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Resource Use Efficiency and Gross Returns from Food Grain Crops in the Low Hill Zone Economy of Himachal Pradesh

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Abstract **- Resource use efficiency in agriculture is defined to include the concepts of technical efficiency, allocative efficiency and environmental efficiency. Public investment, subsidies and credit for agriculture are used in an efficient manner. There are large scale inter regional as well as inter farm variations in factor productivity due to varying influence of different factors in different regions. A number of management factors such as timeliness and method of sowing, transplanting, irrigation and application of right doses of inputs and input mix play an important role in influencing inter-farm variation in crop productivity. Growing marginalization and fragmentation of land holdings coupled with rising incidence of informal tenancies and poor rural infrastructure such as road, electricity, markets and education affect factor productivity. The availability of good quality irrigation water coupled with flexibility of irrigation and drainage system and appropriate methods of application as well as pricing of irrigation water is crucial for sustainable use of land and water resources.**
Keywords: **Resource, Efficiency, Gross Returns, Food Grain Crops, Low Hill Zone Economy**

I. INTRODUCTION

Agriculture development play an important role in the economic development of our country as its populations increasing continuously which lead towards an expanding demand for the production of food grain. The increase in production of food grain is possible by expanding of area under cultivation by reclamation of waste lands or by increasing the productivity per unit of input. The expansion of area under the plough is not a simple task in order to increase the production of food grain and productivity remains unsettled without answering the questions, i.e. how to increase output per unit of output. The one way of reducing the problem of increasing food grain production is to examine how efficiently the farmers are using their resources. If there exists inefficiency in the use of resources hen food grain production can be increased by adopting optimum factor combination principle. In case, if there exist efficient use of resources, then only way out for meeting the objective would be the adoption of modern and improved farm technology of production.

The main aim of this paper is to evaluate the efficiency with which farmers in Himachal Pradesh use their resources in the cultivation of food grain crops and resultant returns where physical topography, hilly terrain and peculiar agro-climatic conditions mingled with small sized fragmented holdings, inadequate irrigation facilities in the state results low yield and thus poor crop income of the people. More specially, the objectives of the present paper are

1. To examine the profitability of selected food grain crops grown in Himachal Pradesh.
2. To find out the level of efficiency of the resources used and calculate the returns to scale in selected crops, and
3. To suggest measures to increase the food grain production and proper utilization of inputs in the study area.

II. DATA AND METHODOLOGY

In order to meet out the above objectives, the area of low-hill zone has been purposively selected for the present study on the basis of equal agro-climatic conditions, cropping patterns, having good production potential, fertile land, better road, transportation and communicational network etc. Besides, all the major food grain crops viz., maize, paddy and wheat all are grown here. There are nine districts in low hill zone of Himachal Pradesh. Out of these districts, one district i.e. Una is selected purposively which represents about 11 per cent of the sample at zone level. Una district is selected because all the major food grain crops are grown there. There are 5 blocks in district Una. Out of the 5 blocks, 2 blocks were selected i.e. Una and Gagret, with the help of multistage random sampling which constitute nearly 40 per cent sample at the block level. At the second stage, 3 Panchayats in each selected block were selected. At the third stage, 4 Villages in each selected Panchayat were selected. In addition to that, the selected farms have further been divided into three size-classes viz., marginal farmers (below 1.0 hectare), small farmers (1-2 hectares), and medium farmers having more than (2 hectares).

The data pertaining to the year 2013-14 were collected by survey method with the help of well structured schedule from 200 farms consisting of 90 marginal,70 small and 40 medium selected randomly on the basis of probability proportional to the number of farms in each size class. In order to examine the cost and net returns, the simple tabular analysis consisting of averages, percentages etc. was extensively employed. Again, to judge the resource use

efficiency, returns to scale and to indicate improvement in input utilization, the unrestricted form of Cobb-Douglas production function was fitted to the cross-section data and the choice of explanatory variables was restricted only to six. The resource use efficiency was tested by comparing marginal value productivity of resources to their respective factor costs. More precisely, the following equation is used in order to judge the resource use efficiency.

$$X=a.X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}$$

The production function can be transformed into log-linear form as

$$\text{Log } y = \log a + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6$$

Where,

Y= Gross value of output in respective crop (in Rs.)
X_1= Area under the respective crop (in hectares)
X_2= Human labour (in mandays)
X_3= Bullock labour+ Tractor hours (in Rs.)
X_4=Value of manures and fertilizers (in Rs.)
X_5= Value of Seeds (in Rs.)
X_6= Others* (in Rs.)
b_1 to b_6 = represents the elasticity coefficients of respective factor inputs.

