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Research Paper

Resource Use Efficiency in Apple Production at Himachal Pradesh : A Comparative Study of Different Farm Size

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ABSTRACT

The act of production involves the transformation of inputs into outputs. The relation between inputs and output has been called the production function. As factor inputs are costly and scarce, and the extent of their use on farms has a direct bearing on crop production the case for their efficient use is self-evident. Therefore, it is necessary to study the extent and magnitude of various farm endowments prevailing on farms in different size classes in the study area. The field survey was conducted on 200 farming households of different farm sizes and Apple output and inputs data had been collected from the respondents with the help of Questioner. The Cobb-Douglas production function has been used to Analyze the input-output relation which explains the resource use efficiency of different farm sizes. The study reveals that the land-use efficiency is significant on marginal farms however in human labour it is higher on small farms. The manures and fertilizers results reveal that it is highest and significant on marginal farms however in seeds it turned out to be non-significant in all farm categories. As far as the others are concern it is significant on medium farms at a 1.00 percent significant level.

HIGHLIGHTS

- Production Elasticity of land is high on marginal farms in the Apple Production.
- Marginal productivity of labour for Small farms is high in the Apple production.
- Manures and fertilizers is playing significant role in the Apple Production on the Marginal farms.

Keywords: Economics of scale, Elasticity coefficient, Input-Output, Production, Resource efficiency

The rich diversity of agro-climatic conditions, topographical variations and altitudinal differences coupled with fertile, deep and well-drained soils favour the cultivation of temperate to sub-tropical fruits in Himachal. This particular suitability of Himachal has resulted in the shifting of land use patterns from agriculture to fruit crops in the past few decades. The area under fruits, which was 792 hectares in 1950-51 with a total production of 1,200 tonnes increased to 2,33,300 hectares during 2019-20 and the total fruit production was 8.45 lakh tonnes, while during 2020-21 (up to December 2020) it has been reported as 4.82 lakh tonnes. During 2020-21 it was envisaged to bring 1,340 hectares of additional area under fruit plants against which 2,588.52 hectares of area was brought under plantation and 7.69 lakh fruit plants of different species were distributed up to 31st December 2020. Apple is the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. The area under apple has increased from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and 1,14,144 hectares in 2019-20. The fluctuations in the production of apples during

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the last few years have attracted the attention of the Government, therefore, requires in-depth study to found the reason and explore the possibilities to improve.

The studies conducted by Bhat and Dhar (1989), Singh and Vashist (1994), Haque (2006), Kumar and Sharma, 2011, Kireeti (2013), Singh (2013), Ravi *et al.* (2017), Binita Kumari *et al.* (2018), Venkatraman *et al.* (2019), Lekshmi *et al.* (2021) identifies the significance of different factor inputs (FYM, chemical fertilizers, human labour) in Agri production. Taking this aspect into consideration, a field investigation was carried out to find the resource use efficiency of different farm sizes on Apple crop production. From the pesent study attempt has been made to understand the Input-Output relation of the different farm size which will reveal the resource efficiency picture of different farm inputs for different farm size in Apple production therefore will be beneficial to the farmers for there rational resource allocation.

MATERIALS AND METHODS

To find the answers to the framed objectives the present study was conducted in Jubbal & Kotkhai Block of district Shimla which was divided into 10 different *panchayats* and thereafter two villages from every *panchayat* with 10 farming households of different categories (Marginal, Small & Medium) from each village has been randomly selected. However, the study is primarily based on primary data hence personal interview, face-to-face association with farmer respondents and observation method has been adopted to collect the relevant information.

Analytical Tools

To know the resource use efficiency, it is necessary to know the marginal productivity of factors and it can be known only if the full technical relationship between output and input is known. For this, Cobb-Douglas production function has been used in the present study to work out the elasticities of the production of factor inputs. A positive elasticity less than one indicates decreasing marginal productivity of factor inputs. The larger the elasticity of factor input, the larger the increase in output in response to a given proportionate increase in that factor input with other inputs held constant. Negative production elasticities of factors indicate their inefficient and excessive use.

$$Y = Ax_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5}$$

Y = Value of output (₹)

A = Constant (Intercept term) b_1 to b_5 = Elasticity co-efficient of respective inputs.

X_1 = Land (hectares)

X_2 = Human Labour (Mandays)

X_3 = Manures and Fertilizers (₹)

X_4 = Seed (₹)

X_5 = Others (₹).

