BKAP5704
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RESEARCH ARTICLE Bhartiya Krishi Anusandhan Patrika

Economics of Cheery Production in Himachal Pradesh: A Study of Different Farm Size

Sikander Kumar[1], Vishal Chauhan[2]

10.18805/BKAP5704

ABSTRACT

Background: Human labour, bullock power, mechanical power, water for irrigation, seeds, manures and fertilizers, insecticides and pesticides and cultivation practices, *etc*. are the major inputs in the farm production and are costly and scarce therefore requires proper allocation and utilization. Cheery production could be a better alternative to the apple production therefore it is necessary to study the resource use efficiency of different size classes by calculating the elasticity coefficient of different inputs (labour man-days, Land, Manures and fertilizers, Seeds and others) with regards to output and to determining the economics of scales of cheery production in the study area.

Methods: The study was conducted during the Year 2018-2019 at Jubbal and kotkhai block of district Shimla of Himachal Pradesh from where input-output data for cherry production was collected from the sample of 200 farmers of different holdings and was analyzed with the Cobb-Douglas production function.

Result: We have found that in marginal farms human labour is a predominant factor followed by manures and fertilizers and seeds whereas in small and medium farms land is a dominating factor and has a key role to play to enhance Cherry production.

Key words: Economics of scale, Elasticity coefficient, Input-output, Production, Resource efficiency.

INTRODUCTION

Agricultural inputs used in farm production are costly and scarce therefore require proper allocation and utilization. However, the resources utilization and its effectiveness are determined by its geographical locations therefore rich diversity of Agro-climatic conditions, topographical variations and altitudinal differences coupled with fertile, deep and well-drained soils favours the cultivation of temperate to sub-tropical fruits in Himachal Pradesh. 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, 34, 779 hectares during 2020-21 with total fruit production of 6.24 lakh tonnes, while during 2021-22 (up to December 2021) it has been reported as 6.97 lakh tonnes .The area under apple has increased from 400 hectares in 1950-51 to 3,025 hectares in 1960-61 and 1, 14, 646 hectares in 2020-21. The area under temperate fruits, other than apples has increased from 900 hectares in 1960-61 to 27,870 hectares in 2020-21 (Himachal Pradesh Economic Survey Report 2012-22).

The act of production involves the transformation of inputs into outputs. The relation between the inputs and output of a firm has been called the production function. Hence in any production activity, the most fundamental aspect is to examine the various inputs required and the relationship of different levels of each input with the output. Without such information, the rational allocation of resources for production cannot take place. In agriculture, such an analysis is of great importance because of the peculiar nature of the business itself. The factor-product relationships or input-output relationships depend upon the technical relationship which includes the time and method of their application of fertilizer at different periods and in different doses have different results. Similarly, the availability of the resources, size of the farm, strength of labour union, transport facility *etc*., have some influence on the input-output relationship.

The issue of how efficiently farmers is using various farm inputs in crop cultivation has been an important topic of research over the years (Channareddy, 1967; Sampath, 1979; Shapiro, 1983; Rao *et al*., 2003; Shanmugam and Venkataramani, 2006). It is theoretically expected that an efficient farmer tends to use all the resources required for crop cultivation in an optimal way so as to reduce the cost and maximize the income (Haque, 2006). Several studies were conducted by Bhat and Dhar (1989), Singh and Vashist

[1]Department of Economics, Himachal Pradesh University, Shimla-171 005, Himachal Pradesh, India.
[2]Department of Economics, St Bede's College, Shimla-171 005, Himachal Pradesh, India.