III. LITERATURE REVIEW

A general review of the literature of the period shows that the researchers were very much interested in measuring resource use efficiency, returns to scale and crop profitability during the study period. The study conducted by G.R.Saini (1979) shows that farmers are quite rational in terms of their response to economic opportunities and to make adjustment in resource use. There is little scope to increase farm income under the given conditions. Similarly, Khan (1938) also arrived at the conclusion that small farmers are more efficient in respect of resource utilization. But a large number of studies pointed out that there is a vast scope for increasing the farm returns by reallocation of resources. It has also been suggested in some studies that there is wide-spread resource use inefficiency in respect of important factor input such as human labour, bullock labour and fertilizer used. The studies showing inefficiency in resource use are Sethuraman (1971), Gupta (1976), Chamak (1979), Sircar (1983), Dueby (1988), Bahadur (1988), Randev (1990), Singh & Sarawagi (1997), Nagra (1998) and Das (1999) are the main ones.

The addition of estimated elasticity of production reveals the nature and extent of returns to scale. Indian agriculture is generally ruled by constant returns to scale. The pioneering studies in this context are Singh (1975), Gupta (1976), Saini (1979), Khandekar and Bahadur (1988). However, there is no dearth of literature relating to increasing returns to scale. The studies made by Singh and Patel (1973), Sharma (1992), Thakur (1994), Sekar (2001) etc., on the basis of various explanations favours increasing returns to scale. Sharma (1989) conducted a study in Himachal Pradesh farming in respect of ginger crop reached at the conclusion that small farmers are bearing increasing returns to scale.

Vaidya (1993) also show that medium farmers are operating under increasing returns to scale. The study conducted by Sudha (1992), Raja (1992) showed decreasing returns to scale in Indian agriculture. Singh & Sarawagi (1997) also arrived at the same conclusion that marginal and small farmers were operating under decreasing returns to scale.

Similarly, Vaidya (1993), Shaw and Dave (2010), Gautam (2014), Satyasai and Premi (2015), also showed that marginal farmers are bearing decreasing returns to scale. But the evidence on extensive literature indicates that in Indian agriculture mostly there exist constant returns to scale and very less of increasing returns to scale.

IV. RESULTS AND DISCUSSION

A. Cost of Cultivation

To study the returns to scale, it is essential to study the structure of input and cost of cultivation as well as have an idea for the share of various input factors to total cost. For determining the cost structure, cost A_1, A_2, B, and C have been estimated. In our study, most of the farmers do not buy all the factor inputs and produce output not exclusively for making 'profit' but to a more extent, for fulfilling their own domestic needs. Since many inputs are not actually paid for and there is no such thing as the cost of 'inputs as a whole' unless it is imputed on the basis of market price of input factors concerned.

Therefore, we have imputed value of all owned factor inputs on the basis of existing market price in order to reach the cost C. However, the imputation of various factor inputs like family labour at the prevailing market wage rate is not based on sound economic reasoning. Thus, the estimates of total cost (C) based on the imputed values would give an unrealistic and misleading picture of costs. Reality is that the farmers try to minimize only out-of-pocket expenses of cultivation and they own, but it is also not justifiable to take into account only paid-out cost. To determine the cost structure, a method similar to Farm Management Studies has been adopted.

The information regarding total cost and input structure per hectare is provided in Table I. The total cost has been calculated by adding the costs of major food grains viz., maize, paddy and wheat. Taking first the overall position, it can be seen from the table that in terms of percentage as well as in absolute terms, the lion's share of cost is human labour followed by rental value of owned land. The cost of cultivation is a little over Rs. 56646 per hectare in 2013 and about Rs. 96423 in 2014.

TABLE I INPUT USE STRUCTURE AND COST OF CULTIVATION IN ALL CROPS

(Rs. per Hectare)

