs, specifically in terms of soil erosion, carbon emissions, and biodiversity loss, which are major social concerns. When the environmental costs are taken into account, annual cash crops appear to be the most costly land-use system, with horticulture becoming most profitable alternative. The shifting cultivation lies in between these two land use system. But, when the benefits of environmental services are taken into account along with the economic performance, *Jhum* become the least profitable land-use practice. Horticulture still retains the best profitable land use. Farmers do not receive any monetary reward for engaging in the production of positive environmental services. So, they do not take into account these services when making land use decisions.

POLICY IMPLICATIONS

The commercial agriculture and the Green Revolution could not touch the NE region. This was mainly due to the region’s inaccessibility. Keeping this in mind, we should refocus our strategy. The financial incentives alone may not be enough to motivate farmers to move from annual crops to perennial crops due to the long phase-in period and the relatively high initial investment costs as most of the farmers were resource poor. There should be an appropriate mechanism to compensate farmers for the environmental services that their practices generate in the cultivation.

To sum up, property rights to the land must be granted urgently to shift away from shifting cultivation. Transfer of Technology through various extension activities need to be strengthened. Further, input delivery system must be developed with appropriate incentives as extended to other states. This in turn helps to transfer the new technology and the productivity of various crops. Horticulture needs to be developed on a large scale. The horticulture based cropping system such as pineapple with silviculture must be given greater support not only to improve incomes but also protect soil and enables to utilize water resources most efficiently. This calls for a new institutional arrangement is made to solve the specific problems of the hill areas.

Notes

1. Ginger is taken as representative of annual cash crop
2. Pineapple is taken as representative of Horticulture crop
3. Labour costs includes all the farm operations such as cutting of forest, burning and clearing, formation of soil guard, sowing, weeding, etc.
4. Non – labour cost includes non-farm operations
5. Loss equivalent to inorganic fertilizers = Net soil loss × Nutrient loss/ton eroded soil X Nutrient: Conversion Factor.
    i. Nutrient loss (kg/ton of eroded soil) is: Ca = 1.58 and OM = 63.82 (Gafur *et al*., 2002).
    ii. Nutrient loss (kg/ton of eroded soil) is: N (total) = 3.15; P (available) = 0.05; K (exchangeable) = 0.29 (Singh and Singh, 1980).
    iii. Nutrient fertilizer converter factor: N (Urea) = 2.14, P (P_2O_5) = 2.292, k – K_2O, = 1.205, Ca (Lime) = 1.399 (Dobermann and Fairhurst, 2000).
6. Economic loss was calculated from the border price of inorganic fertilizer: Urea = ` 7.8, P = ` 9.3, K = ` 6.7, OM = ` 2.3, Ca = ` 2.3 (Rasul, 2009)

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APPENDIX

Biodiversity Index

Land Use	Points per hectare
Crops (annual, grains and tuber)	0.0
Perennial crops (plantain, un-shaded coffee)	0.2
Nature pasture	0.0 without trees, 0.3 with trees
Improve pasture	0.0 without trees, 0.3 < 30 trees, 0.6 > 30 trees
Fruits crops	0.3 mono-crop, 0.4 diverse
Shaded Coffee	0.6
Fodder bank	0.4 mono-crop, 0.6 diverse
Commercial tree plantation	0.4
Bamboo	0.5
Riparian forest	0.8
Secondary forest (>10sqm)	0.9
Primary forest	1.0

+0.1 for multiple species (>5); +0.1 for multiple shade species; +0.1 for multi strata; +0.1 for connectivity; +0.2 with understory; +0.3 with species enrichment; +0.1 if riparian; +0.1 with species enrichment (Stefano Pagiola Index, 2003).

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Research Article

RESOURCE USE EFFICIENCY AND DETERMINANTS OF MENTHA CULTIVATION IN PUNJAB

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ABSTRACT

Mentha is one of the minor crops grown in Punjab. The present study was designed to work out the benefit cost analysis, factors affecting productivity, resource use efficiency and to bring out both biotic and abiotic constraints faced by mentha growers in Punjab. The analysis brought out that the gross returns for mentha oil were higher in Peppermint as compared to Koshi. As former variety govern higher price. The returns over variable cost were higher in the case of Koshi as that of Peppermint due to cheap suckers and less use of fertilizers, insecticides and pesticides on the sample farms. The regression analysis brought out that area under mentha crop, expenses on suckers and herbicide use were the major factors which can enhance the mentha oil productivity significantly. The results revealed that one rupee spent on suckers and human labour will add ` 5.73 and ` 3.75 to the value productivity. Losses due to insect pest incidence was major biotic constraint while post-harvest losses due to delayed processing, unexpected rainfall at maturity, high processing cost, scarcity of labour and price fluctuation were the major abiotic constraints confronted by the selected mentha growers.

Key words: Returns over variable cost, marginal value productivity

INTRODUCTION

Mentha crop (*Mentha Arvensis*) is cultivated in India in the semi-temperate regions in the foot-hills of the Himalayas in Punjab, Himachal Pradesh, Uttar Pradesh and Bihar. Before 1964, there was hardly any production of mentha oil and menthol in India. The area under this crop has increased from 8000 ha in 1980 to 70000 ha in 2004. At present, India is the largest producer and exporter of mentha oil in the world. In Punjab, it is an important minor crop with production of 1400 tonnes in the year 2004. It is cultivated in Punjab over 15000 ha (Anonymous, 2008) of land to

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obtain mentha oil which is used in pharmaceutical, flavour, cosmetic and perfume industries. It grows well under assured irrigation and competes with spring maize and sunflower in potato based crop rotations in the state. There are three varieties usually grown in Punjab with different productivity potentials. However, *Peppermint* and *Koshi* varieties were more popular among Punjab farmers for their better quality and higher market price. Keeping these factors in view, the present study was undertaken with the following specific objectives:

i) to conduct variety wise benefit-cost analysis of mentha crop;
ii) to examine the determinants of value productivity and to workout resource use efficiency and
iii) to bring out both biotic and abiotic constraints confronted by mentha crop.

METHODOLOGY

In order to achieve the stipulated objectives of the present study, a multistage random sampling technique was followed to select the ultimate sampling units for data collection. Firstly, two districts namely Ludhiana and Jalandhar were selected where the concentration of area under mentha was highest. Two popular varieties namely *Peppermint* from Ludhiana and *Koshi* from Jalandhar district were selected. At next stage, two blocks namely, Jagraon from Ludhiana and Jalandhar West from Jalandhar district were selected randomly. From each block, two clusters consisting of 2-4 villages were selected. A complete list of farmers growing mentha crop in a particular cluster was prepared and 30 respondents were randomly selected for each variety. Thus, from two clusters, 60 respondents were randomly selected for detailed study. The relevant information on inputs used in mentha cultivation and output obtained pertaining to the year 2008-09 were collected from the selected respondents with the help of an especially designed schedule.

Evaluation Procedure Followed

To estimate the cost of cultivation of mentha, the various inputs purchased from market were valued at the actual price paid by the farmers. The home produced inputs such as farmyard manure, etc. were also valued at the prevailing market prices in the study area. The custom hiring rates for farm machinery were used to estimate the cost of field preparation, planting, harvesting and transportation charges. Human labour charges were assessed at the prevailing wage rate for casual labour. Although electricity supply to agricultural sector is free in Punjab, still most of the mentha growers relied on diesel run engines or generators as a supplementary source of irrigation due to erratic power supply particularly during the months of April and May. Thus, total diesel charges and maintenance of irrigation machinery was taken into account to estimate the irrigation charges per hectare. The interest on total variable cost was taken @ 8 per cent per annum for half of the crop period. The total output (mentha oil) was evaluated at the market prices, actually realized by the farmers.

Analysis of Data

Different statistical tools such as average, percentage, etc. were applied to analyze the data. The regression analysis was carried out for the growers of *Peppermint* and *Koshi* separately. To examine the factors affecting value productivity of mentha, both linear and log-linear production functions were fitted. Numerous equations were tried by taking different explanatory variables. Best-fit function was determined on the basis of the level of significance of the explanatory variables, the value of Coefficient of Multiple Determination (R^2) and the logical signs of the explanatory variables included in the model. Cobb-Douglas Production Function of the following form was considered the most appropriate for the present investigation:

$$Y = A \prod_{i=1}^{n} X_i^{b_i} e^{u}$$

Where, Y represents the value productivity per hectare of mentha. Xi , the selected explanatory variables (`ha^{-1}) except X_1 and X_2; A, the technical efficiency parameter and bi the coefficient of production elasticity of the respective variable at the mean level of input used and output obtained. The 'e' is an error term. The function was fitted separately for each variety. Various explanatory and explained variables included in the model were as follows:

Y = Value productivity per hectare of mentha crop
X_1 = Operational Holding (ha)
X_2 = Area under mentha crop (ha)
X_3 = Value of suckers
X_4 = Value of herbicide
X_5 = Value of fertilizers
X_6 = Value of Insecticide/ pesticide use
X_7 = Human labour
X_8 = Machine labour

The stochastic variables were also tested for their stochastic independence.

Marginal Value Productivity (MVP)

The marginal value productivity represents estimated change in gross returns per hectare consequent upon a unit change in the variable under consideration while the level of use of other variables are held constant. The marginal value productivity in the present study was estimated directly from the regression estimates at geometric mean level of input and output used as follows:

$$MVP_{(xi)} = b_i\left(\frac{\overline{Y}}{\overline{X}}\right)$$

Where, b_i is the output elasticities of variable X_i and $\overline{X}$ and $\overline{Y}$ are the geometric means of concerned variables.

RESULTS AND DISCUSSION

The results obtained from analysis of data are discussed under different sub-heads as under:

Benefit-cost Analysis of Mentha Crop

The perusal of Table 1 indicates that labour alone constituted about 40 per cent of the operational expenses incurred in cultivation of mentha crop. The second major component of operational expenses was machine labour. Its share in operational expenses was about 12 and 21 per cent in the case of *Peppermint* and *Koshi*varieties,respectively. The share of machine labour was higher in the case of the *Koshi* due to high custom hiring rates prevalent in the study area. Moreover, the location of mentha oil extraction unit being at far off place also resulted in to higher transportation costs. Other major cost components of mentha crop included expenditure on suckers, insecticide/pesticide, fertilizers and herbicide use which accounted for about 12.78, 11.15, 7.29 and 4.50 per cent in the case of *Peppermint* while the corresponding figures for *Koshi,* were 13.11, 3.82, 4.23 and 4.34 per cent, respectively. The share of insecticide/ pesticide was higher in *Peppermint* due to more incidence of insect pest and diseases on this variety. Mentha requires frequent irrigations particularly in the last week of March and April months. The power supply to tube wells in Punjab state is disconnected during these months due to harvesting season of wheat in order to avoid fire incidents due to sparking. Therefore, farmers have to run their tube wells on generators for irrigation to mentha crop, thereby, incurring huge expenses in terms of diesel consumption. The expenditure on irrigation was estimated to be 9.96and 11.90 per cent in *Peppermint* and *Koshi*respectively. The total variable cost was found out to be ` 24741.46and `18512.61for the above said varieties, respectively. The relative higher expenses on human labour, suckers, fertilizers and insecticide use in the case of *Peppermint* variety was higher as compared to the *Koshi* variety. The returns from mentha crop were estimated from the recovery of mentha oil extracted.

Table 1: Benefit-cost analysis of mentha crop on sample farms, Punjab, 2008-09

(` ha^{-1})

Particulars	Varieties of mentha	
	Peppermint	**Koshi**
Human labour	10046.80 (40.61)	7317.79 (39.53)
Machine labour	3062.80 (12.38)	3969.29 (21.44)
Suckers	3162.42 (12.78)	2427.19 (13.11)
Fertilizer	1803.05 (7.29)	783.66 (4.23)
Herbicide	1111.62 (4.50)	803.57 (4.34)
Insecticide/ pesticide	2759.81 (11.15)	707.24 (3.82)
Irrigation	2390.96 (9.66)	2201.59 (11.90)
Interest on variable cost @ 8 %	404.00 (1.63)	302.29 (1.63)
Total variable cost	24741.46 (100.00)	18512.61 (100.00)
Yield of mentha oil (litre/ha)	**42.66**	**94.68**
Price of mentha oil (`/ litre)	**1267.73**	**538.06**
Gross income	54077.43	50944.89
Return over variable cost	29335.98	32432.28
Benefit-cost ratio	2.19	2.75

Figures in parentheses are percentages of total.

The quantity of mentha oil extracted per hectare came out to be 42.7 litres for *Peppermint* and 94.7 litres for *Koshi*. The corresponding prices received by mentha growers were found to be `1267.73 and ` 538.06 per litre, for above said varieties, respectively. The gross returns per hectare came out to be ` 54077.4 for *Peppermint* and ` 50944.9 for *Koshi*. The gross returns were relatively higher in the case of *Peppermint* due to higher price received by the growers for this variety. On the contrary, returns over variable cost per hectare came out to be higher for *Koshi* (` 30884.10) due to lower total variable cost. Similarly, benefit-cost ratio indicated that the mentha growers got ` 2.19 and ` 2.75 returns from *Peppermint* and *Koshi* varieties on investing of one rupee.

Factors Affecting Productivity and Marginal Value Productivities
Peppermint

The perusal of Table 2 showed that Adjusted Coefficient of Multiple Determination (R^2) turned out to be 0.78 which shows that 78 per cent of the variation in the productivity of *Peppermint* variety was explained by the explanatory variables included in the model.

Table 2: Regression coefficients of Cobb-Douglas Production Functions for mentha crop on sample farms, Punjab, 2008-09

Particulars	Units	Varieties of Mentha	
		Peppermint	**Koshi**
Intercept		9.1380	2.3569
Operational holding (ha)		0.0923^{NS}	-0.0382^{NS}
		(0.1826)	(.0797)
Area under mentha crop (ha)		0.3863**	0.2541**
		(0.1820)	(0.1086)
Suckers (`)		0.2340**	0.7860***
		(0.1017)	(0.2722)
Herbicide (`)		0.0003^{NS}	0.0152**
		(0.009)	(0.0057)
Fertilizers (`)		-0.1483^{NS}	-0.0175^{NS}
		(0.2805)	(0.1621)
Insecticide/ Pesticide (`)		0.2156^{NS}	-0.0042^{NS}
		(0.2978)	(0.0054)
Human labour (`)		1.2273^{NS}	0.3822^{NS}
		(1.1257)	(0.3146)
Machine labour (`)		-1.5720^{NS}	-0.1650^{NS}
		(0.9744)	(0.3481)
R^2		0.84	0.79
Adjusted R^2		0.78	0.71

Figures in parentheses are standard errors of regression coefficients
****** and ** indicate significant at 1 and 5 per cent level, respectively.***
Non-significant

The area under *Peppermint* variety and expenses on suckers were the two major explanatory variables affecting mentha oil productivity significantly. The coefficient of area under *Peppermint* variety of mentha came out to be 0.3863 which was significant statistically indicating that with the increase in the area under mentha crop by one per cent the productivity increases by 0.38 per cent. Similarly, coefficient of expenses on suckers came out to be 0.2340 which was significant statistically. It can be inferred that the increase in the expenses on suckers by one per cent the productivity increases by 0.23 per cent. The coefficients of other variables such as operational holding, expenses on herbicide, insecticide/ pesticides and human labour were found to be positive but non-significant. The coefficients of expenses on fertilizers and machine labour were found to be negative but non-significant. The negative signs of these variables showed the excessive use of these inputs, however, these were found to be non-significant.

The marginal value productivities of mentha crop are depicted in Table 3 which shows that coefficient of suckers came out to be 2.99 which were also significant statistically. This shows that rupee one spent on suckers will add ` 2.99 to the value productivity of *Peppermint* variety of mentha. All other coefficients such as expenses on herbicides, fertilizers, insecticides/ pesticides, human labour and machine labour were found to be non-significant.

Koshi

It is clear from Table 2 that area under *Koshi* variety, expenses on suckers and herbicide use were significantly affecting oil productivity of the variety. Adjusted R^2 came out to be 0.71 which shows that 71 per cent of the variation in the productivity is explained by the various explanatory variables included in the model. The coefficient of area under *Koshi* variety of mentha came out to be 0.2541 which was significant statistically. It shows that if one increases the area under mentha crop by one per cent the resultant productivity will increase by 0.25 per cent. The coefficient of expenses on suckers came out to be 0.7860 which was highly significant statistically. This shows that increase the expenses on suckers by one per cent the productivity will increase by 0.79 per cent. Similarly, coefficient of herbicide use came out to be 0.0152 which was significant statistically. Therefore, if we increase the expenses on herbicide use by one per cent the productivity will increase by 0.02 per cent. The coefficients of other variables such as operational holding, fertilizer use, insecticide/ pesticides and machine labour were found to be negative but non-significant. The negative sign of these variables shows the inverse relationship between productivity of mentha crop. The coefficients of expenses on human labour were found to be positive but non-significant.