Corresponding Author: Vishal Chauhan, Department of Economics, St Bede's College, Shimla-171 005, Himachal Pradesh, India. Email: vishal.chauhan333.vc@gmail.com

How to cite this article: Kumar, S. and Chauhan, V. (2023). Economics of Cheery Production in Himachal Pradesh: A Study of Different Farm Size. Bhartiya Krishi Anusandhan Patrika. doi:10.18805/BKAP5704

Submitted: 08-11-2022 **Accepted:** 31-03-2023 **Online:** 13-05-2023

(1994), Haque (2006), Kumar and Sharma, 2011, Kireeti (2013), Singh (2013), Ravi *et al*. (2017), Binita Kumari *et al*. (2018), Venkatraman *et al*. (2019), Shruthi *et al*. (2021) regarding the role of different factor inputs in Agri production and revealed that productivity can be increased by increasing the levels of the variables like FYM, chemical fertilizers, human labour etc. Fertilizer is one of the important inputs of modern agriculture and therefore, many scholars have studied the efficiency of it in different crops. Though most studies on fertilizers seem to suggest a continuing decline in fertilizer response through the 1980s, Sagar (1995) showed a contrary result using field data. Utilizing panel data from India, Foster and Rosenzweig (2011) studied the mechanisation, agency costs and farm efficiency of Indian farmers. They concluded that although the small farmers have lower unit labour costs, large farms use substantially less labour per acre but are more mechanised and also more efficient.

These input-output relationships have opened new dimensions and alternatives demanding various adjustments in allocating farm resources to different farm size groups and at a different level of technology. Therefore, resource use and allocation efficiency on farms becomes an important issue in determining the existing opportunities in agriculture for economic growth and welfare of the farm families. Thus, keeping in view, the importance of resource use efficiency in horticulture an attempt has been made in this paper to investigate the elasticity coefficients of different farm inputs (Land, labor, Manures and Fertilizers, Seeds and Others) and therefore estimate the returns to scale and Input efficiency for different farm size on Cherry Production.

MATERIALS AND METHODS

Sampling framework

Cherry production requires the temperate climate as such an environment is suitable for cheery production, therefore,the block of Jubbal and Kotkhai had been purposely selected for the study. The block was very big hence to get a representation from every sample stratified random sampling was adopted therefore the Block had been divided into 10 different panchayats and thereafter two villages from every panchayat had been selected for collecting the total sample size of 200 farm households of different categories (Marginal, Small and Medium) from each village for the year 2018-2019).

Analytical framework

Resource use efficiency

Resources are scarce and opportunities for adaptation of superior technologies are competitive, effective use of such scarce resources is the need of hour (Ashok 2018). Land, labour, manures and others are crucial resources in Agri Production therefore, to know the resource use efficiency, it is necessary to know the marginal productivity of the factor and it can be known only if the full technical relationship between output and input is known. For this, the Cobb-Douglas production function has been used in the present study to analyze the resource use efficiency in Marginal farms, Medium farms and Small Farms. The specification of the model for cheery production in Marginal, small and medium farms is given as

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

Were

Dependent variable,

Y= Gross returns (Rs/farm).

Independent variables,

X_1= Land (hectares/farm).

X_2= Human labour (Mandays/farm).

X_3= Manures and fertilizers (Rs/farm).

X_4= Seed (Rs/farm).

X_5= Others (Rs/farm).

a= Constant (Intercept term).

u= Random variable.

b_1 to b_5 indicate the regression co-efficient of respective inputs and implicitly represents the elasticities of the production of factor inputs. A positive elasticity of 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.

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

$$\text{Log } Y = \log A + b_1 \text{Log} X_1 + b_2 \text{Log} X_2 + b_3 \text{Log} X_{3+} b_4 \text{Log} X_4 + b_5 \text{Log} X_5$$

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.

$$t = \frac{bi}{\sqrt{var(bi)}} \quad \text{with (n-k-1) degree of freedom}$$

The sum of these production elasticities indicates returns to scale which indicates the proportionate increase in the output when all the inputs are increased by the same proportion. If this sum is less than equal to or greater than unity, it indicates decreasing, constant or increasing returns to scale respectively. Our objective is to see whether returns to scale are increasing, decreasing or constant and to examine their statistical significance. The following hypothesis had been tested in this context with the help of 't' test":

$$t = \frac{\Sigma bi - 1}{\sqrt{\sum_{t=1}^{n} \text{var bi} + 2 \sum_{i=j} \text{cov.bibj.}}}$$