Sl. No.	Items	Farm Size							
		Marginal Farmers		Small Farmers		Medium Farmers		Overall Farmers	
		2013	2014	2013	2014	2013	2014	2013	2014
1	Value of Hired-in Labour	1055.03 (1.45)	2526.00 (2.28)	1789.35 (3.29)	4948.50 (5.65)	3077.01 (6.17)	7717.50 (9.28)	2059.81 (3.63)	5064.00 (5.25)
2	Value of bullock labour (owned+hired-in)	5145.18 (7.09)	-----	3907.56 (7.20)	-----	3051.16 (6.11)	----	3852.7 (6.8)	-----
3	Value of Seeds (Homegrown+Purchased)	1819.19 (2.51)	2130.40 (1.93)	1571.67 (2.89)	1449.24 (1.65)`	1503.91 (3.01)	1340.80 (1.61)	1608.38 (2.83)	1640 (1.70)
4	Value of FYM(owned+purchased)	5635.33 (7.77)	7625.20 (6.90)	3537.47 (6.52)	4966.40 (5.67)	2851.57 (5.71)	4097.20 (4.92)	3716.86 (6.56)	7722.80 (8.0)
5	Value pf chemical fertilizer	2381.49 (3.28)	3595.86 (3.25)	1840.32 (3.39)	2548.14 (2.91)	1897.31 (3.80)	2633.22 (3.16)	1975.98 (3.48)	2925.72 (3.03)
6	Insecticides & pesticides	308.57 (0.42)	416.70 (0.38)	154.53 (0.28)	183.15 (0.21)	265.19 (0.53)	357.80 (0.43)	228.66 (0.40)	304.22 (0.32)
7	Irrigation charges	5.96 (0.008)	10.51 (0.009)	8.84 (0.01)	13.74 (0.016)	5.36 (0.01)	15.99 (0.02)	6.78 (0.01)	20.52 (0.02)
8	Threshing charges	1882.0 (2.60)	1894.50 (1.71)	1658.69 (3.05)	1485.30 (1.70)	1489.82 (2.98)	1353.30 (1.63)	1638.78 (2.89)	1577.70 (1.64)
9	Tractor/ machinery charges (owned+hired-in)	4942.29 (6.81)	14854.67 (13.43)	4579.92 (8.44)	14616.19 (16.69)	4777.71 (9.58)	14595.10 (17.54)	4739.9 (8.36)	14688.65 (15.23)
10	Depreciation charges	562.56 (0.77)	1687.68 (1.53)	279.15 (0.51)	837.45 (0.96)	203.89 (0.40)	611.67 (0.74)	310.27 (0.54)	1045.6 (1.08)
11	Interest on working capital	2285.15 (3.15)	5027.33 (4.55)	500.66 (0.92)	1101.45 (1.26)	329.83 (0.66)	725.26 (0.87)	817.82 (1.44)	2284.68 (2.37)
12	Land Revenue	6.34 (0.008)	12.05 (0.01)	19.26 (0.03)	36.59 (0.042)	20.47 (0.04)	38.89 (0.047)	16.63 (0.02)	29.18 (0.03)
13	Miscellaneous charges	809.09 (1.11)	1618.18 (1.46)	373.87 (0.68)	747.74 (0.84)	401.95 (0.80)	884.27 (1.06)	480.74 (0.84)	1083.40 (1.12)
	Cost A1	26839.04 (36.97)	41399.08 (37.44)	20221.89 (37.27)	31484.65 (35.95)	19875.18 (39.85)	34371 (41.31)	21443.31 (37.86)	38386.47 (39.81)
14	Rent on leased-in land	---	---	---	--	---	---	---	---
	Cost A2	26839.04 (32.97)	41399.08 (37.44)	20221.89 (37.27)	31484.65 (35.95)	19875.18 (39.85)	34371 (41.31)	21886.92 (38.64)	38386.47 (39.81)
15	Rental Value of owned land	12147.0 (16.73)	30367.5 (27.46)	10419.71 (19.20)	26049.28 (29.74)	8955.46 (17.95)	22388.65 (26.91)	10216.49 (18.03)	26268.48 (27.24)
16	Imputed Value of owned fixed capital	928.61 (1.28)	1439.95 (1.30)	745.97 (1.37)	1308.20 (1.49)	809.61 (1.62)	1432.89 (1.72)	809.17 (1.42)	1393.68 (1.45)
	Cost B	39914.65 (54.97)	73206.53 (66.21)	31387.57 (57.85)	58842.13 (67.19)	29640.25 (59.43)	58192.54 (69.94)	32912.58 (58.10)	66048.63 (68.49)
17	Imputed Value of family labour	32691.03 (45.03)	37372.50 (33.80)	22865.35 (42.14)	28739.20 (32.81)	20225.91 (40.56)	25010.40 (30.06)	23724.31 (41.89)	30374.03 (31.50)
	Cost C	72605.68 (100.00)	110579.0 (100.00)	54252.92 (100.00)	87581.33 (100.00)	49866.16 (100.00)	83202.94 (100.00)	56646.69 (100.00)	96422.66 (100.00)