It is evident from the Table 3 that coefficients of suckers and herbicide use was found to be significant statistically. The coefficient of suckers was 13.18 which showed that one rupee invested on suckers will add ` 13.18 to the value productivity of *Koshi* variety of Mentha. The coefficient of herbicide use was found to be 3.90 which was also significant statistically. It means that one rupee invested on herbicide use will add ` 3.90 to the value productivity of *Koshi*. All other coefficients such as expenses on fertilizers, insecticides/ pesticides, human labour and machine labour were found to be non-significant.

Table 3: Marginal value productivities of different inputs in mentha cultivationon sample farms, Punjab, 2008-09

(`)

Particulars	Varieties of Mentha	
	Peppermint	Koshi
Suckers	2.991563**	13.1877***
Herbicide	0.02819NS	3.905266**
Fertilizers	-5.28357 NS	-0.97518 NS
Insecticide/Pesticide	5.096019 NS	-3.73396 NS
Human labour	7.563805 NS	2.094637 NS
Machine labour	-31.6635 NS	-1.6684 NS

******and ** significant at 1 and 5 per cent level, respectively.***
Non-significant

Thus, it can be inferred that area under mentha crop, expenses on suckers and herbicide are the major factors which can enhance the mentha oil productivity significantly.

Biotic and Abiotic Constraints

Various biotic and abiotic constraints having impact on mentha production on the sample farms are presented in Table 4 and discussed as under:

Peppermint

The intensity of biotic constraints such as incidence of insect-pests, diseases and weeds infestation was faced by 80, 20 and 20 per cent of the sample growers which resulted in considerable decline in the yield on the sample farms. Major input constraints reported were the scarcity of labour and machinery availability which were encountered by 26.67 and 10 per cent of the sample farmers. The post-harvest loss due to delayed processing was major marketing constraint observed by 83.33 per cent of the sample farmers. The high processing cost and price fluctuation were other marketing constraints observed by 63.33 and 36.66 per cent of the sample farmers, respectively. The forced sale through processing unit and low demand were found out to be the other marketing constraints observed by 56.67 and 6.67 per cent of the sample farmers. Major environmental constraints reported were the unexpected rainfall at maturity, frost damage to suckers and strong eastern winds at maturity which were observed by 86.67, 20 and 10 per cent of the sample farmers, respectively.

Table 4: Biotic and Abiotic constraints intensity in mentha cultivation on sample farms, Punjab, 2008-09

(Per cent farmers)

Particulars	**Varieties of Mentha**	
	Peppermint	**Koshi**
Biotic Constraints		
Insect-pests	80.00	66.67
Weeds	20.00	13.33
Diseases	20.00	6.67
Abiotic Constraints		
Input Constraints		
Labour availability	26.67	56.67
Machinery availability	10.00	6.67
Marketing Constraints		
Post-harvest losses due to delay in processing	83.33	76.67
High processing cost	63.33	46.67
Forced sale through processing unit	56.67	53.33
Price fluctuation	36.66	40.00
Low demand	6.67	10.00
Environmental Constraints		
Unexpected rainfall at maturity	86.67	76.67
Frost damage to suckers	20.00	13.33
Strong eastern winds at maturity	10.00	16.67

Koshi

The perusal of Table 4 indicated that intensity of biotic constraints such as incidence of insect-pests and weeds infestation was faced by 66.67 and 13.33 per cent of the sample farmers. Disease incidence was also another biotic constraint as reported by 6.67 per cent of the sample farmers. Input availability constraints with respect to labour and machinery availability were observed by 56.67 and 6.67 per cent of the sample farmers, respectively. The post-harvest loss due to delayed processing was major marketing constraint observed by 76.67 per cent of the sample farmers. The high processing cost and price fluctuation were other marketing constraints observed by 46.67 and 40 per cent of the sample farmers. The forced sale through processing unit and low demand were the marketing constraints observed by 53.33 and 10.00 per cent of the sample farmers, respectively. Major environmental constraints experienced by growers on sample farms were the unexpected rainfall at maturity, frost damage to suckers and strong eastern winds at maturity which were observed by 76.67, 13.33 and 16.67 per cent of the sample farmers, respectively.

Promoting Factors and Desired Research Area

There were various factors depicted in Table 5 which promoted mentha cultivation on the sample farms. It was reported by 93.33 and 60.00 per cent of the farmers that they have been growing mentha since it fits well in their crop rotation and fetches an attractive price in the market. On the contrary, 26.67 per cent gave reason of proximity to the processing unit and 20 per cent as contract by growers with processing unit/company. Similarly, 15 per cent were beingguided by the fellow farmers to grow mentha while 13.33 per cent wanted to replace sunflower from crop rotation.

Table 5: Promoting factors and desired research area in mentha cultivation on sample farms, Punjab, 2008-09

Particulars	Farmers (Percent)
Promoting factors	
Fits well in crop rotation	93.33
Fetches an attractive price	60.00
Proximity to processing plant	26.67
Contract with processing unit/company	20.00
For replacing sunflower crop	13.33
Guided by fellow farmers/relatives	15.00
Desired research area	
Develop more oil content varieties	90.00
Develop insect-pest/disease resistant varieties	21.66
Develop excessive rainfall resistant varieties	13.33

As farmers are the major judges of the agricultural technology developed. So, sample farmers were asked to give their priorities. Hence, 90 per cent of the sample farmers wanted that the researchers should develop mentha varieties having more oil content while 21.66 and 13.33 per cent wanted to act on development of insect-pest/ disease and excessive rainfall resistant varieties.

CONCLUSIONS

The foregoing analysis has brought out that mentha cultivation can be further promoted in Punjab state which can play a major role in diversification of Punjab agriculture as well as increasing the income of farmers. In order to augment area and mentha oil productivity, there is a need of assured supply of better quality suckers and herbicide use. To promote its cultivation there is a need for development of insect-pest, excessive rainfall resistant and high oil yielding varieties. Besides, assured electricity supply particularly in the month of April will also help to improve the productivity. The government intervention is also required to check the exploitation of mentha growers at the hands of processing unit/contracting company who were charging exorbitant processing fee and often delay the processing which results into poor oil recovery.

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Research Article

PERFORMANCE OF VEGETABLE PRODUCTION IN INDIA WITH SPECIAL REFERENCE TO PUNJAB

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ABSTRACT

The vegetables all over the world are known for being a rich source of nutrients. The paper aims to analyse vegetable production performancein India with special reference to Punjab. The study was based on secondary data pertaining to area, production, productivity of vegetables and results were supplemented by the findings of the studies conducted earlier. The results of the study showed that the global vegetable production has reached to 1012.5 million tonnes in 2010-11 and India accounts for 14 per cent share and rank second in total vegetable production in the world. The area under vegetables had almost doubled while the production had increased by three times over period 1985-86 through 2010-11 in India. West Bengal had the highest area under vegetable production which constituted 15.9 percent of national vegetable area. The area and production were the highest in the case of potato crop in India as well as in Punjab. During the period 1990-91 to 2005-06, the increase in production of vegetables in Punjab was found to be due to the effect of area but during the 2005-06 to 2010-11, the effect of productivity was higher. Still there is scope of increasing the productivity of vegetables in Punjab as yield of most of the vegetables in comparison to highest yield in some of states were lower by more than 7 per cent.

Key words: Vegetables, production, cultivation, area and interaction affects

INTRODUCTION

The spread of knowledge about the nutrient value of different fruits and vegetables has led to considerable change in food habits of the people in advanced countries and within urban areas in India. Vegetables now form a substantial part of their diet, resulting in their increased demand. Vegetable production is such an enterprise that it gives higher tonnage per unit area in lesser time compared to cereals. Besides, being labored intensive, it also offers more employment

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opportunities. The diets of Indianpopulation are largely cereal based withpreponderance of a single food-grain and meager intakes of low protective foods such as vegetable and fruits. The daily per capita availability of vegetables in India is 140gm which is just the half of the recommended intake by the Indian Council of Medical Research (Rao, 2010).

In Punjab, the monoculture of rice-wheat crop rotation has led to over exploitation of natural resources, depletion of soil fertility and higher susceptibility of crops to the attack of various insect pests and diseases. Further, the productivity of crops like wheat and paddy has reached plateau. Now, a stage has reached where further improvement in productivity seems to be limited and hence, leading to stagnation of the income of the farming community. This call for diversification of agriculture with the vegetable farming which can help in generating higher income along with gave full employment on the farm itself. Farm economists have suggested that the diversification of agriculture but due to non-availability of infrastructure, assured prices of wheat and paddy, ineffective price policy for other crops and economically unviable competing crops, the situation has become further aggravated for the farmers of the Punjab.

Thus, in order to improve incomes, provide gainful employment and save the natural resources from further degradation, diversification from grain crops to vegetables emerges as a major strategy for agricultural growth. Therefore, it is pertinent to study the present status of vegetable production in India with special reference to Punjab.

METHODOLOGY

The study was based on the secondary data pertaining to the area, production and yield of vegetables for the period of 25 years (1985-86 to 2010-11). The data were collected from the Statistical Abstracts of Punjab, National Horticultural Board and indiastat.com, etc.

Analysis of Data

In order to compute the growth rates an exponential model of the form was used:

$$Y_t = AB^t$$

Where,

Y_t=Area/production/yield of a crop for the year‘t’.

t = Time variable (1, 2…n) for each period.

A = Constant

Log transformation of the above function is:

$$\ln Y_t = \ln A + t (\ln B).$$

Where,

$\ln B = \ln (1+r)$, and

$r = [\text{antilog} (\ln B) - 1]$

CAGR (percent) = $[\text{antilog} (\ln B) - 1] \times 100$.

Decomposition of Production

Basically, any change in production of a crop depends upon the change in itsarea and yield. If the production, yield and area are denoted by Q_n, Y_n and A_n for current period and Q_o, Y_o and A_o for the base period, the increase in production Q = (Q_n-Q_o) in n years over base period is a function of change in area $A=(A_n-A_o)$ and yield $Y=(Y_n-Y_o)$. Sharma (1977) and Bhatnagar (2004) computed the change in production of crop

$$Q=A_oY+Y_oA+AY$$

Where,

A_oY= Yield effect

Y_oA= Area effect and

AY= Interaction between area and yield

Thus, the change in production can be decomposed into three components, namely yield, area and interaction effects of both area and yield. Further, triennium averages have been worked out to avoid yearly variations.

RESULTS AND DISCUSSION

The analysis of data has yielded very interesting results which are discussed under sub heads as follow:

International Scenario

The global vegetable production has reached to 1012.5 million tonnes in 2010-11. China ranked first in global vegetable production with 48 per cent share in the world vegetable production. India with total production of 146.6 million tonnes accounts for 14 per cent share and rank second in total vegetable production in the world. Other important countries producing vegetables are UnitedStates of America, Turkey, Egypt and Iran contributing 2 to 3 per cent in global vegetable production (Table 1).

Table 1: Country-wise Important vegetable producers in World, 2010 -11

Country	Area (lakh ha)	Percent share in total	Production (million tonnes)	Percent share in total	Yield (kgha^{-1})
China	210.47	38.99	473.00	46.72	22474
India	84.95	15.74	146.60	14.48	17257
USA	11.23	2.08	35.30	3.49	31434
Turkey	10.89	2.02	25.90	2.56	23783
Egypt	7.58	1.40	19.50	1.93	25726
Iran	7.12	1.32	18.70	1.85	26264
Italy	5.37	0.99	13.50	1.33	25140
Russia	7.59	1.41	13.20	1.30	17391
Spain	3.4	0.63	12.70	1.25	37353
Mexico	6.56	1.22	12.10	1.20	18445
Others	184.58	34.20	242.00	23.90	13111
Total	539.74	100.00	1012.50	100.00	18759

Source: National Horticulture Board

National scenario

There was continuous increase in area under vegetables in India from 4.12 million ha in 1985-86 to 8.50 million ha in year 2010-11. Likewise, production increased from 48.90 to 146.5 million tonnes over the same period. The yield also increased continuously from 11869 kg per hectare in 1985-86 to 17235 kg per hectare in 2010-11 except in year 1990-91, when it decreased to 10446 kg per hectare (Table 2). The technological improvements through evolution of high producing hybrid seeds have contributed a lot in yield improvement for the vegetables.

The perusal of Table 2 showed that area under vegetables in India exhibited highest increase of 35.7 per cent in period of 1985-86 to 1990-91, while the yield decreased by 11.8 per cent during this period. It may be due to reason that during this period, the Government of India had the research priority in food grains and there were limited research support for horticultural sector in India. The area decreased by 1.03 per cent during 1990-91 to 1995-96.The highest increase in yield was observed to be 35.2 per cent in period of 1990-91 to 1995-96, which may be attributed to the government initiatives in promoting horticulture sector in the country through increasing the investment in this sector. During the recent period (2005-06 to 2010-11), the area increased by 17.8 per cent while the production increased by the 31.6 per cent.

Table 2: Area, production and productivity of vegetables, India, 1985-86 to 2010-11

Year	Area (Million ha)	Percent change	Production (Million tonnes)	Percent change	Productivity (kg ha^{-1})	Percent change
1985-86	4.12	-	48.90	-	11869	-
1990-91	5.60	35.7	58.50	19.6	10446	-11.8
1995-96	5.50	-1.03	71.60	22.3	13018	35.2
2001-02	6.20	11.2	88.60	23.8	14290	1.4
2005-06	7.20	17.2	111.40	25.9	15472	6.9
2010-11	8.50	17.8	146.50	31.6	17235	11.7

Source: Indiastat.com

The perusal of Table 3 shows that over the period 1990-91 to 2010-11, onion crop has shown the highest compound growth rate of the area (15.27 per cent per annum), which was the highest amongst all the vegetable in India.

Table 3: Crop wise area of major vegetables and their compound annual growth rate in India, 1990-91 to 2010-11

Year	Potato	Onion	Brinjal	Tomato	Cabbage	Pea	Okra	Cauliflower
1990-91	0.94	0.30	2.56	2.80	1.69	1.65	2.30	1.93
1991-92	1.03	0.32	3.00	2.89	1.77	1.78	2.22	2.03
1992-93	1.05	0.32	2.86	3.06	1.89	1.94	2.98	2.31
1993-94	1.05	0.37	3.01	3.46	2.32	1.82	2.95	1.89
1994-95	1.07	0.38	4.20	3.52	2.17	2.18	4.16	2.16
1995-96	1.11	0.40	4.34	3.56	2.18	2.24	4.31	2.20
1996-97	1.25	0.40	4.64	3.91	2.10	2.54	3.23	2.34
1997-98	1.21	0.40	4.87	4.14	2.28	2.73	3.18	2.48
1998-99	1.32	0.47	4.96	4.66	2.40	2.83	3.26	2.55
1999-00	1.34	0.49	5.00	4.57	2.58	2.73	3.49	2.48
2000-01	1.22	0.42	4.73	4.60	2.45	3.19	3.50	2.56
2001-02	1.21	0.45	5.02	4.58	2.58	3.03	3.47	2.70
2002-03	1.35	0.42	5.07	4.79	2.34	3.05	3.29	2.55
2003-04	1.29	0.50	5.16	5.03	2.55	2.85	3.53	2.68
2004-05	1.32	0.55	5.27	5.05	2.88	2.76	3.57	2.39
2005-06	1.40	0.66	5.60	5.46	2.54	2.86	3.92	2.89
2006-07	1.48	0.70	5.68	5.96	2.49	2.97	3.96	3.02
2007-08	1.55	0.70	5.61	5.66	2.66	3.13	4.07	3.12
2008-09	1.83	0.83	6.00	5.99	3.10	3.48	4.32	3.49
2009-10	1.84	0.76	6.12	6.34	3.31	3.65	4.26	3.48
2010-11	1.86	1.06	6.80	8.65	3.69	3.70	4.98	3.69
CGR (%)	**2.99*** (0.25)**	**15.27** (6.25)**	**4.00*** (0.42)**	**4.53*** (0.27)**	**2.83*** (0.30)**	**3.54*** (0.36)**	**2.47*** (0.49)**	**2.88*** (0.26)**

Figures in parentheses area standard error
***** and *** significant at 5 and 1 percent respectively***

All the vegetables have shown marvelous increase in area in India and it was found to increase by more than 2 per cent per annum for different vegetables during the period under study. It was noticed that CGR_S with respect to area of the crops under study were statistically significant.

