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Estimate the Resource use Efficiency in Production of Chick-Pea in Chhattisgarh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study is based on 225 respondents of various size-groups, marginal, small, medium and large. Cobb-Douglass production function was applied for estimating resource use efficiency of chick-pea cultivation. Objective of the study is to workout resource use efficiency of chick-pea cultivation. Value of R^2 was observed as 0.7940, which explaining that 79.40 per cent variation in yield of chick-pea crop was explained by included factor in the study area. MVP (Marginal Value Product) of all included factors were found more than unity, explaining that there is further scope of investment on this factor to realizing optimum production.

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Keywords: Cobb-Douglas production function; resource use efficiency; marginal value product; elasticities and functional analysis.

JEL Codes: *C10, C19, D61, Q19.*

1. INTRODUCTION

“In many developing countries, chick pea is a major source of protein, especially among the poorest segments of the population, who depend on vegetable sources to meet their protein and energy needs. Chickpea is cultivated under varying environmental conditions in around 57 countries all over the world with 80 percent of the regional contribution, South and Southeast Asia dominates the production of chickpea. India is the world's single largest chickpea producer, accounting for 65 percent (9,075 million tonnes) of global chickpea production. In India in context to the area of the chick-pea Madhya Pradesh accounted for 36.37 percent of the total area and 45.54 percent of the country's total chick-pea production in 2018-19 and secure rank first in both area and production. In terms of area, Maharashtra (16.94 per cent) and Rajasthan (15.92 per cent) were next” [1]. “The ten states Madhya Pradesh, Rajasthan, Maharashtra, Karnataka, Uttar-Pradesh, Andhra-Pradesh, Gujarat, Jharkhand, Chhattisgarh and Telangana accounted for more than 90% of the country's chick-pea output during the reporting period” [2-4]. Chhattisgarh's most important pulse crops are Chickpea, Lathyrus, Pigeon Pea, Black Gram and Green Gram. Chick pea is the most significant pulse crop in the state of Chhattisgarh. It currently occupies an area of 33.09 thousand hectares, with production in Chhattisgarh of 34.55 thousand metric tonnes. Bemetara, Rajnandgaon, Kabirdham and Durg are the main districts for rising chickpea.

2. MATERIALS AND METHODS

2.1 Sampling Procedure

A multi-stage sampling design has been adopted for the ultimate selection of chickpea growing farmers. Multi stage sampling has been selected for the study. State was the first stage, district was the second stage, blocks were the third stage and households of farm categories were the ultimate stage. Chhattisgarh state consists of 28 districts, out of these 28 districts Bemetara district cover largest area i.e. 104235 ha area which is 31.50 % of total area and it also contribute highest relative share in production i.e. 127562 tonnes which is 36.92% of the total production of Chickpea in state and hence Bemetara district was selected purposely for the study. Bemetara district having 5 blocks namely Bemetara, Saja, Navagarh, Thankhamariya and Berala. Out of 5 blocks 2 blocks namely Bemetara and Saja block were selected purposively from the district because it covers largest area i.e. 53755 ha area which is 55.88% of total chickpea area in the district. For the selection of the villages simple random sampling has been adopted. A sample of 5% to the total no. of villages has been selected from each block therefore nine villages were selected from Bemetara block and six villages were selected from Saja block for the study. A total number of fifteen villages were selected randomly. For the selection of the chickpea respondents 15 farmers were selected randomly from each village. A total 225 farmers were selected for the study. These farmers were further classified into different categories based on their land holding i.e. marginal (up to 1.00 ha), small (1.01 ha to 2.00 ha), medium (2.01 ha to 4.00 ha) and large (above 4.00 ha) farmers for the present study. The division of total number of the farmer in each category was done by using stratified sampling technique [5].

2.2 Method of Enquiry and Data Collection

The study was based on primary data. The method of enquiry was conducted by survey method and collection of information was based on primary information. The primary data were obtained from the survey of sample respondents of chickpea growers through personal interview with the help of pre-tested schedules. The data included the various cost incurred in cultivation and returns.

2.3 Analytical Tools

2.3.1 Estimation of marginal physical productivity

The Marginal Physical Productivity (MPP) of different inputs was estimated at geometric mean level of respective input and output with the help of following formula:

Marginal Physical Product (MPP) of Xith input = bi ($\bar{Y}$/ ($\bar{Xi}$))

Where,

Bi = Production elasticity of ith input (Regression coefficient)
$\bar{Y}$ = Geometric mean of output
($\bar{Xi}$) = Geometric mean of ith input

2.3.2 Estimation of Marginal Value Product (MVP)

The marginal value productivity of ith input was calculated by multiplying unit price of output to MPP of respective ith input.

2.3.3 Resource use efficiency

To estimate the resource use efficiency of respective inputs, MVP of resource was compared with its unit costs (factor price) and the ratio of MVP to factor cost was worked out for judging resource use efficiency.