Note: Figures in the Parentheses are percentage to respective column total

Human labour and rental value of land account for about Rs. 33950 i.e; about 60 per cent of the total cost C and these same costs are Rs.56642 which is about 59 per cent of the total cost C in 2014. The other major item of expenditure on farm is FYM, chemical fertilizers, tractor charges accounting for 18 per cent of the total cost C in 2013and 26 per cent in 2014. As regards the input structure between the farms in different size classes, the total cost per hectare has a tendency to decline with the increase in holding size. The cost of family labour also shows a declining trend both in absolute as well as percentage terms. The same can be seen in case of FYM and interest on working capital. Use of hired-in labour, chemical fertilizer and tractor charges increases with the increase in land holding in percentage terms. The out-of-pocket expenses i.e. the cost A_1 increases with the increase in farm size in percentage term while it shows a declining trend in absolute terms. It is little above one-third of the total respective cost C in 2013 and very close to one fourth in 2014 on all farm size categories. In 2013, the total cost C has calculated about Rs. 72606, Rs. 54252, and Rs. 49866 while in 2014 these are Rs. 110579, Rs. 87581 & Rs. 83203 on marginal, small and medium farms respectively indicating declining tendency with the increase in farm size. There exist erratic trend in context of bullock labour, seeds, depreciation, land revenue and irrigation charges.

B. Break-Up of Total Cost into Various Cost Concepts: A Comparative Analysis

Table II reveals the break-up of costs on different farm size groups. As per presentation in table that overall cost of cultivation of all crops is estimated to Rs. 56646.69 in and Rs.96422.66 in 2014. It can be further seen that in both of periods (2013 & 2014) the per hectare cost of cultivation of wheat crop is less than its counterparts viz., maize and paddy. In 2013 the per- hectare cost of these crops is worked out Rs. 17102 for wheat, Rs. 18709 for maize and Rs. 20835 for paddy while in 2014, the per- hectare cost of these crops is worked out to be Rs.34349 for wheat, Rs. 14000 for maize and Rs. 36858 for paddy. However, in respect of cost A_1 which comprises of all cash and kind expenses, per hectare cost wheat of cultivation is more than maize and paddy. In 2013 the cost A_1 for paddy crops is Rs. 6708, Rs. 7101 for maize and Rs. 7641 for wheat. On the other hand, the cost A_1 for paddy crops is Rs.1078, Rs. 13673 for maize and Rs. 14852 for wheat in 2014 respectively.

TABLE II CROP-WISE-BREAK-UP OF THE TOTAL COST INTO VARIOUS COSTS-A COMPARATIVE PICTURE

(Rs. per Hectare)

Sl. No	Crops	Return/ Cost	Farm Size							
			Marginal Farmers		Small Farmers		Medium Farmers		Overall Farmers	
			2013	2014	2013	2014	2013	2014	2013	2014
1	Maize	Gross Returns	17291.71	48884.45	14756.08	45660.95	12524.39	42614.54	14478.70	45719.98
		Cost A_1	8903.50	15499.93	6865.44	12886.29	6247.48	12963.61	7101.48	13673.95
		Cost A_2	8903.50	15499.93	6865.44	12886.29	6247.68	12963.61	7223.29	13673.95
		Cost B	15291.41	23773.42	9758.25	17176.68	8745.81	17119.18	10066.91	19234.15
		Cost C	27041.80	45373.42	17698.06	28555.88	16058.56	26140.78	18709.24	14000.23
2	Paddy	Gross Returns	30359.78	49650.25	25829.04	44625.85	22080.69	43244.65	25322.22	45840.25
		Cost A_1	8611.91	11603.82	6097.79	8875.02	6423.42	9979.96	6708.08	10078.2
		Cost A_2	8611.91	11603.82	6097.79	8875.02	6423.42	9979.96	6871.22	10078.2
		Cost B	14433.75	26104.98	11000.83	21118.47	10690.78	20675.12	11719.22	22558.12
		Cost C	12784.77	43251.78	20032.67	34449.97	18705.00	33097.52	20835.02	36858.35
3	Wheat	Gross Returns	19831.94	56445.45	17302.24	48491.42	15147.53	41977.78	16987.41	48971.55
		Cost A_1	9122.69	22607.39	7258.66	13827.74	7204.28	13721.41	7641.75	14851.76
		Cost A_2	9122.69	22607.39	7258.66	13827.74	7204.28	13721.41	799241	14851.76
		Cost B	13013.02	32205.15	10628.49	22046.62	10203.66	22841.66	11126.45	23830.72
		Cost C	21168.89	46123.65	16522.19	32244.22	15102.60	30279.26	17102.43	34348.62
4	All Crops	Gross Returns	67483.43	154980.15	57887.36	138778.2	49751.92	127836.97	56758.33	140531.78
		Cost A_1	26839.04	41399.08	20221.89	31484.65	19875.18	34371.0	21443.31	38386.47
		Cost A_2	26839.04	41399.08	20221.89	31484.65	19875.18	34371.0	21886.92	38386.47
		Cost B	39914.65	73206.53	31387.57	58842.13	29640.25	58192.54	32912.58	66048.63
		Cost C	72605.68	110579.0	54252.92	87581.33	49866.16	83202.94	56646.69	96422.66