It can be seen from Table 4, West Bengal had the highest area under vegetable production (15.9 percent).The other important states in terms of vegetable acreage were Bihar, Uttar Pradesh, Andhra Pradesh, and Maharashtra, having 9.90, 9.80, 7.70, and 7.20 percent of total area under vegetables in India, respectively. West Bengal was also the leading state in terms of production of vegetables in India, contributing about 18 per cent to total production in India. The other prominent vegetable producing states in India are Uttar Pradesh, Bihar, Andhra Pradesh, and Gujarat contributing 12.10, 10.00, 8.10, and 6.40 percent respectively in total vegetable production in the country.

Table 4: Important vegetable producer states in India, 2010-11

States	Area		Production		Yield	
	Lakh ha	Percent share	Lakh tonnes	Percent share	Kg ha^{-1}	Percent of highest yield
West Bengal	13.49	15.90	267.25	18.20	19811	92.90
Bihar	8.45	9.90	146.30	10.00	17314	81.19
U.P.	8.29	9.80	176.79	12.10	21326	100.00
A.P.	6.51	7.70	118.47	8.10	18198	85.33
Maharashtra	6.11	7.20	75.04	5.10	12282	57.59
Orissa	5.53	6.50	77.90	5.30	14087	66.06
Gujarat	5.16	6.10	93.79	6.40	18176	85.23
Karnataka	4.66	5.50	90.56	6.20	19433	91.13
Haryana	3.46	4.10	46.49	3.20	13436	63.01
Punjab	1.74	2.05	35.86	2.40	20609	96.64
Others	21.55	25.35	337.10	23.00	15643	73.35
Total	**84.95**	**100.00**	**1465.55**	**100.00**	**17252**	**80.90**

Source: National Horticulture Board

Decomposition Analysis of Production

The production of any crop is mostly affected by area and/or yield. The production was decomposed to examine the contribution of area, productivity to the production of vegetables. The results indicated that in period of 1985-86 to 1990-91, the effect of area for the change in production of vegetables in India was found to be the highest amongst different periods under study, while the effect of other factors was negative (Table 5).During this period, the area under vegetables in India was found to increase significantly by compound growth rate of 2.23 percent per annum. The results revealed that yield has contributed by 105.03 per cent in production during 1990-91 to 1995-96. The yield has increased by 6.23 percent per annum during this period which was the highest amongst different periods under study. The interaction effect was found to be the highest (6.58 per cent) during 2005-06 to 2010-11whereas area and productivity was found to have increased by more than two percent during this period. In Punjab, during 1985-86 to 1990-91, the area effect was found to be the lowest amongst different periods under study. Afterwards, area effect in production was higher except during the 2005-06 to 2010-11, when the effect of productivity was higher. The growth rate of productivity of vegetables was also the highest during this period (6.28 per cent per annum).

Table 5: Production performance of vegetable in India and Punjab

(Per cent)

Particulars		**1985-91**	**1990-96**	**1995-01**	**2000-06**	**2005-11**
Area effect	India	180.73	-3.94	57.47	67.84	56.35
	Punjab	1.87	274.3	442	285.03	313.33
CAGR	India	2.23**	-0.34NS	3.15**	2.86**	2.87**
	Punjab	0.47NS	5.71***	6.21***	3.08**	2.91**
Yield effect	India	-59.49	105.03	38.23	27.44	37.05
	Punjab	403.48	-84.51	26.51	-126.76	350.46
CAGR	India	3.27**	6.23***	3.00**	0.85NS	2.46**
	Punjab	5.79***	-1.03NS	1.59*	-1.34NS	6.28***
Interaction effect	India	-21.26	-1.08	4.28	4.71	6.58
	Punjab	0.73	-22.44	11.34	-34.98	106.3

, ** and *** significant at 10, 5 and 1 percent respectively.
NS: Non-significant

The perusal of Table 6 shows crop-wise area, production and yield of vegetables in the year 2010-11 in India. It was observed that area and production were the highest in the case of potato crop, which accounted for about 22.9 and 28.8 percent, share oftotal vegetable production in India respectively. Onion, tomato and brinjal were the other important vegetables of India contributing 12.29, 8.15 and 7.54 per cent to the total area under vegetables in the country. In terms of production, these vegetables contributed 10.76, 9.57 and 7.85 per cent respectively.

Table 6: Crop-wise area, production and productivity of different vegetables, India, 2010-11

Year	Area		Production		Productivity (kg ha^{-1})
	(Million ha)	Percent of total	(Million tonnes)	Percent of total	
Potato	1.89	22.99	39.90	28.80	21110
Onion	1.01	12.29	14.82	10.76	14673
Tomato	0.67	8.15	13.18	9.57	19672
Brinjal	0.62	7.54	10.18	7.85	17429
Okra	0.45	5.47	5.04	3.66	11200
Pea	0.38	4.63	3.20	2.32	8221
Cauliflower	0.37	4.50	6.98	5.07	18865
Cabbage	0.35	4.26	7.59	5.51	21686
Tapioca	0.23	2.80	7.52	5.46	32696
Sweet potato	0.12	1.46	1.14	0.83	9500
Others	2.15	26.16	27.75	20.16	12907
Total	**8.22**	**100**	**137.69**	**100**	**16751**

Source: National Horticulture Board, 2010

The data presented in Table 7 show the leading states in terms of area, production and productivity of different vegetable in India during 2009-10. It was noticed that West Bengal was the leading state in terms of area, production and productivity of brinjal, cabbage, cauliflower and okra in India.Similarly, the area, production and productivity of onion, peas, tomato, potato, sweet potato, and tapioca were the highest in Maharashtra, Uttar Pradesh, Andhra Pradesh, Uttar Pradesh, Orissa, and Tamil Nadu respectively.

Table 7: Crop-wise leading States in terms of area, production and productivity, India, 2009-10

Crop	States	Area (000ha)	Production (000mt)	Yield (kgha^{-1})
Brinjal	West Bengal	153.9	2734.9	25470
Cabbage	West Bengal	74.3	2059.0	6076
Cauliflower	West Bengal	69.2	1754.1	18521
Okra	West Bengal	73.1	839.3	14139
Onion	Maharashtra	200.0	3146.0	1666
Peas	Uttar Pradesh	159.0	1465.8	21500
Tomato	Andhra Pradesh	87.0	1652.1	23898
Potato	Uttar Pradesh	540.8	13447.3	24355
Sweet potato	Orissa	50.5	438.8	22574
Tapioca	Tamil Nadu	129.4	5113.8	10983

Source: National Horticulture Board

Punjab Scenario

The perusal of Table 8 shows the crop-wise area, production and yield of vegetables in Punjab. It was observed that potato was the most important vegetable in state which accounted for 45.32 and 60.10 per cent share of the total area and production of vegetables in the state respectively. The pea, root crops and cucurbits were the other important vegetables of Punjab contributing 10.37, 8.73 and 6.65 per cent to the total area and in terms of total production contributing about 3.27, 8.41and 5 per cent respectively in the state. The results further revealed that yield of potato in comparison to highest yield (Gujarat) can be increased by 7.72 per cent. Similarly, yield of pea (Jharkhand), onion (Gujarat), cauliflower (West Bengal), tomato (Karnataka), cabbage (Orissa) and brinjal (Karnataka) can be increased by 56.64, 13.65, 5.91, 25.54, 19.09 and 36.08 percent respectively.

Table 8: Crop wise area, production and productivity of vegetables, Punjab, 2009-10

Crop	Area (000 ha)	Per cent in total	Production (000 t)	Per cent in total	Yield (kg ha^{-1})	As percent of highest yield of the state
Potato	83.10	45.32	2116.52	60.10	25470	92.28
Pea	19.00	10.37	115.45	3.27	6076	43.36
Root crops	16.00	8.73	296.34	8.41	18521	N.A
Cucurbits	12.20	6.65	172.50	4.89	14139	N.A
Chili	10.50	5.73	17.49	0.50	1666	N.A
Onion	8.10	4.42	174.15	4.95	21500	86.35
Cauliflower	8.00	4.36	191.18	5.43	23898	94.09
Tomato	6.20	3.38	151.00	4.29	24355	74.46
Cabbage	4.30	2.34	97.07	2.76	22574	80.91
Garlic	3.50	1.91	38.44	1.09	10983	N.A
Brinjal	3.20	1.75	48.50	1.38	15156	63.92
Others	8.80	4.8	102.91	2.92	11694	N.A
Total	183.35	100	3521.55	100	19207	N.A

N.A. Not applicable

The results presented in Table 9 exhibited the returns from different summer vegetables and paddy in Punjab. The returns over variable costs were higher for all the vegetable crops under study as compared to paddy crop. It shows that vegetables were more remunerative as compared to the paddy crop and can provide much needed impetus to the diversification agriculture by adoption of vegetable farming in Punjab provided the requisites changes in the agricultural and price policy at national level are effected.

Table 9: Returns from different vegetables and paddy in Punjab

(` ha^{-1})

Particulars	Okra	Brinjal	Sponge Gourd	Capsicum	Tomato	Paddy
Gross returns	35798	39043	29895	47649	57729	24875
Production costs	16541	15096	11685	22447	26008	13030
Returns over production costs	19252	23947	18210	25202	26721	11541
Marketing costs	2031	2876	4387	3938	5634	338
Returns over variable costs	17226	21071	13823	21244	21087	11176

Sharma *et al.*, 2000

The perusal of Table 10 shows that okra cultivation has generated 1003 man hours per hectare. The corresponding figures for brinjal, sponge gourd, capsicum and tomato were estimated to be 890, 882, 1573 and 3678 man hours per hectare respectively.

Table 10: Employment provided by different summer vegetables and paddy crop in Punjab

(Man Hours ha^{-1})

Particulars	Okra	Brinjal	Sponge Gourd	Capsicum	Tomato	Paddy
Family labour	289 (29)	282 (32)	270 (32)	453 (29)	940 (26)	183 (25)
Hired labour	715 (71)	608 (68)	562 (67)	1120 (71)	2889 (74)	558 (75)
Total labour	1003 (100)	890 (100)	882 (100)	1573 (100)	3678 (100)	740 (100)

Sharma *et al.*, (2000)

The employment generated in the cultivation of vegetable was much higher as compare to paddy (740 man days/ha) in summer season. The results further revealed that the cultivation of summer vegetable has also utilized the more family labour as compared to paddy crop. This clearly evinced that the cultivation of vegetables has increased the employment opportunities for the rural folks on the farm itself and can help in overcoming the unemployment problem in Punjab state through diversification by promotion of vegetables.

CONCLUSIONS

The global vegetable production has reached to 1012.5 million tonnes in 2010-11 and India accounts for 14 per cent share and rank second in total vegetable production in the world. Thearea under vegetables had almost doubled while the production had increased by three times over period 1985-86 through 2010-11 in India.It has been noticed that West Bengal had the highest area under vegetable production which constituted 15.9 percent of national vegetable area.It was observed that area and production were the highest in the case of potato crop in India as well as in Punjab. During the period 1990-91 to 2005-06, the increase in production of vegetables in Punjab was found to be due to the effect of area but during the latest period (2005-06 to 2010-11), the effect of productivity was higher.Still there is scope of increasing the productivity of vegetables in the state as yield of potato in comparison to highest yield (Gujarat) can be increased by 7.72 per cent. Similarly, yield of pea (Jharkhand), onion (Gujarat), cauliflower (West Bengal), tomato (Karnataka), cabbage (Orissa) and brinjal (Karnataka) can be increased by 56.64, 13.65, 5.91, 25.54, 19.09 and 36.08 percent respectively. The results revealed that the cultivation of vegetable has increased the employment opportunities for the rural folks on the farm itself. Moreover, vegetables cultivation was also found to be more remunerative as compared to the paddy crop.

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Research Article

VEGETABLE FARMING IN PUNJAB: AN OVERVIEW

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ABSTRACT

The present study has been undertaken to ascertain the overtime changes in the importance of vegetable farming in the cropping pattern of Punjab and the production profile of different vegetables in the state. The study based on the secondary data entailed in-depth analysis of major vegetable producing districts of the state. The vegetable production details have been explicated for District Jalandhar and Hoshiarpur, which together accounted for approximately one third of State's vegetable acreage and production in the reference period TE 2008-09. The findings of the study can provide a fruitful input in framing the policy directives for the much needed diversification plan envisaged for the State of Punjab apart from creating enabling environment for efficient marketing and value addition options in the vegetable growing pockets of the state.

INTRODUCTION

The importance of vegetables in improving the nutritional and economic status needs no elaboration. Vegetable farming preserves our natural resources like soil and water, and produces more tonnage per unit of area in comparison to other crops. By virtue of being short duration vegetable farming provides a continuous flow of income to the farmers and gives higher returns as compared to Wheat and Paddy (Singh and Toor, 2003).

India has been growing vegetables for several centuries and is the second largest producer of vegetables in the world (after China), accounting for nearly 14 per cent of the vegetable production in the world.More than 70 kinds of vegetables belonging to different groups namely cucurbits, cole crops, solanaceous vegetables, root and leafy vegetables are grown in the country (Salaria and Salaria, 2010). The production of vegetables in 2008-09 stands at over 129 million metric tonnes from an area of eight million hectares put to vegetable cultivation (Anonymous. 2009a). In spite of this seemingly high level of production, the per capita consumption of

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vegetables in India is only about 140 grams, which is far below the minimum requirement of 300 grams /day/person as per the dietary guidelines by National Institute of Nutrition, ICMR, Hyderabad (Anonymous. 2009b). Ours' being predominantly a vegetarian society, the role of vegetables in improving the dietary standards of the people becomes all the more vital.

In the wake of agrarian crisis looming large on Punjab agriculture, efforts have hitherto been directed towards the fulfillment of the need to shift from supply driven agriculture to demand driven agriculture and diversify the crop base to include poultry, dairy, fruits and vegetables. In view of the dismal agricultural scenario of the State, noted farm economist Dr. S.S.Johl in his report submitted to the Punjab Government, proposed transfer of one million hectares of land from paddy- wheat rotation to other less water consuming crops (Anonymous, 2002). In this context, the Government of Punjab had set-up a 'State Farmers' Commission' to examine and review the status of agriculture and to suggest the measures for economically viable and ecologically sustainable agricultural development of the state. The diversification towards vegetable production has been emphasized by the Commission for increasing income and employment opportunities and particularly so for the small holders. A positive step has been recorded in this direction with area under vegetable crops in Punjab increasing from 1.20 lakh hectares in 1998-99 to 1.78 lakh hectares in 2008-09 (Anonymous, 2009). But this change is still far below the level which could effectively fulfill our multifaceted goal of food, nutritional and economic security.

Thus, keeping in mind the various aspects of vegetable farming and its role in the economic upliftment of farming community, the present study was planned with the objective to ascertain the importance of vegetable farming in the cropping pattern of the state and over time change in production profile of different vegetables in Punjab.

METHODOLGY

In order to ascertain the over time changes and the current situation in vegetable farming, secondary time-series data on the pertinent variables was collected from 1971 onwards. The time frame for the study to observe changes in the production profile of major vegetables in Punjab as a whole and the two selected districts was set up as 1998-99 to 2008-09. The information on pertinent variables was extracted from various issues of Statistical Abstract of Punjab, Reports of Horticulture Department of Punjab, Chandigarh and Indian Horticulture Database, 2009.

Table 1: Share of different districts in vegetable acreage and production in Punjab, TE 2008-09

Districts	Percent Share according to	
	Area	Production
Jalandhar	**18.7**	**20.3**
Hoshiarpur	**14.1**	**12.3**
Amritsar	8.7	8.1
Patiala	7.8	8.0
Kapurthala	7.6	9.2
Ludhiana	6.4	7.7
Nawanshahar	5.5	4.3
Tran Taran	4.8	2.6
Moga	4.0	4.7
Others*	22.4	22.8

Source: Department of Horticulture, Punjab
****Having less than 4 percent share in total area and production.***

The objective of the study called for selection of two top ranking districts in terms of vegetable acreage and production. Thus, on the basis of information in Table 1 reflecting the respective contribution of all districts of Punjab to vegetable acreage and production, for the reference period TE 2008-09, the two top ranking districts Jalandhar and Hoshiarpur were selected.The data collected were subjected to various statistical analyses for meaningful presentation of the results.

RESULTS AND DISCUSSION

Vegetable Production Scenario in Punjab

It has been widely recognized that diversification of agriculture from mono cropping of paddy and wheat towards vegetables is the key instrument for economically viable and ecologically sustainable agricultural development of the state of Punjab. So an overview of vegetable farming in Punjab has been highlighted in this section.

Importance of Vegetables in Punjab's Cropping Pattern

In order to assess as to what extent the vegetable crops have found place in the cropping pattern of the state, the time series data, spanning over four decades, from 1970-71 to 2008-09 to be more precise, on cropping pattern of the state have been reviewed and the pertinent information has been presented in Table 2.