RESULTS AND DISCUSSION

Marginal farms cheery cultivation

From the estimated data in Table 1, one can understand the efficiency of different farm inputs in the cheery production on the marginal farms. The elasticity co-efficient of factor inputs explained the response of total output to a given

increase in factor inputs therefore results from Table 1 revealed that the inputs like human Labour and Manures and Fertilizers had led to an increase in Gross returns by 0.741 and 0.673 units from its geometric mean level in the cherry production and was found statistically significant at 10 per cent and 5 percent. The land and seeds also influenced cherry production by 0.001 and 0.255 percent however it was found to be statistically non-significant. Whereas production elasticity in respect of others (X_5) inputs is negative -0.525 on marginal farms which indicates the excess use of the given resources, which implies that if these other resources increase by one percent, then average production shall be reduced by 0.52 per cent.

The Economics of Scale reveals the response of output to an overall factor inputs and it was found 1.1434 which indicates increasing returns to scale as they are greater than unity however when these are tested for their deviation from unity it was found to -0.1551 which indicates constant returns to scale. The coefficient of multiple determinations, (R^2) for cherry production on marginal farms was found to be 0.24 indicating that about 24 percent of the variation in the production is explained by the variable considered in the model. The analyzed data for per-hectare yield and cost was tabulated in (Table 2) and it was found to be Rs 120253.75 and Rs 83132.18 respectively.

Manures and Fertilizers, 0.001, 0.741, 0.673, 0.255 and -0.525, respectively which**.** However human labour was whereas manures and fertilizers were found statistically significant at 5 per cent and remaining factors like land, seeds and others were.

As far as returns to scale is concern the sums of regression coefficients on marginal farms .

Small farmers cherry cultivation

The response of total output to a given increase in factor inputs on small farms had been Tabulated in (Table 1). It had been found that the factor inputs Land, Human Labour and Manures and Fertilizers had elasticity coefficient values of 0.609,0.596 and 0.400 respectively which explains that one unit increase in the input use of Land, Human Labour and Manures and Fertilizers will lead to increase in Gross returns by 0.609, 0.596 and 0.400 units in cheery output and was found statistically significant at 1 per cent and 5 percent respectively. The production elasticity in respect of seeds and other factor Inputs (X_5) was negative on small farms which indicates the inefficients use of the given resources, which implies that if these other resources increase by one percent, then average production shall be reduced by 0.06 and 0.05 per cent. The coefficient of multiple determinations, (R^2) for cherry production on small farms was found tobe 0.56 indicating that about 56 percent of the variation in the production was explained by the variable considered in the model.

As far as returns to scale is concern the sum of regression coefficients on small farms was 1.4898 indicating increasing returns to scale as they are greater than unity however when these are tested for their deviation from unity,

Table 1: Estimates of Cobb-Douglas production function in marginal, small and medium farms in cherry production.

Variables	Parameters	Farm size		
		Marginal farmers	Small farmers	Medium farmers
Intercept	A	4.700	8.198*	11.887*
		(3.119)	(2.566)	(2.385)
Land under crop in hectares (X_1)	$_{b1}$	0.001	0.609*	0.722*
		(0.000)	(0.182)	(0.156)
Human labour in mandays (X_2)	$_{b2}$	0.741***	0.596*	0.402*
		(0.4410	(0.207)	(0.127)
Manures and fertilizer in Rs (X_3)	B3	0.673**	0.400**	-0.085
		(0.329)	(0.194)	(0.118)
Seeds in Rs (X_4)	B4	0.255	-0.063	0.132**
		(0.172)	(0.089)	(0.056)
Others in Rs (X_5)	B5	-0.525	-0.054	-0.021
		(0.465)	(0.228)	(0.230)
Coefficient of multiple determination	R_2	0.24	0.56	0.72
Sum of elasticity coefficients	(Σbi)	1.1434	1.4898	1.1518
Deviation from unity	Σbi-1	0.1434	0.4898	0.1518
value for deviation from unity	T	-0.1551	0.9527	0.2802
Returns to scale as indicated by t-test		Constant	Constant	Constant
Number of observations	N	40	60	100

Note: i) Figures in the Parentheses are standard error.

ii) * Significant at 1 per cent probability level.

iii) ** Significant at 5 per cent probability level.

iv)*** Significant at 10 per cent probability level.