Note: Gross Returns or Gross Revenue i.e. gross Value of output (main+ by-product) at farm harvest prices from respective crop enterprise

Coming to the average cost of cultivation of these crops in different farm size groups, it can be seen that there is a declining tendency in all the costs with the increase in farm size. It is also significant to note that per hectare cost of paddy crop cultivation is more on all the farm size as compared to its counterpart's viz., maize and wheat. It has been cleared in the overall analysis in terms of high reflected through more rental value of owned land; in 2013 per hectare cost of cultivation of all the crops is estimated as Rs. 72606 for marginal, Rs. 54252 for small and Rs. 49866 for medium farms whereas, in 2014 these costs are as Rs.110579 for marginal, Rs.87581 for small and Rs.56647 for medium farms respectively.

The substantive point that has emerged from a close examination of the per hectare cost of cultivation of different crops between farm sizes in both of study periods is that, all the cost concepts viz. cost A_1, Cost A_2, Cost B and Cost C are high on marginal farms as compared to small and medium farms. Also there exists a big cost gap between marginal and small or medium farms. The explanation of this point lies on high dose of farm inputs especially farm

yard manure and family labour reflected in more imputed value on marginal holding as compared to small and medium holdings.

C. Gross Returns

Table II also provides gross returns per cropped hectare in various food grain crops on farms of different size-groups. The gross revenue is decreasing with the increase in size of holdings. It can also be noticed from the data given in the table that gross returns are low on medium holdings as compared to their counterparts. It points out the fact that land is not intensively utilized/cultivated or there is no provision of proper management of the resources. By taking the overall position, the gross revenue for the maize, paddy and wheat crop in 2013 is calculated to be Rs. 14478, Rs. 25322 and Rs. 16987 on marginal, small and medium farms whereas in 2014, the gross revenue for same crops is worked out to be Rs. 45720, Rs. 45840 and 548971 on marginal, small and medium farms. The overall gross returns for all the crops in 2013 is estimated to be Rs. 56758 while in 2014 is estimated to be Rs.140532 respectively.

D. Elasticity Coefficients, Returns to Scale and Resource Use Efficiency

In the production economics efficiency is an important concept when resources are meager and opportunities for adopting better technologies are competitive. It is also important to know that how well the resources are being utilized and what possibilities exist for improving operational efficiency. Efficiency studies also revealed that it is possible to raise the crop productivity with the improvement level of efficiency without actually increases in the resource use. Estimates on the extent of inefficiency could also help to decides whether to improve efficiency or to develop new technologies to raise the crop productivity. From the policy point of view, it is also important because such analysis suggests the extent to which modern inputs can/should be pushed to get the specified level of output. Thus, the process of resource use efficiency on farms in low income nations becomes a major issue in determining the existing opportunities in agriculture for economic development and welfare of the farmers. Similarly, the analysis of returns to scale holds greater significance to ascertain whether the production is rational or irrational. With the Cobb-Douglas type of production function, the nature of returns to scale can be examined by checking $\sum bi=1$. If this sum is more than, equal to or less than unity, it shows increasing, decreasing or constant returns to scale respectively. The increasing returns to scale signify the scope for intensifying the input use to increase the production and on the other hand, decreasing returns to scale helps in finding out the optimum level of production. The estimated results of Cobb-Douglas production function for the pooled analysis have been presented in Table III.

TABLE III REGRESSION COEFFICIENT FOR ALL CROPS

Sl. No.	Items	Farm Size							
		Marginal Farmers		Small Farmers		Medium Farmers		Overall Farmers	
		2013	2014	2013	2014	2013	2014	2013	2014
1	Constant (log a)	1.536* (0.409)	2.304* (0.613)	1.487* (0.440)	2.230* (0.661)	0.754 (.953)	1.131 (1.429)	1.550 (.294)	2.325 (0.441)
2	Land in Hect. (x_1)	0.4051* (0.119)	0.607* (0.178)	0.375* (0.134)	0.562* (0.201)	0.221 (.260)	0.433 (0.392)	0.286* (.083)	0.429* (0.1245)
3	Human Labour in Mandays (x_2)	0.943* (0.144)	1.414* (0.216)	0.733* (0.158)	1.099* (0.237)	0.360 (.267)	0.541 (0.400)	0.649* (0.102)	0.973* (0.156)
4	Bullock labour hours in Rs. (x_3)	0.312* (.075)	0.468* (0.112)	0.473* (.097)	0.655* (0.145)	0.602* (.206)	0.903* (0.309)	0.335* (0.057)	0.5025* (0.0855)
5	Manure and Fertilizsers in Rs.(x_4)	0.107* (.045)	0.160* (0.067)	0.0241 (0.045)	0.0363 (0.067)	0.234* (0.062)	0.351* (0.093)	0.146* (0.030)	0.219* (0.045)
6	Seeds in Rs. (x_5)	(-).152* (.042)	-0.228* (0.063)	(-).087** (.041)	(-).130** (0.0615)	(-).120** (.053)	-.181** (0.079)	-.0638** (.026)	-.0957** (0.039)
7	Others in Rs. (x_6)	0.0123 (.020)	0.0283 (0.031)	0.0639* (0.26)	0.0958* (0.392)	0.0879* (.053)	0.1318* (.0795)	0.0308** (0.015)	0.0462** (0.0225)
8	R^2	0.81	0.84	0.81	0.89	0.78	0.76	0.84	0.82
9	n	247	230	175	176	120	102	542	508