Table 2: Importance of vegetables in Punjab's cropping pattern

(000' ha)

Year	Area under vegetables	GCA	Area under vegetables as percent of GCA
1970-71	18.15	5678	0.32
1980-81	30.31	6763	0.45
1990-91	54.61	7502	0.73
1998-99	120.35	7945	1.51
1999-00	135.35	7847	1.72
2000-01	140.45	7941	1.77
2001-02	145.10	7941	1.83
2002-03	148.34	7773	1.91
2003-04	153.61	7905	1.94
2004-05	158.64	7932	2.00
2005-06	163.31	7868	2.08
2006-07	168.23	7861	2.14
2007-08	173.34	7870	2.20
2008-09	178.41	7912	2.25

Sources: Statistical Abstract of Punjab, Various issues and Horticulture Department of Punjab, Chandigarh

The vegetable acreage in Punjab, when seen in reference to state's gross cropped area (GCA) reveals that the GCA has increased from 5.7 million ha in 1970-71 to 7.5 million ha by 1990-91 registering a growth rate of 1.41 percent per annum. The acreage put to vegetable cultivation increased from 18 thousand ha to 55 thousand ha during the same period, the rate of increase being 5.66 per cent per annum. The vegetable area, as percent of GCA increased from 0.32 percent in 1970-71 to 0.73 per cent by 1990-91 and further to 1.72 per cent by 1999-2000 and has been increasing consistently thereafter. As a result of the emphasis laid on the vegetable cultivation, the vegetable acreage increased from 135 thousand ha in 1999-2000 to 178 thousand ha by 2008-09, registering an increase of 32 percent over the ten years period. On the other hand, the GCA during the same period increased by less than one percent and the vegetable area as percent of GCA increased from 1.72 percent to 2.25 percent. It is obvious that although, vegetable acreage has shown an impressive increase over the years, yet the importance of vegetables in the cropping pattern of the state has remained more or less the same, particularly when seen in reference to diversification along crop dimensions.

Production Profile of Major Vegetables in Punjab: Change Over time

This section has been devoted exclusively to the study of production profile of different vegetables in Punjab. The time frame for studying the over time changes in area, production and productivity of different vegetable crops has been earmarked from 1998-99 to 2008-09 and the relevant information has been presented in Table 3. A quick glance at the table reveals that the total acreage under major vegetable crops in Punjab has undergone an increase from 1.3 lakh ha in TE 2000-01 to 1.7 lakh ha by TE 2008-09 with a highly significant ($p<0.01$) growth rate of 3.52 percent per annum. The results exhibit an expansion in area under all the vegetable crops during the study period. This increase was found to be statistically significant in all the vegetable crops except for tomato, wherein the acreage increased by 840 hectares from TE 2000-01 to TE 2008-09 registering a non-significant CAGR of 1.14 percent. The highest growth in acreage, as indicated by CAGR of 9.36 percent, has been recorded in the case of cauliflower.

During the same period, quite a significant increase has been recorded in the production of the vegetables. The total production of major vegetables increased from 21.8 lakh metric tonnes in TE 2000-01 to 29.1 lakh metric tonnes by TE 2008-09 with a significant ($p \leq 0.01$) CAGR of 3.71 percent. The highest CAGR has been recorded in the production of cauliflower (8.72%), followed by garlic (7.15%) and okra (5.39%) and all were statistically significant at one percent level of significance. Due to non-significant increase in tomato acreage, its production also showed a non-significant increase of 3955 metric tonnes over the study period.

As regards the productivity of vegetable crops, it has been observed that garlic recorded the highest rate of increase (CAGR 1.42%). The productivity of tomato has undergone a decline from 24.2 to 22.2 tonne per hectare. Similar pattern has been observed in case of cauliflower with productivity exhibiting a down slide from 24.3 to 23.0 tonne per hectare; however the increase in productivity can be attributed more to expansion in the acreage. The above discussion clearly elucidates that the production of all the vegetables barring tomato has shown a significant increase over the study period from 1998-99 to 2008-09. An increase in area under the vegetable crops across the period 2002-2006 in Punjab was observed (Kumar 2007) and a similar trend in Uttar Pradesh was also reported with an increase of 3.08 percent per annum in vegetable acreage and 3.80 percent in the case of production over a period of 10 years (Ali and Kapoor, 2008).

Table 3: Production profile of major vegetables in Punjab: Change over time

Major vegetables	Area (ha)		Production (metric tonnes)		Yield (kg ha^{-1})		Compound growth rates [@] (Percent)		
	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	Area	Production	Yield
Potato	61796	79073	1213039	1597283	19564	20136	3.38***	3.53**	0.19NS
Onion	5481	7975	117484	171041	21439	21449	4.88***	4.89***	0.004NS
Garlic	1238	2003	15051	28013	12163	13730	5.65**	7.15***	1.42***
Tomato	6778	7618	164294	168249	24238	22258	1.14NS	0.38NS	-0.76NS
Brinjal	2497	2977	36057	44279	14423	14869	2.12***	2.45**	0.32NS
Cauliflower	3290	6790	79948	155996	24277	22974	9.36***	8.72***	-0.59**
Okra	1487	2256	11163	17060	7505	7560	5.29***	5.39***	0.09***
Chilli	8236	10311	13014	16828	1580	1632	2.72***	3.19***	0.41***
Pea	13985	18358	83845	110637	5995	6026	3.44***	3.51***	0.07**
Total	**132051**	**173329**	**2181810**	**2913447**	**-**	**-**	**3.52*****	**3.71*****	**-**

Source: Horticulture Department of Punjab, Chandigarh
[@] 1998-99 to 2008-09
***** and *** significant at 5 and 1 percent level respectively***
NS: Non-significant

Vegetable Production Scenario in the Study Area

This section aims to have an insight into the dynamics of vegetable production in the two top ranking districts viz. Jalandhar and Hoshiarpur, in terms of vegetable acreage and production.

Importance of vegetables in the cropping pattern of selected districts

It was necessary to impart depth to the study by making an assessment of the selected districts with respect to vegetable production. The information pertaining to this aspect presented in Table 4 makes an important revelation that the importance of vegetables in the cropping patterns of the selected districts has increased considerably and more so after the late nineties.

The area under vegetable cultivation in district Jalandhar has been recorded as 2.5 thousand ha in 1970-71, which increased to 13.5 thousand ha by 1990-91. The corresponding figures for Hoshiarpur district stood at 1.4 and 7.5 thousand ha, respectively. By 1990-2000, the vegetable acreage increased to 26.4 thousand ha in case of Jalandhar district and 19.8 thousand ha in case of Hoshiarpur district. In district Jalandhar, the percentage share of vegetables in gross cropped area showed a remarkable increase from 0.63 percent in 1970-71 to 6.4 percent by 1999-2000. Similarly in case of Hoshiarpur district, the vegetable area as percent of gross cropped area increased from 0.4 percent in 1970-71 to 5.6 percent by 1999-2000. As per the latest information available for 2008-09, the share of vegetables in the respective gross cropped area has been recorded at 7.67 percent for Jalandhar and 7.23 percent for Hoshiarpur district, as against the considerably lower figure of 2.25 percent for the state as a whole.

Table 4: Importance of vegetables in the cropping pattern of selected districts

Year	Area (000 ha)		Area under Vegetables as percent of GCA	
	Jalandhar	Hoshiarpur	Jalandhar	Hoshiarpur
1970-71	2.50	1.40	0.63	0.40
1980-81	2.70	1.60	0.57	0.42
1990-91	13.50	7.50	2.60	1.89
1998-99	26.70	20.70	6.50	5.95
1999-00	26.40	19.80	6.39	5.59
2000-01	26.80	20.90	6.47	5.71
2001-02	27.30	21.40	6.59	5.85
2002-03	28.70	20.60	6.98	6.04
2003-04	29.60	21.50	7.08	5.99
2004-05	30.40	22.20	7.19	6.20
2005-06	31.30	22.90	7.35	6.41
2006-07	32.50	23.50	7.78	6.62
2007-08	32.90	23.90	7.80	6.73
2008-09	32.30	26.40	7.67	7.23

Sources: Statistical Abstract of Punjab

Production profile of major vegetables in district Jalandhar

The information pertaining to vegetable production scenario of district Jalandhar, presented in the Table 5 revealed that total area under vegetable increased from 26635 ha in TE 2000-01 to 32547 ha by TE 2008-09 at statistically significant ($p \leq 0.01$) CAGR of 2.52 percent. The percent share of district Jalandhar in Punjab's vegetable acreage has however, decreased from 20.2 to 18.7 percent in the above said period. Among the major vegetables grown in Jalandhar district during the TE 2000-01, potato recorded the highest acreage (16718 ha) which at the end of TE 2008-09, increased to 19363 hectares with CAGR of 1.85 per cent. However, the share of Jalandhar district in Punjab's potato acreage decreased from 27 per cent in TE 2000-01 to 24.5 percent by TE 2008-09. During the study period, pea was the only vegetable crop that registered a decline in acreage to the tune of 446 hectares. The minimum area was under garlic (65 ha) during the TE 2000-01 contributing a meager 5.2 percent to Punjab's garlic acreage, which increased to 14.6 percent registering a CAGR of 16.47 percent during the period. A high CAGR of nearly 21 percent ($p \leq 0.01$) was observed in both okra and cauliflower, with area increasing from 106 hectares in TE 2000-01 to 481 hectares by TE 2008-09, in case of cauliflower and from 95 hectare 409 hectares during the same period in case of okra.

The production of vegetables in Jalandhar district has increased from 4.6 lakh metric tonnes in TE 2000-01 to 5.9 lakh metric tonnes by TE 2008-09, accounted for one-fifth which of Punjab's total vegetable production. The district Jalandhar has always been a major contributor to Punjab's potato output but did not show a significant increase in potato production over the study period. Consequent upon a decline in pea acreage, its production has also decreased by 2673 metric tonnes over the study period. However, the cauliflower production increased significantly from 2633 metric tonnes to 11951 metric tonnes over the observed period, from 1998-99 to 2008-09, with a significant CAGR of 20.8 percent and was the highest among all other major vegetable crops.

As regards the productivity of vegetable crops in Jalandhar district, there has been no significant increase in potato yield, although in absolute terms the yield increased from 18983 kg per hectare in TE 2000-01 to 19710 kg per hectare in TE 2008-09. But all other vegetables showed a significant increase in yield over the study period, 1998-99 to 2008-09, with highest CAGR observed in the case of garlic (1.55 %), followed by chilli (0.51 %) and brinjal (0.12 %) .

Table 5: Production profile of major vegetables in District Jalandhar: Change over time, 1998-99 to 2008-09

Major vegetables	Area (ha)		Production (metric tonnes)		Yield (kg ha^{-1})		Compound growth rates @ (Percent)		
	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	Area	Production	Yield
Potato	16718 (27.1)	19363 (24.5)	317372 (26.2)	381036 (23.9)	18983	19710	1.85***	2.22NS	0.36NS
Onion	210 (3.8)	337 (4.2)	4880 (4.2)	7856 (4.6)	23275	23332	6.46***	6.49***	0.03**
Garlic	65 (5.2)	292 (14.6)	879 (5.8)	4570 (16.3)	13594	15641	16.47***	18.28***	1.55***
Tomato	536 (7.9)	811 (10.6)	13569 (8.3)	20547 (12.2)	25299	25325	5.85***	5.87***	0.01***
Brinjal	290 (11.6)	442 (14.8)	4546 (12.6)	7004 (15.8)	15694	15851	5.42***	5.54***	0.12***
Cauliflower	106 (3.2)	481 (7.1)	2633 (3.3)	11951 (7.7)	24766	24845	20.77***	20.82***	0.04***
Okra	95 (6.4)	409 (18.1)	715 (6.4)	3090 (18.1)	7525	7555	20.70***	20.76***	0.05***
Chilli	1041 (12.6)	1412 (13.7)	1694 (13.0)	2389 (14.2)	1628	1694	3.66***	4.20***	0.51***
Pea	1618 (11.6)	1172 (6.4)	9879 (11.8)	7206 (6.5)	6107	6154	-4.45***	-4.35***	0.10**
Total	26635 (20.2)	32547 (18.8)	464535 (21.3)	593712 (20.4)	-	-	2.52***	3.12**	-

Source: Horticulture Department of Punjab, Chandigarh
Figures in parentheses are the percentages of corresponding figures for Punjab
***** and *** significant at 5 percent and 1 percent level respectively.***
NS: Non-significant

Production profile of major vegetables in district Hoshiarpur

The production profile of major vegetables in district Hoshiarpur has been presented in Table 6. The information presented therein reveals that in district Hoshiarpur, total area under vegetable crops has increased from 20430 hectares in TE 2000-01 to 24565 hectares in TE 2008-09 with a significant CAGR of 2.33 percent observed over the period 1998-99 to 2008-09.

In Hoshiarpur district, area under potato was the highest (12778 ha and 16059 ha) in both the trienniums studied, TE 2000-01 and TE 2008-09 followed by pea (3466 ha and 5550 ha) and the lowest was in case of okra (25 hectares in TE 2000-01 and 60 hectares in TE 2008-09). The most notable increase in acreage as indicated by CAGR, has been observed in case of cauliflower (18.47 %) followed by okra (11.82%) and onion (6.38%). The area under tomato and garlic showed a decline over the study period. The area under tomato has declined from 337 hectares in TE 2000-01 to 171 hectares by TE 2008-09, which is a matter of concern.

The production of major vegetables in district Hoshiarpur increased from 3.06 lakh metric tonnes in TE 2000-01 to 3.61 lakh metric tonnes in TE 2008-09 though with a non-significant CAGR (1.94 %). Similar results were observed in the case of potato, garlic and brinjal. In absolute terms, the production of potato has increased from 2.2 lakh metric tonnes in TE 2000-01 to 2.7 lakh metric tonnes in TE 2008-09.

Over the same period the garlic production increased from 960 metric tonnes to 1106 metric tonnes and that of brinjal registered an increase from 1601 metric tonnes in TE 2000-01 to 2147 metric tonnes by TE 2008-09. Cauliflower production registered the highest CAGR of 18.21 percent, followed by okra (CAGR of 11.87 percent). The possible reason for unprecedented increase in both cauliflower and okra production may be the remarkable increase in acreage. The figures corresponding to pea production profile highlight that Hoshiarpur district alone accounted for nearly one-fourthof the State's pea acreage and production. The yield of garlic increased from 14308 kg per hectare in TE 2000-01 to 19509 kg per hectare in TE 2008-09 registering the highest CAGR of 4.2 percent over the study period 1998-99 to 2008-09. However, a significant decrease in the yield was recorded in case of cauliflower and tomato with negative CAGR of 0.21 and 0.32 percent, respectively.

Table 6: Production profile of major vegetables in District Hoshiarpur: Change over time, 1998-99 to 2008-09

Major vegetables	Area (ha)		Production (metric tonnes)		Yield (kg ha^{-1})		Compound growth rates @ (Percent)		
	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	TE 2000-01	TE 2008-09	Area	Production	Yield
Potato	12778 (20.7)	16059 (20.3)	218070 (18)	271081 (17.0)	17043	16818	3.00**	2.57^{NS}	-0.42^{NS}
Onion	151 (2.8)	235 (2.9)	3447 (2.9)	5369 (3.1)	22829	22848	6.38*	6.39*	0.01**
Garlic	67 (5.4)	57 (2.8)	960 (6.4)	1106 (3.9)	14308	19509	-6.89^{NS}	-2.99^{NS}	4.20*
Tomato	337 (5.0)	171 (2.2)	7754 (4.7)	3809 (2.3)	22988	22322	-7.61*	-7.90**	-0.32**
Brinjal	110 (4.4)	148 (5.0)	1601 (4.4)	2147 (4.8)	14507	14538	3.12^{NS}	3.15^{NS}	0.03**
Cauliflower	188 (5.7)	674 (9.9)	4497 (5.6)	15810 (10.1)	23918	23456	18.47**	18.21**	-0.21*
Okra	25 (1.7)	60 (2.7)	178 (1.6)	434 (2.5)	7209	7234	11.82**	11.87**	0.04**
Chilli	71 (0.9)	132 (1.3)	113 (0.9)	218 (1.3)	1586	1636	7.70*	8.09*	0.40**
Pea	3466 (24.8)	5550 (30.2)	20942 (25.0)	33748 (30.5)	6042	6080	6.11**	6.19**	0.08**
Total	20430 (15.5)	24565 (14.2)	306526 (14.1)	361139 (12.4)	-	-	2.33**	1.94^{NS}	-

Source: Horticulture Department of Punjab, Chandigarh
Figures in parentheses are the percentages of corresponding figures for Punjab
***** and *** significant at 5 percent and 1 percent level respectively***
NS: Non-significant

CONCLUSIONS

The study has highlighted that vegetable farming has picked up the momentum in the state of Punjab as enunciated by an impressive increase in the vegetable acreage over the years, although the importance of vegetables in the cropping pattern of the state has remained more or less the same, particularly when seen in reference to diversification along crop dimensions. The important revelation of the study is that the importance of vegetables in the cropping patterns of the selected districts, Jalandhar and Hoshiarpur, has increased considerably and more so after the late nineties. As per the figures corresponding to the year 2008-09, the share of vegetables in the respective gross cropped area has been recorded at 7.67 percent for Jalandhar and 7.23 percent for Hoshiarpur district, as against the considerably lower figure of 2.25 percent for the state as a whole. The findings of the study can provide a fruitful input in framing the policy directives for the much needed diversification plan envisaged for the State of Punjab apart from creating enabling environment for efficient marketing and value addition options in the vegetable growing pockets of the state.