Such type of function can be transformed into the logarithmic form so that it can be solved by the methods of least squares.

$$Log\ Y = log\ A + b_1 LogX_1 + b_2 LogX_2 + b_3 LogX_3 + b_4 LogX_4 + b_5 LogX_5$$

The statistical significance levels of regression coefficients had been worked out to find out the goodness of fit. It had been carried out by calculating the '*t*' statistics by following the formula for regression coefficients:

$$t = \frac{bi}{\sqrt{\text{var}(bi)}}$$ With (n–k–I) degree of freedom

RESULTS AND DISCUSSION

Human labour, bullock power, mechanical power, water for irrigation, seeds, manures and fertilizers, insecticides, and pesticides are the various inputs which determines the Agriculture Output therefore Table 1 revealed the production elasticity of different farm inputs for different farm sizes. The land is a factor which doesn't have any substitute in agriculture production hence occupies a very important place in the crop production, therefore it was found from the study that the production elasticity of land on marginal farms turn out to be 1.06 and is significant in comparison to the other farm size. The higher coefficient indicates that productivity is higher and it has a significant impact on the gross output, therefore, land productivity is higher on marginal farms and it indicates that if the use of land is increased by 1 percent, then on

Table 1: Coefficients of Production Function for different Farm Inputs for different farm size

Sl. No.	Items	Farm Size		
		Marginal Farmers	Small Farmers	Medium Farmers
1	Constants (Log a)	6.807*** (3.774)	11.946* (2.250)	7.076* (1.821)
2	Land in Hectares (X_1)	1.061** (0.496)	0.369 (0.275)	0.113 (0.144)
3	Human Labour in Mandays (X_2)	0.771*** (0.390)	1.315* (0.180)	0.749* (0.121)
4	Manures & Fertilizer in ₹ (X_3)	0.551** (0.251)	-0.362 (0.145)	-0.106 (0.085)
5	Seeds in ₹ (X_4)	-0.385 (0.198)	-0.099 (0.092)	-0.080 (0.076)
6	Others in Rs (X_5)	0.167 (0.454)	-0.071 (0.235)	0.371** (0.174)
7	Sum of Elasticity Coefficient ($\sum bi$)	2.1656	1.1513	1.0472
8	Returns to scale as indicated by t-test	Increasing	Increasing	Increasing
9	Deviation from Unity	1.1656	0.1513	0.0472
10	R^2	0.60	0.63	0.71
11	N (Number of Observations)	40	60	100

Note: *(i) Figures in the parentheses are standard errors; (ii)*Significant at a 1 percent probability level; (iii)** Significant at 5 percent probability level; (iv)*** Significant at 10 percent probability level; (v) R^2 Coefficient of multiple determination; (vi) n number of observations.*

average, the gross output will also increase by 1.06 percent. In the case of human labour production elasticity on marginal farms is 0.77, a small farm is 1.31 and 0.74 on medium farms and is significant therefore indicates that with an increase in labour by 1 percent the gross output will increase by 0.77 percent on marginal farms, 1.31 percent on small farms and 0.74 percent on medium farms hence revealing resource efficiency picture of different farm size. Whereas manures and fertilizers are turned out to be significant on marginal farms hence revealing that it is influencing the output in marginal farms by 0.55 percent with every change of 1 percent. As far as seeds are concern they are non-significant in all farm sizes however others (X_5) (Depreciation, Interest on working capital, Miscellaneous Expenses) are concern they are significant on medium farms at a 5 percent probability level.

The coefficient of multiple determinations (R^2) determines the correlation between the variables and explains the percentage of variation in output is explained by the independent variables, which are included in the model. From the study it was revealed that R^2 is 0.60 on marginal farms, 0.63 on small farms and 0.71 on medium farms hence indicates the percentage variation in output is explained by the independent variables for different farm sizes.

However, the economics of scale is indicated by the sum of these production elasticities which reveals the proportionate increase in the output when all the inputs are increased by the same proportion therefore Table 1 gives returns to scale for the Apple crop. If this sum is less than equal to or greater than unity, it indicates decreasing, constant, or increasing returns to scale respectively. The sum of regression coefficients i.e., output elasticities vary from 2.1656 on marginal farms to 1.0472 on medium farm size therefore it is also clear from the table that the sum of elasticity coefficients is more than one, hence, hereby indicating increasing returns to scale on all farm size categories but in comparison returns on marginal farms is highest followed by small and medium farms, therefore, revealing the law of Diminishing returns in Agriculture sector.

CONCLUSION

It was concluded from the research that the Marginal productivity of land is higher on marginal farms indicating more response to increasing the gross output. In the human labour case, it is higher on small farms with a one percent significance level. However,in manures and fertilizers, it is highest and significant on marginal farms at a 5 percent level. It was revealed that seeds turned out to be non-significant in all farm categories whereas the others (X_5) is significant on medium farms at a 1.00 percent significant level. Therefore from the research,it is evident that the resource use efficiency of farmers is decreasing with the increasing farm size in the study area hence justifies the diminishing returns principle which leads us to the following suggestions:

1. Land productivity is decreasing with increasing farm size, therefore, recommends medium and small farms to the rational crop diversification to obtain optimum resource efficiency.
2. The low marginal productivity of labour in marginal farms in comparison to the others can be due to the underutilization of the resources, therefore, recommends farmers for the adoption of modern farm technology and methods to improve its efficiency.
3. Manures and Fertilizers are not indicating positive trends on small and medium farms in apple production, therefore,recommends its application as per the requirement.

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