Note: * Significant at 1 per cent probability level
** Significant at 5 per cent probability level
*** Significant at 10 per cent probability level
R^2: Coefficient of multiple determinations
N: number of observations

Taking the overall situation first of all, it is clear from the table that regression coefficients of estimated production function turn out to be significant in all factor inputs. Regression coefficients in respect various input factors indicate that human labour is the most important factor to which output is highly responsive followed by bullock labour & tractor use, land and manure fertilizers. The coefficients of human labour is 0.649 in 2013 and 0.973 in 2014, significant at one per cent probability level indicating that by increasing human labour by 100 per cent, holding

other inputs constant, the gross output increases by 64.9 per cent in 2013 and 97 per cent in 2014. The second important factor in the production process is bullock labour & tractor use. The magnitude of the coefficients of bullock labour & tractor use is not only positive but also significant at 1 per cent probability level. It means that by increasing bullock labour and tractor use by 100 per cent, the gross output increases by 33.5 per cent in the year 2013 and 50.2 per cent in 2014, holding other inputs constant. Land has also due importance in the process of farm production. The coefficient of land in 2013 is 0.286 and 0.429 in 2014, which are significant at 1 per cent probability level. It also means that by increasing land input by 100 per cent, holding all other inputs constant the output increases by 28.6 per cent in 2013 and 42.9 per cent in 2014. The next important factor input in the order of its importance is manure and fertilizers. The magnitude of coefficient in 2013 is 0.146 and 0.219 in 2014, which are significant at 1 per cent probability level. Negative elasticity coefficient is observed in the context of seeds and others (X_6) which are significant at 5 per cent probability level. These elasticity in 2013 are (-) 0.0638 & (-) 0.0308 and in 2014 these are (-) 0957 & (-) 0.0462 respectively for above mentioned variables, however, the negativity of coefficients is not very high in both of periods. The negative coefficient of seed indicates that there is an excess use of this input in order to avoid risk and uncertainty of poor generation. In respect of others (X_6) variable, there is also excess expenditure on this item thus in order to avoid the loss the farmers of the study area may be suggested to curtail the expenditure on the concerned input. The production elasticity of seeds and others (X_6) are found to be negative, indicating, excessive use of explanatory variables. One possible explanation for negative elasticity seeds can be given to avoid risk of poor germination and less use of HYV seeds. The elasticity of others (X_6) is also negative but not significant it may be due to over expenditure on this item. On the small size of farms, the coefficient of human labour in 2013 is more i.e. 0.733 followed by bullock team + tractor use i.e. 0.473, land i.e. 0.375 on the other hand in 2014, these are 1.099 for human labour followed by bullock team + tractor use i.e.0.655, land i.e. 0.562 and all are significant at 1 per cent significant, thus, hereby indicated that there is no scope for adding more manure & fertilizers in land to increase production on small farms. The regression coefficients of seeds and others (X_6) are negative and significant at 5 per cent and 1 per cent probability level. These elasticity coefficients show the excessive use of respective factor inputs. On medium farm size, the production elasticities of bullock labour & tractor use and manure & fertilizers are significant at 1 per cent probability level. The contribution of these two factor inputs is sizable as the probability level. The regression coefficient of manure and fertilizers is found to be very low in 2013 i.e. 0.0241 while is 0.0363 in 2014 but not magnitude of the production elasticities (1.602 and 0.234) in 2013 while (0.903 and 0.351) in 2014, which are higher than other factor inputs. However, in 2013 the regression coefficient of human labour is 0.360 but it is not significant followed by land being 0.221 (non-significant) whereas in 2014, the regression coefficient of human labour is 0.541 but it is also not significant followed by land 0.433 (non-significant) respectively.