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Review Article

FARM OUTSOURCING: WORLD SCENARIO AND INDIAN PERSPECTIVE

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ABSTRACT

The present paper aims at highlighting the crucial issues in farm outsourcing at a global level with particular reference to India. Farm outsourcing is emerging as a new investment trade. Globally millions of lands worth billions of dollar are traded. In the recent past the farm outsourcing business had seen tremendous change. The private investors are replaced by government agencies and cash crops are replaced by staple crops and bio-fuel. These changes are mainly due to the raising concerns over the food security and international food price volatility. Major countries involved in trade are the oil rich Gulf States and countries with high population. India is one of the prospective farm outsourcing nations. Agriculture in India is facing challenges such as stagnant productivity, decreasing land availability, climate change and higher demand. These challenges are urging for investments in countries the need of investing in other countries with less production risks for greater food security.

Key Words: Farm outsourcing, foreign investments, land acquisitions, food security, livelihood.

INTRODUCTION

Farm outsourcing is buying or leasing farmland abroad. It is an acquisition of land in developing or least developed countries, instead of buying food from these food importing countries directly (Anonymous, 2009). The ongoing effect of food price crisis and price volatility in international market on the world food production system had proliferated farmland acquisition in developing and least developed countries (Braun and Dick, 2009). History of farm outsourcing accounts, to 16th century (Indigo plantation), colonialism in India and other colonial nations. After the collapse of Soviet Union in 1991, foreign investors rushed for state-owned and collective farms which were technologically sophisticated large farms. There are

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numerous instances of such farm investmentsby colonist nations in their respective ex-colonies (Moyo, 2007).

Farm Race

The world is now witnessing a sudden surge in global farm outsourcing trade. About 15-20 m ha farmland of least developed countries has been traded in 2006-2010 with transaction of worth $ 20-30 billion. In the above trade, two major types of countries are involved. First are the food importing countries with land and water constrains, but rich in capital resources Gulf States (UAE, Libya, Saudi Arabia etc.). Second are the countries with large population, but in need of food security (China, India, South Korea etc.). The recent trends in farm outsourcing differ from past inferences. Earlier, mostly private companies were into farm outsourcing. However, today most government agencies are grabbing land using sovereign wealth fund. The cash crops, of the past, have been replaced by staple crops and bio-fuel crops (Anonymous, 2009).

The declining average cereals yield (3-6%) in developing countries has further stirred this farm race. Due to the rising concerns over the volatility of food prices in international market, the farm acquisitions have attained new dimensions. There are an increasing number of countries, who are getting engaged, in farm outsourcing around the world. Major Asian buyers are China, South Korea, Japan, Vietnam, and India. Middle East countries such as Kuwait, Qatar, Jordan, Saudi Arabia, UAE and Bahrain have bought large farm tracks across the African continent (Wouterse *et al.,* 2011). The leading countries offering land for sale include Africa, Asia and South America.

The new outsourcing opportunity has gained momentum after the food crisis of 2007-08. Many food deficit countries have started buying arable land in Asia, Africa and South America. The investments are of three types, Government to Government, Private to Government, and Private to Private.

Government to Government investment

For the Middle East countries Africa is a bread basket for many years (Okyere, 2012). Major investor countries are Qatar, Kuwait, Saudi Arabia and UAE. China is robust investors acquiring millions of land over different countries for rice, wheat, potatoes, vegetables, bio-fuel and plantation crops. South Korea, India and other oil rich African countries are also investing in the land over there. The perusal of Table 1 shows that Democratic Republic of Congo has outsourced 2.8 m ha of land to China for bio-fuel palm cultivation. India has invested $ 4 billion in Ethiopia for agriculture, floriculture and sugar estates.

Qatar has leased 40,000 ha of land from Kenya for fruit and vegetable cultivation in exchange for construction of a port worth $ 2.3 billion. Libya has secured 100,000 ha of land for rice cultivation in Mali. In Sudan many countries such as Egypt, Jordan, Kuwait, Qatar, Saudi Arabia, South Korea and UAE, have invested for livestock and crop production.

Table 1: Government to government investment in Africa

Target country	**Investor country**	**Nature of deal**
Democratic Republic of Congo	China (ZTE International)	2.8 million ha secured for bio-fuel oil palm plantation
Ethiopia	India	US$4 billion invested, including in agriculture, flower growing, and sugar estates
Kenya	Qatar	40,000 ha leased for fruit and vegetable cultivation in exchange for funding US$2.3 billion port
Malawi	Djibouti	Unknown area of farmland leased
Mali	Libya	100,000 ha secured for rice
Mozambique	China	US$800 million investment to expand rice production from 100,000 to 500,000 metric tons; political opposition to deal
Sudan	Egypt	Land secured to grow 2 million tons of wheat annually
	Jordan	25,000 ha secured for livestock and crops
	Kuwait	Giant Strategic Partnership: No further information
	Qatar	Joint holding company set up to invest in agriculture
	Saudi Arabia	9,200-10,117 ha leased for wheat, vegetables, and animal feed; 60 percent paid by Saudi Government
	South Korea	690,000 ha secured for wheat
	UAE	378,000 ha total invested in by UAE
	UAE	30,000 ha secured for corn, alfalfa, and possibly wheat, potatoes, and beans
Tanzania	Saudi Arabia	500,000 ha requested for lease
	China	300 ha secured for rice
Zambia	China	2 million ha requested for Jatropha (bio-fuel)

Source: www.ifpri.org

In Tanzania 500,000 ha of land has been sought by Saudi Arabia and 300 ha of land has been secured by China for rice cultivation. China has requested 2 m ha land for cultivation of Jatropha in Zambia (Table 1).

Table 2: Government to government investment in Asia and other countries

Target country	Investor country	Nature of deal
Cambodia	Kuwait	Land leased for rice
	Vietnam	100,000 ha secured for rubber
Indonesia	Saudi Arabia	500,000 ha secured in US$4.3 billion investment for rice; put on hold by Bin Laden Group
Laos	Vietnam	100,000 ha secured for rubber
Pakistan	UAE	324,000 ha purchased
Philippines	Bahrain	10,000 ha secured for agro-fishery
	China	1.24 million ha leased; deal put on hold
	Qatar	100,000 ha leased
Turkey	Bahrain	US$500 million agricultural project; may rise to US$3-$6 billion
Ukraine	Libya	247,000 acres or hectares secured

Source: www.ifpri.org

Investments in Asian countries are chiefly on rice and plantation crops cultivation (Table 2). Investors are from Middle East, Asian and oil rich African countries. These deals are mostly leasing of land unlike that of acquisition in Africa. Saudi Arabian investment in Indonesian in and Chinese investment in Philippines was discontinued due to political opposition.

In Asian countries like Cambodia, Kuwait has leased land for rice cultivation. Vietnam has secured 100,000 ha land in Cambodia and another 100,000 ha in Laos for rubber cultivation. UAE has purchased 324,000 ha land in Pakistan. In Philippines 10,000 ha of land was secured for agro-fisheries by Bahrain and another 100,000 ha of land were leased by Qatar. Bahrain has invested $ 500 m for an agricultural project in Turkey. Libya has secured 247,000 acres of land in Ukraine (Table 2).

Private to Government Investment

Private companies purchase land in foreign countries by signing deal with the governments of the target countries. They do have shifted from perennial cash crops to staple crops. Lonrho a UK based company has leased 25,000 ha for rice cultivation in Angola. In Democratic Republic of Congo farmers union has offered 10 million ha of land to *Agriculture South Africa*, a South African private enterprise. Trans4mation Agritech Limited, a UK based company has secured 10,000 ha in Nigeria. In South Sudan 400,000 ha of land was signed by Jarch Capital (Table 3).

Table 3: Private to government investment

Target country	Investor country	Nature of deal
Angola	Lonrho (UK)	25,000 ha leased for rice. Lonrho is negotiating for a further 125,000 ha in Mali and Malawi
Democratic Republic of Congo	Agriculture South Africa (South Africa)	10 million ha offered by farmers' union
Ethiopia	Unknown private investors (Saudi Arabia)	Land leased in exchange for US$100 million investment
Madagascar	Daewoo (South Korea)	1.3 million ha secured for maize
Nigeria	Trans4mation Agrictech Limited (UK)	10,000 ha secured
Sudan	Jarch Capital (USA)	400,000 ha in Southern Sudan signed with local army Commander

Source: www.ifpri.org

Private to Private Investment

The private companies of the investor country are also buying stakes of the private companies in the target country, by buying stakes, joint ventures, mergers or acquisition.

Table 4: Private to Private investment

Target country	Investor country	Nature of deal
East Africa Agribusiness (Ethiopia)	Dubai World Trading Company (UAE)	5,000 ha secured in joint venture for tea
KhorolZerno (Russia)	Hyundai (South Korea)	10,000 ha secured in company takeover

Source: www.ifpri.org

Dubai World Trading Corporation (UAE) has started a joint venture with East Africa Agribusiness (Ethiopia) and secured 5,000 ha of land for tea cultivation.

Hyundai of South Korea has secured 10,000 ha in KhorolZerno, a Russian company (Table 4).

The above discussion has clearly revealed the uniqueness of the investment in different countries. Many governments, their state-owned entities, private sectors, public- private partnerships are engaged in negotiations. The size and terms of contracts differ, from land leasing, concession, contract or purchase of land. The deals are over large size of land mainly for staple crops or bio-fuels. Documented details about the status of deals, size of land purchased or leased and capital invested are scare and some reports are even contradictory. The major countries involved in farm outsourcing as China, South Korea, UAE, Saudi Arabia and Qatar.

Opportunities and Threats of Farm Outsourcing

Farm outsourcing has provided lucrative opportunities for both investor and target countries. The investor countries, sans fertile land, water and cultivable conditions, but with sufficient capital can invest in farmlands of other countries. Increased pressure on natural resources, water scarcity, and export restrictions imposed by major producers coupled with distrust in the global markets, has pushed these investor countries towards farm outsourcing (Braun and Dick, 2009).

The target country is endowed with surplus factors of production other than capital. Agriculture sector needs more investment for new seeds and modern cultivation techniques, to make it capital intensive. To attain this phase technologically sophisticated large farm are in demand. Such a farm requires a huge initial investment. Most of the least developed countries with large area of land, suffer from disastrous underinvestment, due to lack of capital. Fiscal inability of the countries prevents it from providing necessary infusion of capital into agriculture. Such countries require capital investment in agriculture which can reduce poverty, benefiting the rural poor, by creation of potentially significant number of farm and off-farm jobs (Mwangi *et al.,* 2007). It can also develop rural infrastructure such as hospitals, roads, educational institutions and bring back them to the development stream (Brautingam *et al.,* 2012).

These murky investments do possess some severe threats and risks. The investors are viewed as land grabbers or neo-colonialists. Also, it is extremely difficult to do projects in countries with ethical conflicts. Most of the underdeveloped countries of Africa, South America and Asia are war torn affected with civil war or in ethnic conflict (Anseew and Alden, 2010). The investment faces threat from the unstable political scenario over there. Large scale land acquisitions often threaten native's livelihood and ecological sustainability (Pinon*et al.,* 2012). Even though the deals make provision for addressing all stakeholders, they may not be in equal terms. As the bargaining power rests with the investors and aspirant elite host people (Kirt and Tuan, 2009). The small holder's livelihoods are kept at stake (Laurent, 2010). Small holders using land under the customary land tenure will be pushed off the land without any proper compensation (Bomuhangi, 2011). The rights over land and land reforms often lead to political conflict (Walker, 2007 and Clover, 2010)). The land being acquired by foreign investors tagged as unproductive or underutilized is actually valuable livelihood sources for grazing, fuel wood and medicinal plants. Such large scale land acquisitions further jeopardize the welfare of the indigenous people (Ajayi *et al.,* 2012).

The ecological sustainability of land and water resources is another important issue associated with large scale foreign acquisitions. Intensive agriculture threatens biodiversity, land and water resources. This can also lead to long term sustainability problems such as salinity, water logging and soil erosion (Kissinger and Ress, 2009).

Another important issue is the political conflicts associated with such land dealings. Chinese deal with Mozambique worth US $ 800 m and Philippines (1.24 m ha) were terminated due to the local resistance over legal validity and dumping of Chinese agricultural workers (Fan *et al.,* 2010). In Madagascar a deal of South Korean company Daewoo Logistics, acquiring land of about 1.3 million hectares (50% of total arable land) was cancelled due to political conflict (Anonymous, 2008).

India in Farm Outsourcing

Population of India is burgeoning and has reached 1.21 billion (Anonymous, 2011). This has increased the pressure on land with the due increase in the demand for food grains (Kumar *et al.,* 2012). The changing lifestyle of Indians is also resulting in significant changes in dietary pattern. The stress is moving away from staple food grains to horticultural and animal products (Kumar and Dey, 2007 and Mittal, 2007). The recent trend in production is incapable of meeting the future needs through domestic production (Kumar *et al.*, 2009). India is facing a big deficit of pulses, vegetables oil and sugarcane making it vulnerable to global market shocks. The projected supply-demand gap shows a huge deficit in total cereals, pulses, edible oil and sugar cane (Mittal, 2006). India is also the largest buyer of pulse (15 percent of total global trade) and is dependent on import for nearly half of its edible oil needs (Chand *et al.*, 2004). India vegetable oil rose 17 percent from 2009-10 to $ 6.6 billion in 2010-11. The decrease in import from 3.51 million tonnes in 2009-10 to 2.69 million tonnes in 2010-11 will be reversed in this year because of adverse climate and rising demand of food commodities (Kumar *et al.,* 2012).

The Government of India has decided to extend institutional and sovereign support to India Inc's acquisition of farmland abroad. This acquisition would guarantee buyback of harvested produces from the target country. India is not a major outsourcer but a prospective one. The Government is planning to setup a food processing cluster in Africa covering 4-5 countries with investment worth ` 120 crores (Tiwari and Tiwari, 2012). There are roughly about 70 Indian companies already in process of investment in African continent. Over a dozen of Indian companies are investing more than $4 billion in Ethiopia alone to produce sugar, tea and other crops (Kapur, 2009). The countries offering opportunities include Ethiopia, Malawi, Kenya, Uganda, Liberia, Ghana, Congo and Rwanda (Dattagupta and Ghosal, 2010).

Africa is a potential destination of investment with large tracts of land for potential cultivation of wheat and pulses (Bresigner, 2010). South America could be a favourite destination for producing vegetable oil as their contribution of share to global vegetable oil production is high (Anonymous, 2012). African nations due to their proximity, South American nations due to their better cultural compatibility and trade relations, and Asian nations due to their agro-climatic similarity can be alternative options of investment.

CONCLUSIONS

Farm outsourcing can ensure food security for countries like India. It can also provide required infrastructure, better livelihood and initiate development in the target countries. However, this large scale investment does involve greater risks. These threats and risks can be reduced by formulating a win-win strategy for both local communities and foreign investors, increasing the transparency of negotiation, respecting the customary land rights of the people, rehabilitating and compensating the people, sharing profits with the local people, conducting careful environment assessment and ensuring sustainable agricultural practices. There is a greater significance of conducting a careful environmental assessment ensuring sustainable agricultural practices. Strong collective action by institutionalization of small holders can empower them in negotiation and hence, protect their livelihood. Involvement of civil societies and local communities is required to reduce threat and realize the benefits. Indian agro-industry can also be benefited from outsourcing. Mutual sharing of knowledge and resources can improve agricultural productivity, food security and ensure future global price stability.

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Review Article

CAUSES AND CONSEQUENCES OF DOWRY IN INDIAN SOCIETY-AN OVERVIEW

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ABSTRACT

The recorded history and available sources indicate that prevalence of dowry is a century old phenomenon in Indian Society. Basically, the phenomenon of dowry was considered little help in starting new life of the married couple and was also sanctioned by religious and cultural ethos. This traditional practice of dowry has now turned into an evil form with many fold negative consequences in the society. One of the major negative consequences of dowry in the present time has been the rising number of dowry deaths and cruelty by the husbands and their family. The Fear of dowry has given rise to the phenomenon of female foeticide and domestic violence in Indian society. Keeping in view the alarming situation of increasing dowry, various anti-dowry associations are coming forward but there is need of educating youth and enforcement of strict laws against give and take of dowry.