Table 2: Returns and cost in cheery production (Rupees per hectare).

Crops	Return/Cost	Size of holdings		
		Marginal farmers	Small farmers	Medium farmers
Cherry	Returns (Rs)	120253.75	129500.30	164409.19
	Cost (Rs)	83132.18	130472.44	138607.68

they indicate constant returns to scale which means that if we increase the use of all the factor inputs by 1.00 per cent there will be 0.9527 per cent increase in the cherry output. However, analyzed data in (Table 2) explains the per hectare return and cost on small farms and it was found to be Rs 129500.30 and Rs 130472.44 respectively.

Medium farmers cherry cultivation

The medium farmers cherry yield and Yield Attributes data had been recorded in (Table1) and it was found that the factor inputs land and human labourhad elasticity coefficient values of 0.722 and 0.402 respectively which revealed that one unit increase in the input use of Land and Human Labour will lead to increase in gross returns by 0.722 and 0.402 units and was found statistically significant at 1 per cent respectively. The seeds had also a significant impact on cherry production and it had been observed that the 1 percent increase in seeds had led to an increase in the Gross returns by 0.132 units and was found statistically significant at 5 per cent respectively. The production elasticity in respect of manures and Fertilizers and others (X_5) was negative which indicates the excess use of the given resources and implies that if these other resources increase by one percent, then average production shall be reduced by 0.08 and 0.02 per cent. However, the coefficient of multiple determinations, (R^2) for cherry production on medium farms was found to be 0.72 indicating that about 72 percent of the variation in the cheery production wasexplained by the variable considered in the model.

Economics of scale explains the overall picture of the farm Input-Output efficiency which revealed the response of output to an overall increase in the use of all the factor inputs. The study had found 1.1518 sum of regression coefficients on medium farms indicating increasing returns to scale however when these are tested for their deviation from unity, they indicate constant returns to scale which means that response of output to an overall increase in the use of all the factor inputs by 1.00 per cent will be 0.2802 per cent. However, analyzed data tabulated in (Table 2) revealed the per hectare return and cost on Medium farms and it was found to be Rs 164409.19 and Rs 138607.68 respectively.

CONCLUSION

The research conducted revealed that the elasticity coefficient of land on cheery production is higher on medium farms and significant at 1.00 per cent probability level indicating more response to increasing the gross output as compare to other farm sizes whereas as a coefficient of human labour mandays is concern it is higher on marginal farms with a ten per cent significance level. However, the coefficient of manures and fertilizers used is highest on marginal farms for cheery production with significance at a 5 percent level as compared to the medium farms which are negative. As far as the coefficient of others(X_5) is concerned it was found to be negative on all farm size, therefore, indicating excess use of the given resources whereas the coefficient of seeds was found to be significant on medium farms at a 5.00 percent level.

Thus from the research one can conclude that the resource performance of all the farm size for most of the Inputs looks positive for cheery production of the study area however, the T-test reveals that every farm size is getting constant returns to scale which leads us to the following suggestions:

The performance of land input on marginal farms is very less in cheery production and a possible reason for the same can be land holding, soil quality and poor farm technology which needed to be enhanced to obtain optimum land productivity.Medium farms are facing a problem of labour output which is less in comparison to the other holdings therefore recommends to improve the same with the proper labour management with removing the disguised unemployment from the farm.However, manures and fertilizers are not showing a positive elasticity picture for small and medium farms therefore recommend the need base application of inputs as per the requirement of the soil.

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