The elasticity of others (X_6) is positive and significant at one per cent probability level but is very low being 0.0879 in 2013 and 0.1318 in 2014. The negative elasticity of seeds once more on medium farms indicated excessive use of this explanatory variable. The value of R^2 in the selected regression for various size groups explain about 81, 81, 78 and 84 per cent in 2013 and in 2014, these are 84, 89,76 and 82 per cent of variations in gross output on marginal, small, medium and all farm size categories respectively.

By comparing the farm sizes of the year 2013 and 2014, it is found that the elasticity of land as well as human labour decreases as farms size increases, indicating thereby less importance of increasing these inputs to increase production. The coefficient of bullock labour & tractorization increases as one move from marginal holding to medium holding, which is an indication of importance of this factor input in order to increase the food grain production in the area under study.

TABLE IV RETURNS TO SCALE FOR ALL CROPS

Sl. No.	Items	Farm Size							
		Marginal Farmers		Small Farmers		Medium Farmers		Overall Farmers	
		2013	2014	2013	2014	2013	2014	2013	2014
1	Sum of elasticity coefficients (∑bi)	1.6487*	2.4727*	1.4535*	2.1802*	1.3849	2.0773	1.3214*	1.9821*
2	Deviation from unity	0.6487	0.9730	0.4535	0.6802	0.3849	0.5773	0.3214	0.4821
3	't' value for deviation from unity	9.26	12.56	6.47	9.70	1.18	1.77	6.69	9.3421
4	Return to scale as indicated by 't' test	Increasing	Increasing	Increasing	Increasing	constant	constant	Increasing	Increasing

Note: * Returns to scale are estimated at 5 per cent probability level

The sum of production elasticity computed from Cobb-Douglas production gives the nature of returns to scale of 2013 as well as in 2014 when all the inputs are increase by one per cent then there it revealed the proportionate increase in the output. The returns to scale are increasing, constant or decreasing as the sum of regression coefficients is greater

than, equal to or less than unity respectively. The sum of production elasticity is given in Table IV. It can be noticed from the table that sum of overall regression coefficients is 1.3214 in 2013 and 1.9821 in 2014. From the analysis of sum of elasticity, it can be said that there exist increasing returns to scale in the agricultural region of the study area. However, to test the validity of the nature of returns to scale, the sum of production elasticity is tested by 't' test. The 't' test shows that sum of elasticity is significantly different from one. Therefore, It is confirmed by 't' test that overall returns to scale in all crops are increasing. The hypothesis of constant returns to scale as suggested by Khusro, Krishna, and Saini is hereby rejected in our study.

As far as in 2013, farm sizes are concerned, the sum of Production elasticity are 1.647, 1.4535 and 1.3849 while in 2014, these are 2.4727, 2.1802 and 2.0773 on marginal, small and medium farms respectively. Increasing returns to scale is indicated by the analysis of table as the sum of this elasticity is greater than one. However, to test the validity of increasing returns to scale the sum of production elasticity is tested for their deviation from unity. The 't' test indicates that in the case of marginal and small farms the sum of elasticity is significantly different from one. Hence, in case of medium farms returns to scale are found to be constant. On the basis of the above analysis, it can be said that there is still a scope for increasing the food grain production in the area under study.

V. CLASSIFICATION OF VARIABLES

Gross Output (Y): The gross output or returns revealed the sum of gross output value (main plus by products) of each and all crops evaluated at their respective harvest prices in the reference year irrespective of being consumed, sold or maintained in the stock.

Land (X_1): The land as operational holding is an important determinant of the farm management. The land input used is measured in the form of acre /hectare under the concerned crops. The calculation of difference in fertility of soil in farm to farm has been ignored due to the lack of authentic official data and conservation factor. Land is considered an exogenous variable in our study.

Human Labour (X_2): The measurement of human labour calculated in terms of hours of labour actually put in the family labour along with casual and attached labour for carrying out various farm activities in different crops. The differences in the efficiency of labour have been taken into account by converting female and child labour days into standard mandays on the appropriate criterion that 4 female days are equal to 3 mandays and 2 child labour days are equal to 1 mandays. To avoid multicollinearity between human and bullock labour inputs, the number of days of human labour worked with bullocks have not been includes under this head.