Key words: Dowry, society, female foeticide, domestic violence, cultural ethos

INTRODUCTION

The practice of dowry is a century old phenomenon, however overtime it has taken an evil form. Dowry means any property or valuable security given or agreed to be given either directly or indirectly (Indian Penal Code).The demand of dowry in the society is being felt so immensely that it has become part and parcel of our social customs. In the contemporary society a lot of household items as well as luxurious items are given at the time of marriage (Bhave, 2007). Many studies indicate that dowry is one of the prime causes of declining sex ratio in the Indian society. The number of females in comparison to males is declining with its multifold negative consequences. Sever (2001) attempted to rank the 32 Indian states on basis of dowry deaths. The state of Punjab was put on the 9th rank while the worst one was Haryana

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and least dowry death prone state was Meghalaya. According to the National Crime Report Bureau there was 14.8 percent increase in dowry deaths from 2001 to 2009(Anonymous, 2011). Till 1970, dowry was at a slow pace elevation but after the emergence of Green Revolution, this phenomenon has risen up sharply. Increased income in the rural sector during this period, emergence of consumerism, cultural values, improved status of education, arrival of mass media, etc. played an important role to enhance the phenomenon of giving and taking dowry at quite a higher level and in some cases dowry has reached at the alarming stage to solemnize the matrimonial alliances (Coulter, 2009).The custom of dowry affects the lives of unmarried girls as they are being considered as economic liability. The people who cannot afford dowry particularly the lower section are the sufferers of this practice. Due to the increased indebtedness because of the burden of dowry many suicides are reported in India in the recent past (Sharma, 2011). Keeping this view, the present study was undertaken with the following objectives:

i. to know the reasons associated with dowry and
ii. to study the consequences of dowry in Indian society

METHODOLOGY

The discussion in the paper is based on the secondary data. The prime purpose of the paper was to highlight the causes and consequences of dowry deaths. For this purpose data from available secondary sources were used for analysis. Also old manuscripts, books, journals, printed material and other related studies were used to arrive at conclusions. The data were analysed and compared by using simple descriptive statistics.

RESULTS AND DISCUSSION

The results so obtained are discussed under different sub-headings as:

Religious/Mythological Reasons: Various myths as well as religious reasons are seen behind the phenomenon of dowry. Some historians justify the tradition of dowry to *Kanyadana* concept along with the basis of *Stridhana*. The *Kanyadaan* means giving '*dana*' to the bride which held the belief that the gifts are given so as to achieve high spiritual and cultural recognition. *Kanyadana* was initially done by the father of bride as giving daughter as a gift to the groom. In the Patriarchal System, marriage was not just a simple structure but various kinds of rights and rituals have to be performed by the bride's side and the brides were given various gifts in the form of dowry. There were three practices done by the upper caste people in India namely

Kanyadana, *Varadakshina* and *Stridhana* which also supports dowry. According to Manu Smiti gifts to virgin bride was called *Kanyadana*, whereas voluntary gifts given by the bride's father to the groom was conceived as *Varadakshina* and voluntary gifts given by the relatives and others to the bride was *Stridhana.*

Economic Reasons: It is the prime factor because when newlywed couple starts life, the parents give dowry to their daughters so that they could set up their life with an ease. It is revealed that the parents give dowry in form of compensation of the share of property (Chaterjee, 1992). Also groom's parents take dowry with a great pride as they feel it as compensation of upbringing and educating their sons. Furthermore, dowry is also meant for re-allocation of wealth from the brides' to the grooms. It may seem ironic yet even economically independent women have to not only live with dowry but also with the consequences of not bringing enough dowry (Anonymous, 2012). Another idea pertaining to dowry is compensation to the women being non-productive member of the family. In addition to this in some societies, dowry claims for the welfare of women if the marriage dissolves (Goody, 1976). In addition to this dowry has become an easy way of bettering one's economic position of acquiring material goods.

Social Reasons: The typical Indian Society is considered as very rigid and orthodox. In social framework, woman was considered quite low in comparison to men. That may be one of the causes that position of women went down in India. In olden times, girls used to get married at early age and if girls not married till a reasonable age (18-22) years then parents used to give more dowry (Edlund, 2000). The Marriage is a kind of business in which boys and girls are sold in the name of customs and traditions. Also, if a girl lacks beauty or is physically handicapped, etc. chances of more dowries was there. Furthermore, in the cases when the women get divorced or widow, the dowry provided to her may help her as economic support and she would not have to turn up to her parents for economic support.

Psychological Reasons: Showing superiority on the others has been a human nature and it remained a part of human life. It is human psychology to show off. Slowly and steadily show off also turned as one of the reason for perpetuation of dowry. In rich families, brides try to bring more and more dowries in order to impress in- laws family (Afzal, 2002). A new culture of impressing other by show off and display of expensive cars, jewellery etc. has given emergence to dowry (Dhillon, 2001). In addition to this many other factors such as enhancing status by providing more dowry, getting suitable matches from rich strata, showing off good financial position are important factors giving rise to dowry (Mandelbaum, 1978). Also people cannot afford the luxurious which they see in advertisements. So they see dowry as an avenue to fulfillment of their dreams (Negi, 1997). It is reticulate that illiterate boys are being offered cars and other valuable things at time of marriage. Also grooms justify taking dowry as they do not want to see their parents angry (Afzal, 2002).

Cultural factors: Conceptually, culture refers to the composition of material as well as non-material things which can be transferred from one generation to another. Overtime, the practice of dowry has taken the cultural form and hence it is becoming a part of culture in Indian Society. A lot of studies indicate that dowry has turned into a practice and its continuity may fuel the existing social problems like female feoticide and bride burning etc. (Rao, 1993).

Means of Spending Money: Dowry is considered to be one of the ways in which ill-gotten wealth and black money is spent. Spending a large amount of money on marriages and giving huge dowry is practiced by rich classes. But, now it is increasing and is common among all social groups. It is seen that very large expenditures are made on housing, feeding, entertainment and gifting a large number of family members and other guests (Rao, 2000). Also paying dowry at their daughter's marriage is an investment for fetching high dowry through their son's marriage. Girls too think it is their right to take dowry. Another feeling among mother-in-law is also that when she herself brought dowry from her house at time of marriage, why she shouldn't take it for her sons (Bandhu, 2002).

Caste System: It is an important factor in which the upper caste people want to show superiority and started offering valuable things at the marriage of their daughters. Arranged marriage is a caste based commercial transaction in which the caste and the economic status of the groom and the bride form the basis for this contract. Also it has become mandatory in Hindu tradition to spend a huge amount of money on marriages (Sharma, 2000).

Assurance of Secure Future: Many scholars revealed that dowry formed as the basis of assurance of secure future for the daughter once she is married off. In an effort to secure the future of their daughter by way of giving dowry people spend more and more (Sharma, 2000). Also the treatment of daughter-in-law depends very much on the quantum of dowry the brides bring along with her (Anderson, 2001).

Property Rights: Property rights are also one of the major factors for providing dowry. In many cases sons do not want to share their property with their sisters so dowry is given as a share in form of dowry (Sheel, 1999). It became a norm of passing down of movable property to the daughters.

Consequences: Though the dowry used to be considered as one of the facilitator to establish new life and for the security to the girl yet, it has generated various kinds of social and economic problems. It has given rise to show-off culture which encourages wasteful expenditure in the society. It has given rise to various to problems which are a matter of concern and have been discussed under various sub headings**:**

Dowry Deaths: Dowry death is one of the most heinous crimes against the women. The figures of alleged dowry death cases are spiraling and ever increasing to the extent that one woman in India is killed for dowry every 10 minutes. The reported dowry deaths in the country jumped from about 6995 in 2000 to 8391in 2010 as per the National Crime Records Bureau Statistics. In Punjabi society, this phenomenon of dowry has turned into a problematic issue requiring serious attention. In Punjab, dowry death figures rose from 55 in 1986 to 264 in 2008. The incidence of dowry deaths was found to be higher in rural than urban areas, perhaps due to free availability of pesticides in rural households. The rural areas accounted for 71 per cent of the total dowry deaths (Anonymous, 2004). As about geographical prevalence of the dowry, Doaba, Punjab's NRI belt, with 19.6 per cent of its population, accounts for 33 per cent dowry deaths in the state (Kaur, 2008).

Table1: Dowry Deaths in India from 2000 to 2010

Year	Dowry Deaths	Percent increase over the preceding year
2000	6995	-
2001	6851	-2.06
2002	6822	-0.42
2003	6208	-9.00
2004	7026	13.17
2005	6787	-3.40
2006	7618	12.24
2007	7791	2.27
2008	8093	3.88
2009	8194	1.25
2010	8391	2.40

Source: National Crime Record Bureau, 2011 and The Tribune, 4 May 2012.

The results revealed that up to the year 2003 there was a decline in dowry death over the preceding years but in 2004 there was quantum increase 13.17 percent in the dowry death over 2003. There was decline of 3.40 percent death due to dowry in 2005 over 2004. It was disturbing to note that from year 2006 onwards there was a continuous increase in percent of death recorded in preceding years.

Female Foeticide: Skewed sex ratio and female foeticide and domestic violence are highly inter-connected with the phenomenon of dowry.Srinivasan (2005) reported that the expectation of a large dowry payment tops the list of causes for the undesirability of daughters. It is generally, believed that people started killing of daughters in the wombs for fearing of marriages of the daughters due to high demands of groom's family coupled with other socio and psychological pressures.

Thus, the institution of marriage has been on the stage of deteriorating and is taking shape of "demands" that are to be fulfilled by bride's family. As most of the parents feel girls as burden, they go for sex-determination and thus, female-foeticide is becoming very popular in India (Negi, 1997).

Economic Consequences: The rural sector of Punjab has been witnessing sharp increase of spending on dowry. The demonstration effect has engulfed all sections and communities in the vicious circle of 'increased dowry'. The marriages which used to be simple and sacred affair are being done in extravagant marriage palaces. As a result of this, high level spending on daughter's marriage, many people are reported becoming heavily indebted. Some of the persons are even committing suicides due to non-repayment of loan. Besides, the indebtedness due to marriage, numerous incidents of bride burning, harassment, physical torture of young brides have been reported as routine matter. A recent field survey by the Institute of Development and Communication (IDC) revealed that 259 cases were reported, a staggering 27,649 cases of dowry harassment were not on the record in 2009. Only 5 per cent of dowry related cases were legally reported and pursued whereas lot of cases goes unregistered.

Domestic Violence: When the demands of dowry are not fulfilled the husband often beat up his wife and thus domestic violence occurs and sometimes takes a very bad shape leading to many suicides by girls. Furthermore, their husband often abandons women if dowry amount is not appropriate as demanded (Kumari, 1989). To be a single woman in India with child is seen to be a social stigma which is worse than death. Domestic violence has a very negative effect on lives of growing children especially girls who get haunted by the name of marriage when they see their parents fighting in a bad manner (Sharma, 2003).

Various Measures to be taken

The data pertaining to the dowry and its related issue such as dowry deaths, cruelty by husband and psychological suppression of various types lead to ponder upon the issue seriously and concrete steps should be taken to check the practice of dowry. There is a need to bring more strict law by the State to punish the guilty in dowry cases. However, overtime it is felt that the social mechanisms are more useful to check this practice rather than the written law which are many a times violated by the offenders. In this regard, a report concludes that whatever may be the dynamics at play, be it man being more than the women, dowry needs to be eradicated from our socio-cultural milieu. Instead of toning down the dowry law as the Law Commission has favoured, we need laws that address the social mechanism through which dowry has perpetuated itself over decades (Anonymous, 2012).

CONCLUSIONS

Based on the above discussion it can be inferred that the dowry was meant to assist the newly-wed couple to start their new life. Earlier the people used to give dowry in the form of cows, land, jewellery or household gifts. There are various myths and religious reasons associated with emergence of dowry as it was essential form of "Kanyadaan". Giving and taking dowry has become a part and parcel of our society. It serves as the basis in form of compensation of the share of property; upbringing and educating sons are also some of the reasons associated with dowry. The social reasons (low status of women, early marriage etc.), psychological reasons (impressing others, modernization etc.), cultural factors , means of spending money, caste system, assurance of secure future and property rights are also the reasons associated with dowry. A new culture called as a "show off culture" has been emerged. People also try to impress others by giving more dowry. Now the dowry has taken an ill-form. Grooms as well as their families demand dowry and when the demands are not fulfilled then there are harmful consequences. The dowry deaths and dowry harassment cases are increasingly on rise. So keeping in view various anti dowry associations are coming forward. There is a need for youth to come forward and also strict legislations should be made so that dowry could be abolished from the society.

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Review Article

CASH OR GRAIN TRANSFER: THE WAY AHEAD

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ABSTRACT

The present paper is an attempt to study the performance of public distribution system (PDS) and look for a feasible alternative to it. There is failure of targeting below poverty line (BPL) approach in PDS still we failed to de-link National Food Security Bill (NFSB) from BPL targeting. There are problems related to identification and exclusion errors in BPL targeting. The NFSB gives power to the government to provide food security allowance in cash instead of kind. In the present Indian scenario, cash transfers and food coupons, as alternative to PDS seem difficult to administer. This is because banks and markets places are away from villages and moreover people prefer PDS to cash. Keeping in view the problems associated with identification of BPL families and impracticability involved in immediate widening of banking network required for cash transfer, the efficiently working PDS seems to be the only way ahead.

Key Words: PDS, Cash transfer, Food Security, BPL, NFSB

INTRODUCTION

The National Advisory Council (NAC) has given final proposal on National Food Security Act. It has recommended subsidized foodgrains to 75 per cent of the total population of the country covering 90 per cent of the rural and 50 per cent of the urban population. This is further divided into two categories, a priority group comprising 46 per cent of rural and 28 per centof urban population will get 35 kg of foodgrains per household and a general group 44 per centof rural and 22 per centof urban population, who are to get 20 kg of foodgrains at half of the minimum support price (MSP).

The National Food Security Bill (NFSB) diluted the NAC suggestions on Public Distribution System (PDS). The NAC suggested 90 percent coverage of rural

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population, while government reduced it to 75 percent. The general category would get 3 kg grains per head while the NAC suggested 4 kg per head. The NFSB also advocated that general category would get foodgrains at the half of MSP means more than BPL and APL prices.

This Bill gives power to government to provide food security allowance in cash instead of kind. Thus, it shows that the government wants to replace PDS with cash transfer. This is an attack on the food security of the country which will not only affect food security of the households but also will adversely affect production, procurement and storage system in the country. A case for cash transfer is given by the moderate success of old age pension (6 Million) and widow pension, (3 Million) schemes. The leakages are moderate in social pension schemes (Dutta *et al*., 2010). It may be due to small number of recipients and payments involved are small. Once the pensioner names are in the list it is difficult to diverse the fund. But the experience of Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) in cash transfer is quite disappointing. The cash transfer system has not been found effective in India.

The grouping of the population in different categories like priority (BPL), General (APL) may be difficult to administer in practice. There is also failure of targeting BPL approach in PDS still Ministry of Food failed to delink, NFSB from BPL targeting. The problems related to identification and exclusion errors in BPL targeting are well known. NAC has also withdrawn its earlier proposal of universal PDS (UPDS) in poorest district (no experiment also). The Rangarajan Committee to evaluate NAC proposal has also suggested food security only for the priority group and extending it to other if possible.

What India need is to strengthen the PDS through universalisation and reforms to ensure minimum leakages and efficient distribution. The present paper is an attempt to highlight the failure of targeted PDS (TPDS) and suggest a UPDS instead of cash transfer as the only option for country's food security.

The Problems of Targeted Public Distribution System

The shift to TPDS in 1997 was based on the finding of studies conducted by Ahluwalia (1993), Parikh (1994) and Anonymous (1996) which showed that UPDS was inefficient and did not reach the poor. A study Radhakrishnan (1996) has revealed that under the PDS, the cost of transferring one ` of income to the poor was `5.37. It has been reported by Parekh (1994) that for every rupee spent less than `0.22 reached the poor. According to Ahluwalia (1993) another problem with the PDS is the amount of leakages of foodgrains and other commodities in the form of losses in transport and storage and diversion of it to the free market. A little more than a third of the foodgrains and half of the edible oil, 38 per cent of wheat, 36 per cent of rice, 39 per cent of sugar and 55 per cent of edible oil does not reach the actual users of PDS. The major part of the leakages was due to diversion of food grains to the open market.

Later on the studies of last decade have shown that targeting BPL approach in PDS which was introduced in 1997 did no better and in reality increased inefficiency and leakages in PDS. The high level committee appointed by Ministry of Food and Consumer Affairs (2002) recommended that government should return to the UPDS. The committee found that the TPDS was a failure. According to Planning Commission consumption of grains from PDS shops was only 46 per cent of the grains supplied to them in 2004-05, down from 72 per cent in last decade. It showed that more than 50 per cent foodgrains were diverted to open market. The Planning Commission (2008) was of the opinion that the leakages from the PDS has doubled after adoption of TPDS. It also showed that more than half (54 per cent) of the grain taken off for the TPDS disappeared before it reached buyers in fair price shops (FPS). Later on leakages from Public Distribution System (TPDS) declined to 47 percent (Khera, 2011 and Himanshu and Sen, 2011).

The National Sample Survey (NSS) data for the year 1993-94 and 2004-05 on consumption expenditure shows that in 1993-94 leakages in rice was 19 per cent which increased to 40 per cent in 2004-05 and for wheat it went up from 41 per cent to 73 per cent. The per capita per month consumption of PDS rice and wheat remained unchanged although PDS off take doubled and subsidy increased even more during 1993-94 to 2004-05 (Himanshu and Sen, 2011). For the bottom 50 percent people the PDS access has improved marginally during the period 1993-94 to 2004-05 from 28 to 30 per cent respectively.

A study by Svedberg (2012) showed that each ` transferred to poor households through the TPDS, the Government of India had a budget expenditure of ` 9, the said figure is ` 3.65 given by Planning Commission (2008). The study found that almost two-thirds of the poor households were not covered by TPDS and 62 per cent of all BPL and Antyodaya Anna Yojna (AAY) cards were in the hands of non-poor households. This suggests a large systemic inclusion and exclusion errors in TPDS.

Another study by Dutta and Ramaswami (2001) about efficiency of PDS in Andhra Pradesh and Maharashtra has found that about 5 percent of households in Andhra Pradesh are beneficiaries of the PDS and the corresponding figure for Maharashtra was 33 percent. It was noticed that 30 percent of the poor were excluded due to an incomplete coverage in Maharashtra. This is not the case in Andhra Pradesh as PDS is universal. Due to UPDS, more people have benefited from PDS in Andhra Pradesh.

The 64th NSS Round of 2007-08 showed that more than 50 per cent households purchased foodgrains from PDS in Andhra Pradesh, Himachal Pradesh, Kerala and Tamil Nadu where universal PDS (UPDS) was in vogue. The poor states like Assam, Bihar, Jharkhand and Uttar Pradesh which continued with TPDS reported low PDS purchase and high leakages. The state of Chhattisgarh with near UPDS and other reforms has achieved high PDS access and reduced leakage to zero in 2007-08. None of low leakage states have adopted the identification methodology of the BPL Census 2002 or the Planning Commission BPL cut off. The recent revival of PDS in India is attributed to extension of TPDS to near UPDS (Khera, 2011).

The above discussion clearly evinced that TPDS has failed to deliver the food subsidy to the poor. It had problems of targeting like unfair exclusion, unjustified inclusion and considerable leakages in PDS. As such the TPDS has failed to deliver food subsidy to the poor. Similarly the objective of the TPDS was to increase access to poor but it has also failed to achieve this end. India needs to strengthen the PDS through universalisation and reforms to ensure minimum leakages and efficient distribution.

Why Not Cash Transfer?

The right to food is basic economic and social right to achieve economic democracy in India. This will lead to achieve the real socio-economic development of the Nation. The proposed National Food Security Act seems to curtail the government expenditure to feed PDS. As draft suggests UPDS is not financially viable, TPDS is what government is planning to go ahead with. But food security means a right to food, and rights cannot be targeted, they have to be universal. Having every household 35 kg of cereals every month would cost ` 25,000 crores more of the present expenditure on PDS (Bannerjee, 2011). So it is not justifiable to go for TPDS instead of UPDS on cost consideration.

The cash transfer will also be targeted to BPL people so the problems of targeting like unfair exclusion, unjustified inclusion, administrative loss, possibilities of leakage in PDS can be seen in cash transfer as well. The failure of TPDS had lead the policy makers to think about food coupons or cash transfer in the BPL household's saving bank account (Kotwal *et al.,* 2011). The policy of cash transfer in some countries of the world is used along with provision of kind subsidy. Foodgrains subsidy protects poor consumers from rising prices. In India just by cash transfer to poor we cannot achieve the food security.

The studies on cash and kind transfer programs showed that people do prefer cash to grain transfer. A study by International Food and Research Institute (IFPRI) comparing various cash and kind transfer programmes in Bangladesh found that the poor people prefer payment in kind while rich prefer cash payment (Ahmed, 2009). The study of Delhi slums also revealed that slum women preferred receiving food rations rather than cash transfers or food coupons for specific value. Poor people are worried about the food inflation, so they prefer foodgrains to cash (Parsai, 2011). In Brazil and Mexico cash transfer programs are attached with other public services like education, health, etc. which have expanded with time. Brazil spends eight per cent of Gross Domestic Product on health services (Soares *et al.,* 2007).

The studies have also found the possibility of misuse of cash by male members of the family in the purchase of non-food items including liquor. The cash transfer to women of the households will not solve the problem due to the domination of men in decision making in India. Moreover, due to inaccessibility of poor to the market will also adversely affect the procurement of foodgrains. At the same time the experience of the MNREGS of cash transfer was quite disappointing.

Those who are in favour of cash transfers to food subsidies also recommend the use of technology for this purpose. They want the use of Unique Identification Card (UID) for the cash transfer. It is observed that the problem of inclusion and exclusion persist in the implementation of this programme. It is difficult at this stage to believe the success of UID scheme in India for cash transfer programme will be successful at this stage. It may also be difficult task to widen and deepen of the banking network system at this stage for cash transfer pertaining to PDS.

CONCLUSIONS

In the present Indian scenario cash transfers alternative to PDS look difficult. If the role of government is minimized in the procurement and storage of foodgrains than it can adversely affect the food security of the country. Unsuccessful working of TPDS has led policy makers to think about food coupons or cash transfer for the BPL household’s saving bank account. It has been found that people do prefer PDS to cash. This is because of increase in prices of food commodities, inaccessibility to banks and food markets. Moreover, the cash receipts are also diverted for the purchase of non-food commodities such as liquor. If the role of government is minimized in the procurement and storage of foodgrains than it can adversely affect the food security of the country. This calls for a universal and efficient PDS instead of targeted PDS. ThePDS infrastructure is already available and with some reforms it can ensure a complete food security. Although, the cash transfers will help the consumers to buy local staple food of their choice but food coupons or cash transfer will require an expansion of network of banking system in the rural areas for its objective implementation and it will be difficult task to widen at this stage. Also identifying poor in India is a difficult task as different committees have given different number of poor's varying from twenty-seven per cent to seventy per cent. The universalisation and efficient working of PDS to achieve food security instead of cash transfer is seems to be better alternative in India.

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Research Note

SHIFT IN CROPPING PATTERN VIS-À-VIS STRESS ON WATER RESOURCES IN PUNJAB

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ABSTRACT

The study aims to analyze emerging stress on water resources related to shift in cropping pattern in Punjab. Both primary as well as secondary data sources have been tapped to achieve the stipulated objectives. The results revealed that due to assured prices and public procurement the area under paddy, a non-traditional crop has increased. Continuation of the monoculture in cropping pattern over the last four decades has put severe pressure on the water resources of the state. The annual average rainfall in Punjab has shown a declining trend along with a decrease in the use of canal irrigation resulting intoincreased pressure on groundwater resources. This has necessitated theincreased investment on deepening of wells and installation of submersible pumps thereby increasing the debt burden on the farming community as financial requirements in majority of cases were met through borrowings.

Key words: Cropping pattern, water stress, investment

INTRODUCTION

Water is the basis of all life on planet Earth. Though, there is no dearth of water here, but utilizable water is limited in quantity. In India it has been calculated at 1086 billion cubic meters (BCM) in 2010, whereas total water demand has been put at 813 BCM. Eighty five per cent of total demand is comprised of irrigation purpose highlighting the importance of water in agriculture.

Punjab state has been on the forefront by contributing a major share of food grains (rice and wheat) to the Central Pool since the inception of Green Revolution technologies. Stress laid by policy makers on increased domestic production to cater to present requirements as well as creating buffer stocks is a strategy of self-sufficiency (Bajwa, 2002). The concept of 'food security' involves the linkage between population growth and food production and the need to evolve measures to satisfy the ever growing food needs. The study aims to delve into issues related to

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production of basic food grains, Punjab's contribution to central pool and emerging stress on water resources related to paddy cultivation in the state. The specific objectives of the study were:

i. to examine the shift in cropping pattern leading to growth of paddy cultivation in Punjab,
ii. to analyze the source-wise irrigation status and exploitation of ground water resources in Punjab and
iii. to examine the extent of investment on irrigation structures in the state.

METHODOLOGY

The time series data pertaining to area under different crops, area irrigated by various sources in Punjab, average annual rainfall and number of tubewells has been taken from various issues of Statistical Abstracts of Punjab. Information pertaining to water demand in different seasons has been derived from Reports of Punjab Environment 2007 and Central Water Commission. The primary data have been collected regarding investment pattern in irrigation sources. A multistage random sampling technique was followed for the sample selection. Four districts namely, Hoshiarpur, Ludhiana, Kapurthala and Bathinda were randomly chosen from the state. These districts are one each from Kandi belt and south-western districts (cotton belt) and two from the central plain zone being large in area. Then two blocks were selected from each district and further two villages from each selected block randomly. In all, 320 households were selected from sample of 16 villages. The sampled farmers were categorized into five national farm categories on the basis of operational holdings. Simple statistical techniques were used to analyse the data.

RESULTS AND DISCUSSIONS

Punjab has emerged as 'grain basket' of India in post Green Revolution era. However, this has pushed the diversified agriculture of Punjab towards the state of mono-culture. A clear shift has been witnessed in cropping pattern and in favour of cereal crops at the cost of oilseeds, sugarcane, pulses, etc. The perusal of Table 1 showed that, area under cereal crops has increased from 45.65 percent in 1960-61 to 81.31 per cent in 2008-09 of GCA. Wheat has shown an increase of fifteen per cent, whereas paddy increased by thirty per cent during this period. On the other hand proportionate area under pulses declined from 19.08 per cent to a mere 0.27 per cent under the span. This shift can be attributed to the agricultural and procurement policies of governments at the center as well as at the state level.

Table 1: Shift in cropping pattern in Punjab, 1960-61 through 2009-10

(% area)

Year	Food grains	Cereals	Wheat	Rice	Cotton	Oilseeds	Sugarcane	Pulses
1960-61	64.73	45.65	29.59	4.80	9.45	3.91	2.81	19.08
1970-71	69.18	61.89	40.49	6.87	6.99	5.20	2.25	7.29
1980-81	77.77	66.76	41.57	17.49	9.60	3.52	1.05	5.04
1990-91	75.55	73.65	43.63	26.86	9.34	1.39	1.35	1.91
2000-01	79.04	78.36	42.92	34.81	5.96	1.08	1.52	0.68
2005-06	80.27	79.89	44.07	33.58	7.07	1.04	1.06	0.38
2008-09	81.58	81.31	44.56	34.56	6.66	0.75	1.02	0.27

Source: Statistical Abstracts of Punjab, various issues

A steady increase in minimum support price (MSP) of wheat and paddy, especially during 1990's and assured procurement of these crops by the government has led to shift in cropping pattern. No other crop rotation has competed with this rotation, as the net returns being highest in paddy- potato- wheat (` 49739 per acre) as compared to maize-potato-wheat (`35549 per acre) and maize-wheat-summer moong (` 34480 per acre). The MSP of wheat and rice has increased from ` 280 to ` 1120 per quintal and ` 230 to ` 1150 per quintal in 2010-11 as against 1991-92.

This growth in area under cereal crops along with higher yields has proved to be a boon for India's food security. Punjab has been on the forefront by contributing a major share of food grains (wheat and rice) to the Central Pool. The perusal of Table 2 shows that the state has contributed 42.2 and 29.5 per cent of wheat and rice towards central pool in 2009-10. It is also clear that our absolute contribution has increased over time, though our relative share has declined. This has happened due to increased production of wheat and paddy in other states which also spare some quantity for the Central Pool.

Table 2: Contribution of wheat and rice to Central Pool

(Lakh tonnes)

Year	Wheat		Rice	
	Contribution to Central Pool	Percentage Share	Contribution to Central Pool	Percentag e Share
1980-81	42.8	73.0	25.2	45.3
1990-91	67.5	61.0	48.2	41.0
2000-01	94.2	57.6	69.4	33.3
2008-09	99.4	43.8	85.5	25.4
2009-10	-	42.2	-	29.5

Source: Statistical Abstracts of Punjab, various issues

Under the influence of market forces the area under paddy a non-traditional crop has shown an increase of about 600 per cent during the 1970-71 and 2009-10 and its production has increased by approximately 16 times during the same period. Paddy is an irrigation intensive cropespecially in transplanted condition in Punjab (Dhaliwal *et al.*, 1994). The water requirement of major crops cultivated in Punjab has been presented in Table 3. The recommended water requirement of paddy is 165 hectare meter with 22 irrigations, which is four times higher than that of wheat. Sugarcane is next high water intensive crop, but area under it has declined substantially due to problems of procurement and payment by the sugar mills.

Table 3: Water requirement of major crops cultivated in Punjab

Crop	Irrigations (No.)	Recommended water requirement (ham)
Paddy	22	165.0
Maize	4-6	37.5
Cotton	4-6	37.5
Wheat	5	37.5
Barley	1-2	15.0
Gram	1	7.5
Sugarcane: Planted	18	135.0
: Ratooned	10	75.0
Rapeseed and Mustard	1-2	15.0

Source: Report of Comprehensive Scheme of Studying Cost of Cultivation of Principal Crops in Punjab

Table 4: Source-wise irrigation status in Punjab

(000' ha)

Year	No. of tube wells(lakh)	Net Tubewell Irrigated Area	Net Canal Irrigated Area	Average Annual Rainfall(mm)
1970-71	1.92	1591	1286	672.3
1980-81	6.00	1939	1430	739.1
1990-91	8.00	2233	1660	754.6
2000-01	10.73	3074	962	391.9
2008-09	12.76	2950	1110	529.2

Source: Anonymous (1971 to 2010)

With the evolution of Green-Revolution technologies, the use of ground water has increased as a source of irrigation. As the new dwarf wheat varieties, along with the paddy in a transplanted condition, increased cropping intensity in the state, erratic pattern in the average annual rainfall and rather declining trend in it the last decade, declining canal irrigated area has put pressure on ground water resources. The number of tube wells as shown in Table 4 has increased by 6.5 times since 1970-71 and area irrigated with tube wells has almost doubled, whereas the net canal irrigated area has declined by 13.7 per cent. Though average annual rainfall has shown an inconsistent behaviour, but has depicted a decline of 21.3 per cent during the study period. It has been found that gross irrigated area under rice during this period has increased by 7.6 times. The water demand for irrigation during kharif season was 50.5 per cent of total water demand as compared to rabi season, where it was 31.3 per cent of total water demand.

Table 5: Extent of groundwater exploitation in Punjab, 1992-2009

Blocks Category	1992	1999	2005	2009
Over-exploited	63	73	104	107
Critical	7	11	5	5
Semi-critical	15	16	4	4
Safe	33	38	25	26
Total blocks (No.)	118	137	138	142

Source: Department of Soil Water Engineering, PAU, Ludhiana

In the wake of all these developments, ground water table in the state has been falling at an alarming rate. As quantity of surface water resources is limited and over time it has declined. This is adversely affected by the water intensive crop rotation followed which led to ground water exploitation in Punjab. The perusal of Table 5 reveals that the proportion of overexploited blocks in ground water use was 53 per cent in 1992, which has increased to 75 per cent in 2009. On the other hand, 28 per cent of state's blocks were in the safe category in 1992, which have declined to 18 per cent in 2009. According to State's Environment Report (2007) 10.5 million acres of cultivable land of state needs 5feet plus of water for a paddy/wheat crop by conventional flood irrigation method. Thus, state would require 55 million acre feet (MAF) of water. At present, Punjab has less than 25 MAF of water available from rivers and canals. Thus, faster extraction of ground water is the only alternative available for irrigation, resulting in over exploitation.

A grim situation of ground water depletion overtime has been reported by Kaur and Sidhu (2008). Between in 1982-87, fall in ground water level was 18 centimeters, but between 2002 and 2006 it declined to the extent of 75 centimeters (Kaur and Sidhu, 2008).