Bullock Labour + Tractorization (X_3): During the survey, it has been found that some households in a village hold this animal power and other who cannot afford tractor due to one or the other reasons hire this respective input whenever they indeed it. In the present study, bullock team has been calculated by taking eight hours per day worked by a pair of bullocks with one man or farmer .Number of bullock days utilized have been converted in term of rupees for a selected crop in study area and it has been included with that of tractor expenses needed to operate a farm. In order to bring uniformity these two variables have been clubbed together due to the fact that some farmers operate their fields with bullock, some are with tractor and there are also some farmers who utilize both tractor inputs. Therefore, if we want to calculate regression coefficients with these three variables then there are so many regression equations and with low degree of freedom no clear-cut generalization can be made. Hence, to avoid this problem and in order to increase degree of freedom, we have no any other alternative than to club them together under one exogenous variable in terms of rupees.

Manure and Fertilizers (X_4): In order to increase the agricultural production manure and chemical fertilizers are considered crucial inputs. These provide nutrients to the soil as well as plant growth. With the help of these inputs agricultural productivity can be increased in a short period of time. The continuous use of land for agriculture deteriorates the fertility of soil so therefore manures and fertilizers become necessary to maintain fertility of land. The physical quantities of different fertilizers and manures used are multiplied with their respective market prices. The prices of manures are evaluated with the imputed price prevailing in the study area. It is considered as an explanatory variable in our study.

Seeds (X_5): High yielding verities of seeds is a part of modern technology. It is very difficult to aggregate them on physical terms because of the difference in quality of seeds actually used on farm. Therefore, this factor is taken in the form of rupee terms i.e. actual quantities of seeds utilized under respective crop multiplied by their respective prices. The value of own seed has been imputed on the local prices prevailing in the study area.

Others (X_6): This variables includes different type of expenditure as depreciation and interest on farm buildings, expenditure on implements and machinery, irrigation, expenditure on insecticides and pesticides etc. in value terms under various selected crops.

The factor price is to be taken as the opportunity cost of inputs which is employed elsewhere for the purpose of earning. In agriculture sector, it is very difficult to calculate the opportunity cost of the inputs, because most of the factors are owned by farmers and no markets available for these factors. The factor price of inputs has been imputed in the following manner.

1. The factor price of land has been calculated as the average rental value of land per hectare of the net area under the same farm category and respective crop. All this has done to adjust the land inputs for the differences in its quality on individual farms without changing the sown area. It is taken as 18 per cent of the total selected crop.
2. Factor price of human labour has been taken as average wage and worked out by dividing the total wage bill by total number of labour days used in the respective crop and farm categories.
3. The bullock labour factor cost and tractorization, manure and fertilizers, seeds and others has been taken as one rupee, since inputs have been measured in value terms.

VI. CONCLUSION

The results of the study indicated that there is a vast scope to increase food grain production and negative returns can be turn out into positive with efficient use of resources in different crops viz., maize, wheat and paddy. The overall analysis revealed that in order to increase the agricultural production, in place of homegrown seeds farmers should be used High Yielding Varity seeds (HYVs), insecticides and pesticides, bullock labour and tractorization, improved implements etc. The expenditure as on fixed assets like farm buildings, depreciation and repair, traditional equipments, homegrown seeds, etc. should be minimized. The farmers are, in general, quite efficient in the use of their resources particularly in land, human labour and manure and fertilizers. Therefore the appropriateness of use of market wage rate for the estimation of family labour is a real phenomena and as a guideline to labour use. Further, it is observed that there exists vast scope for increase in food grain production in the study area as indicated by increasing returns to scale. Again, land distribution in the study area is highly unequal and there are wide disparities of fragmentation of land holdings in spite of land holding act. The provision of consolidation of land holding and redistribution of land in favour of landless farmers will certainly increase the agricultural production. Creation of irrigational potential and its optimum utilization is also of primary importance. There is a need to develop low cost water harvesting technology for soil and moisture conservation in the study area. The on-going work on water harvesting and storage tanks for providing irrigation needs to be speeded up on a large scale along with increasing efficiency of existing irrigation potential and to carry on research on watershed management on a priority basis. The research and development organizations in the state should concentrate on the development of more high yielding variety of seeds which must be stalk rot resistant, dwarf and early maturing with high yield potential, keeping in view the local conditions like environment, climate and availability of fodder, etc. The problem of stray-animals like cow, swine, fox, rabbit, and bird has posed a serious threat to agricultural sustainability in the study area. It must be handled on a priority basis in order to provide relief to the farmers of the study area. There is also a need to encourage credit flow to agriculture sector to purchase improved agricultural implements and machinery and necessary inputs like HYV seeds, chemical fertilizers, insecticides and pesticides, etc. In spite of strenuous efforts made by the state Government for the agricultural development in the state, it also becomes imperative on the part of the state to show seriousness on the aforesaid suggestions and it is anticipated that these suggestions will ensure judicious and optimum utilization of resources which in turn improve the level of production there by lead to an improvement in the well-being of farm families.

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