The popular policy of Government of providing free electricity for agriculture and intensive use of tube well irrigation in the wake of decreasing use of canal irrigation, erratic rainfall and higher temperature in pre-monsoon season leading to higher evapo-transpiration rate due to early transplanting of paddy has led to more withdrawal of ground water (Arora *et al.*,2008). Water decline was more in Central Zone of the state having 72 per cent of the total area under paddy. Here, ground water decline has been recorded in the range of 0.25 to 3.53 meters in 1999-2002 by Central Water Commission (CWC).

The falling ground water table is posing a serious threat to sustain the current level of agricultural production besides increasing the cost of cultivation in agriculture (Kaur, 2010). It has been found that ` 6455 per farm have been invested on deepening of wells to extract water from deeper layers. Similarly ` 32422 per farm have been invested on sinking submersible pumps during 2003-2008 (Table 7). This constituted 50.10 and 51.92 percent of borrowed funds for the purpose respectively.

Table 6: Investment on deepening of wells and submersible pumps in Punjab (2003-08)

(`farm^{-1})

Zone	Amount invested on deepening of wells	Invested as percentage of borrowed	Amount invested on submersible pumps	Invested as percentage of borrowed
Sub-mountainous(I)	2013	68.89	72813	39.38
Central Plain (II)	8041	38.05	26046	65.75
South-Western(III)	7753	70.15	4839	91.75
Punjab	6455	50.10	32422	51.92

The zone-wise analysis of investment on extraction of ground water shows that amount invested on deepening wells was highest in Zone-II (Central plain zone) having highest area under paddy cultivation and it is lowest in Zone-I which is Sub-mountainous Zone of the State with least area under paddy since 1970-71. However, with more blocks falling under semi critical or critical categories due to receding water table even in Zone-I the trend of installing submersible pumps is fast catching up. This resulted into maximum per farm investment on submersible pumps in Zone-I. However, amount invested on submersible pumps was lowest in Zone-III. Zone-III being South-western Zone having cotton and wheat as the prominent crops as well as, well laid out canal irrigation network has shown lower investment on private irrigation structures. Also, water being saline in this part of Punjab, is not considered fit for irrigation purposes. However, maximum investment for deepening of wells consisted approximately 70 per cent of the borrowed funds in Zone-III. The lowest share of borrowed amount was found in Zone-II during the study period. So far as investment on submersible pumps was concerned the share of credit was highest in Zone-II, though the amount invested was lowest and nearly 40 per cent of investment is through borrowed funds in Zone-I (Table 6).

CONCLUSIONS

Thus we can say that changes in the cropping pattern in the wake of new technologies adopted in state agriculture has led to higher production of wheat and rice crops, but at the same time has put great stress on underground water reservoirs also. Due to high water intensity of prevailing crop rotation, along with decline in canal irrigation as well as rainfall trends has increased the area irrigated with tubewells. Huge investments have been undertaken by the farmers on irrigation structures to extract water from deeper layers of the soil. The need is to take urgent measures to check this exploitation as the very existence of Punjab depends on abundance of water, the symbolic name it stands for. Already having a semi-arid climate, it is a water stressed region which suffers from periodic shortage of water that has serious consequences for its agriculture. In the wake of above findings it is suggested to strictly implement *Punjab Preservation of Sub Soil Water Act*. According to one estimate fall in the water level can be checked by 30 centimeters if paddy transplantation is on or after 15th June (Singh, 2009). Also a well laid out policy is required for diversified cropping pattern, discouraging mono-culture in the state. Concrete steps are needed in terms of assured prices and procurement of other crops. Also the provision of free electricity should be need based covering small and marginal farmers only to avoid misuse of ground water. A strong political will is required to turn the market forces in favour of other crops and taking some firm decisions to check the fragile ecological health of Punjab.

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Research Note

A STUDY INTO ECONOMICS OF FRESH WATER FISH CULTURE IN MANIPUR

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ABSTRACT

The present study was conducted to examine the costs and returns of fresh water fish culture in Manipur. In order to achieve the stipulated objective multi-stage sampling technique was adopted to draw a representative sample. The requisite data on costs and returns were collected through personal interview method using well-structured questionnaire. It has been found that the most essential component of variable cost were fingerling and labour. The lime, manure and fertilizer were also important constituents of variable cost. As such the farmers could generate more income from fish production if one uses quality seeds and skilled labour. The present analysis clearly revealed that there is vast scope to augment the fish production in Manipur which in turn will help to supplement and ensure regular flow of the income to the fish farmers.

Key words: Fish, fingerlings fixed costs, variable costs, income

INTRODUCTION

Fishery plays important role in economic development of Manipur. It contributes three percent to the gross domestic product (Anonymous, 2003) of the State. About 90 percent people in the state are fish eaters. Though, the state has no marine fishery, it has vast inland fishery resources like natural lakes, marshy areas, swampy areas, rivers, reservoirs, ponds, tanks, submerged cropped land, low lying paddy field, etc. The most appropriate soil/place for fish farming is clay loam in valley districts of Imphal East, Imphal West, Thoubal and Bishnupur. There were about, eight fish farmers' development agencies, 107 total fish farms, 18 government fish farms and 34,064 total fishermen in Manipur (Anonymous, 2007). The total fish production was 18.65 thousand tonnes in 2007-08. The per capita production of fish was 7.12 kg in 2007-08 as compared to the estimated per capita requirements at

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10.50 kg, with a shortfall of 3.38 kg per annum. The total requirement of fish far exceeds its indigenous production. The existence of gap between the demand and supply of fish yield a significant scope to increase the flow income to the fish farmers. However, large quantities of fishes are being imported from outside the state every year to fill this gap. This huge gap is to be met by harnessing the vast fishery resources of state by adopting advanced scientific techniques of fish culture and consolidating the available infrastructures already set up and by introducing new schemes and projects. This could enable to meet not only the requirement of fish in the state but also could export to neighbouring states like Assam, Nagaland, Mizoram, and even to the neighbouring country Myanmar. Besides, the fishing provides gainful employment to a large number of people in the state. It has been noticed that the fish farming has not been adopted on commercial lines by most of the fish farmers in the study area. The analysis of profitability of the fish culture will plug the lope holes in the production process. This will help to augment their income from fish farming with exiting resource usages. In the back drop of this the present study was carried out to estimate the cost and returns of fish production in Manipur.

METHODOLOGY

The state comprises of nine districts, of which five districts are hilly and four are plain. The fish farming is confined to all the districts but fish farmers are concentrated in the four districts of valley region. A multistage sampling technique was employed to select district, sub-divisions, villages and fish farmers. Out of the four plain districts, the Thoubal district was selected purposively for the study having the highest number of fish producers among the four districts. Above all, the district was one of the highest producers of fish among the four districts. The Thoubal district consists of three sub-divisions namely Thoubal, Lilong and Kakching. Keeping in view the concentration of fish producers four, ten and eleven villages were selected randomly from Thoubal, Lilong and Kakching sub-divisions respectively. The four farmers who cultivate fish were selected randomly from each of the samples village thus, forming a sample of 100 fish farmers. The farmers were then divided into two categories on the basis of fish stocked area. The Category-I comprised of the farmers having stocked area less than one hectare and Category-II consist of the farmers having stocked area more than and equal to one hectare. Accordingly, 41 and 59 farmers were selected from Category I and II respectively. The primary data pertaining to the expenditure on seed, lime, manure, fertilizers, hired labour, interest on working capital, land revenue, etc. were collected from respondents through personal interview for 2008-09.

Analysis of Data

Total fixed costs

The total fixed cost comprises sum of all fixed costs such as cost on imputed value of pond, water pumping set with accessories, farm equipment, implements, land revenue, interest on fixed capital.

Total variable costs

The total variable cost consist of sum of all variable cost such as cost on seed, lime, manure (cow dung, rice bran, oil cake), fertilizer (urea and single super phosphate), hired labour use, imputed value of family labour other working expenses (medicines), interest on working capital for 6 months at the rate of 12 percent per annum (Kahlon and Singh, 1992).

The cost concepts approach to farm costing is widely used in India. These cost concepts include Cost A_1, Cost A_2, Cost B and Cost C. Various costs have been worked out by applying following methods:

Cost A_1 = Includes the cost onvalue of hired human labour, hired machinery charges, value of fertilizers, value of manure, value of seed, value of lime, land revenue, depreciation on farm implements, interest on working capital for 6 months at the rate of 12 percent per annum, miscellaneous expenses (medicines)

Cost A_2 = Cost A_1+ Rent paid for leased in land

Cost B = Cost A_2+ imputed value of owned land (Less land Revenue paid thereupon) and Imputed interest on fixed capital (excluding land).

Cost C1 = Cost B1+ Imputed value of family labour

Returns at each cost level were worked by deducting the cost from the gross value of output, and profitability (benefit –cost ratio) for each category. The income concepts for farm revenue were used to find out the profitability in fish production.

Gross farm income/returns (GFI) = Gross value of output per year (adding together gross sales, home consumption of farm products, changes in inventory, and purchases).

Net farm income (NFI) = GFI-Total costs

Farm business income = GFI-Cost A_1

Family labour income = GFI-Cost B

Farm investment income = NFI + Interest on owned fixed capital + Rented value of owned land.

RESULTS AND DISCUSSIONS

Cost of Fish Production

The results presented in Table 1 revealed that average total cost per hectare of fish production was estimated to be ` 64540 of which the variable cost and fixed cost accounted for 82.01 and 17.98 per cent respectively. The sustainability and profitability could be increase by reducing cost per hectare for fish production. The perusal of the Table 1 brought out that the average total cost was to the extent of ` 71984 and ` 57094 on Category I and II farms respectively. This shows the economics of scale as per unit cost for larger farm was comparatively lower than the smaller farm.

The results indicate that the expenditure on hired labour, seed (fingerlings) and imputed value family were the most important components of variable cost which constituted 34.80, 23.55 and 17.00 per cent of the total cost respectively. Similar results were reported by Debnath *et al.* (2007) and Singh (2007). The main reason being the skilled labour and cheaper and quality seeds were not available at local level.

The fixed cost of fish production was worked out to be `13891 (19.30 per cent) and `9324 (16.33 per cent) per hectare for Category-I and II farms, respectively. The proportion of fixed cost to total cost being lower in Category-I compared to Category-II farms which implies the large farm used of fixed farm resources efficiently. On the other hand, the variable costs covered a major share of fish production which were estimated at ` 58094 (80.70 per cent) and ` 47770 (83.67 per cent) per hectare on Category-I and II, respectively. This indicates that the proportion of variable cost to total cost was higher in Category-II farms as compared to Category-I farms which implies that fish production costs was higher in Category-II farms utilizing more of variable inputs. However, a farm with fewer variable costs (and hence a larger number of fixed costs) may magnify potential profits (and losses) because revenue increases (or decreases) are applied to a more constant cost level. The results indicate that the total cost were inversely proportional to the pond size showing scale of economies (Chaudhary *et al.,* 2004).

It has therefore, been estimated that Category-I farm yield 15.68 quintal per hectare which was higher than the Category-II farm with the yield 10.52 quintal per hectare. While other states like Chhattisgarh per hectare productivity was 23 quintals (Jain and Pathak, 2004). In the categories, expenditure on seeds (fingerlings), cost on hired labour and imputed value of family labour have been found to be major variable cost. These constituted 30.67, 24.56 and 18.72 per cent respectively in Category-I farm. While in Category-II they constituted 14.56, 47.72 and 14.83 per cent respectively. It has been seen that the cost incurred on lime, manure, fertilizer, value of pond, irrigation charges and farm implements ranged between 0.16 to 7.31 per cent of the total cost of production across the categories of fish farms.

Table1: Costs of fish production for different categories of sample farms

(` ha^{-1})

Sr. No.	Items	Category-I	Category-II	Overall
1	Seed expenditure	22082 (30.67)	8313 (14.56)	15198 (23.55)
2	Lime expenditure	416 (0.58)	247 (0.43)	331 (0.51)
3	Manure expenditure	1605 (2.23)	701 (1.23)	1153 (1.79)
4	Fertilizer expenditure	116 (0.16)	167 (0.29)	142 (0.22)
5	Imputed value of family labour	13472 (18.72)	8469 (14.83)	10971 (17.00)
6	Hired labour expenses	17676 (24.56)	27248 (47.72)	22462 (34.80)
7	Other expenses	200 (0.28)	400 (0.70)	300.00 (0.46)
8	Interest on working capital	2526 (3.51)	2225 (3.90)	2375 (3.68)
I	**Total variable cost (1 to 8)**	**58094 (80.70)**	**47770 (83.67)**	**52932 (82.01)**
1	Imputed value of pond	5225 (7.26)	3507 (5.11)	4367 (6.77)
2	Water pumping set with accessories (irrigation charge)	4893 (6.80)	2915 (5.13)	3904 (6.05)
3	Farm equipment / implements	1223 (1.70)	1223 (2.14)	1223 (1.89)
4	Land revenue	62 (0.09)	62 (0.11)	62 (0.10)
5	Interest rate on fixed capital	2488 (3.46)	1618 (2.83)	2053 (3.18)
II	**Total fixed cost (1 to 5)**	**13891 (19.30)**	**9324 (16.33)**	**11607 (17.98)**
III	**Total cost (I to II)**	**71984 (100)**	**57094 (100)**	**64540 (100)**

Figures in parentheses are the percentage to the total cost

The results revealed that the hired labour charge, expenditure on seeds and imputed value of family labour were considered to be the most important cost items in fish production in the study area. Therefore, the fish production in the study area could be increase through proper fisheries management, increase availability of good quality and cost effective seeds and feeds at local level, increase availability of skilled labour, credit and support subsidy particularly in the creation of ponds, on purchase of feeds and extension support.

The perusal of Table 2 show that the cost of fish production on per hectare basis for different category at cost A_1 cost A_2, cost B, and cost C. On an average, the direct expenses out of explicit cost, Cost A_1 was estimated at `47,149.59 which was equal to Cost A_2 as there was no land under leased in and leased out.

Table 2: Break-up cost of cultivation of fish production

(` ha^{-1})

Items	Category-I	Category-II	Overall
Cost A_1	50798.81	43500.37	47149.59
Cost A_2	50798.81	43500.37	47149.59
Cost B	58551.98	48625.4	53588.69
Cost C	71984.45	57094.48	64539.47

Returns from Fish Production

The analysis of income depicts financial status of the sample farmers of the study area. The perusal of Table 3 shows that average gross farm income was estimated to be `81252 per hectare. The results revealed that gross farm income was found to be higher in Category-I farms than the Category-II farms. The gross farm income of Category-I farms was amounted to `84639 which was higher by 8.7 per cent than Category-II farms. The Net returns per hectare were estimated about 60.29 per cent higher in the case of Category-II farms as compared to Category-I farms. Thus, the net returns increases with the increase in size of the pond due to scale of economies. Farm business income was found to be higher in category-II farms by 1.56 per cent as compared to Category-I farms which indicates that the farmer income was higher for Category-II farms. The further analysis reveals that family labour income for the Category-II farms exceeded the Category-I farms by 11.03 per cent. The results revealed that farm investment income was higher in Category-II farms by 27.14 per cent than the Category-I farms. The net returns over variable cost were estimated to be ` 40018 in Category- I farms which was higher by 3.76 per cent than Category-II farms. This may be due to the poor management of the farm in absence of scientific and economic method of fish cultivation. The benefit-cost ratio based on cost A_1 and on total cost, on an average, was estimated to be 1.73 and

1.26 respectively. The benefit-cost ratio for category-I and category-II farms were 1.67, 1.19 and 1.78, 1.37 respectively which higher in case of Category-II than the Category-I. The higher profitability ratio for Category-II was due to low cost of production.Therefore, the analysis of benefit-cost ratio shows that Category-II farms seem to perform more efficiently than the Category-I farms. Thus, the fish farming is found to be profitable venture for the Category-II farms.

Table 3: Returns from fish production for different category of sample farms

(` ha^{-1})

Particulars	Category-I	Category-II	Overall
Gross farm income (GFI)	84639	77865	81252
Net farm income (NFI)	13177	21122	17149
Farm business income	33840	34365	34103
Family labour income	26649	29591	28120
Farm investment income	20368	25896	23132
Net returns over variable cost	40018	38564	39291
Benefit-cost ratio (cost A_1)	1.67	1.78	1.73
Benefit-cost ratio (cost C)	1.19	1.37	1.26

CONCLUSIONS

The results of the cost and returns structure analysis revealed that the most important component of variable cost were seeds and labour. The other vital components of variable cost were lime, manure and fertilizer. Therefore, the farmers could generate more income from fish production by increasing the expenditure on good quality seeds and efficient use of skilled labour in production process. The present analysis clearly revealed that there is vast scope to augment the fish production in Manipur which in turn will help to supplement and ensure regular flow of the income to the fish farmers.

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