Ratio		Level of resource use
a) MVP / Factor price	=	1 Optimum utilization of resource
b) MVP /Factor price	>	1 Under utilization of resource
c) MVP / Factor price	<	1 Excess utilization of resource

2.4 Model and Estimation

To estimate resource use efficiency in chickpea production, Cobb-Douglas production function (non-linear) was fitted to chickpea input-output data separately for each category.

Y= a.x1b1. x2b2. x3b3…….xnbn. e

This function can easily be transformed into a linear form by making logarithmic transformation, after logarithmic transformation this function is.

Log Y = log a + b1 log X1 +b2 log X2 + ---------- b6 log X6 + a log e

Where,

Y = Yield (qt ha-1)
X1= Land input (ha)
X2= Labour input (hrs ha-1)
X3= Fertilizer and manure input (Rs/ ha-1)
X4= Irrigation water input (cost plot-1)
X5= Seeds input (cost kg-1)
X6= Plant protection Chemicals (Rs ha-1)
b1 to b6 = Regression coefficient of respective variables
e = Random term with zero mean and constant variance.

3. RESULTS AND DISCUSSION

3.1 Production Function Analysis for Estimation of Resource use Efficiency

- The resource use efficiency for chick-pea production has been analyzed with Cobb–Douglas production function frame work. Cobb-Douglas production function was fitted to the sample data separately for chick-pea cultivation. The Cobb-Douglas production function was found to be “best fit” to the present data. The regression coefficient for identified resources for chick-pea is presented in Table 1.
- The coefficient multiple determinations (R2) indicates that proportion of total variation in the dependent variable (i.e. crop output) explained by the 6 independent variable jointly. It was observed that form Table 1 overall level the value of coefficient of multiple determinations (R2) was 0.7940, indicated that 79.40 per cent variation in chick-pea production was explained by variables included in the function Thakur et al. [6]. It is also revealed from Table 1 that the regression coefficient for land (X1) was found positive and statistically non-significant indicating no significant effect of these variables on yield of chick-pea.
- Human labor (X2) was found positive and statistically non-significant indicating no significant effect of these variables on yield of chick-pea.,
- Irrigation (X4) was found positive and statistically non-significant indicating no significant effect of these variables on yield of chick-pea.
- Fertilizer (X3) was positive and found statistically significant at 1 per cent level of probability. Seed input (X5) and plant protection chemicals (X6) were positive and found statistically significant at 1 per cent level of probability. A.K. Verma et al. [7].
- As we consider, positive and significant coefficients indicated that, one unit increase in the fertilizer, plant protection chemicals and seed inputs were increase the yield by 0.026, 0.183 and 0.167 per cent, respectively [8,9].

Table 1. Regression co-efficient of independent variables in estimated Cobb-Douglas production function in chick-pea

S. No.	Particulars	Parameters	Regression Coefficient(bi)	Standard Error(SE)
1.	Intercept	A	0.323	0.507
2.	Land (ha.)	X1	0.057	0.069
3.	Human Labor (man days)	X2	0.089	0.056
4.	Fertilizer (Rs.)	X3	0.026*	0.067
5.	Irrigation(Rs.)	X4	0.153	0.054
5.	Seed input (Rs.)	X5	0.167**	0.062
6.	Plant protection chemicals (Rs.)	X6	0.183**	0.039
7.	R square	R^2	0.7940	
8.	Return to scale(Sum of bi)	$\sum \boldsymbol{bi}$	0.675	

Note: *- ** Significant at 1% level of probability; * Significant at 5% level of probability; (R^2 =Coefficient of multiple determinations)*

Table 2. Marginal value product (MVP) and Resource use efficiency (RAU) for chick-pea

S. No.	Variables	Marginal Value Product (MVP)	Marginal Factor Cost (MFC)	MVP/MFC ratio	Remark
1	Land (ha.)	4208.65	12500	0.336692	Overutiliized
2	Human Labor (man days)	0.3606	150	0.002404	Over utilized
3	Fertilizer (Rs.)	9.6291	24	0.401212	Overutiliized
4	Irrigation (Rs.)	3.8320	800	0.00479	Overutiliized
5	Seed (Rs.)	1.4813	60	0.024688	Overutiliized
6	Plant protection Chemical (Rs.)	12.6892	540	0.023498	Overutiliized

3.2 Resource use Efficiency for Chick-Pea

The production function analysis has been generally used to determine the resource use efficiency which requires estimated of marginal value product of resources [10,11]. The resource is considered to be most efficiently used if its marginal value product just offsets its cost. The resource use efficiency was studied and the marginal value product (MVP) of each explanatory variables were computed with marginal factor cost (MFC) to know the resource use efficiency of farmer and the results are presented in Table 2. It is seen that at overall level the ratio of MVP/PX is less than unity in case for all. The resources showed excess utilization of these resources [12,13]. Use of these resources should be curtailed down for maximization of profit. From the above discussion, variation in the resource productivities as well as in their use efficiency in chick-pea cultivation was noticed. It is seen that at overall level the ratio of MVP to MFC is less than unity for land (0.336692) followed by human labor (0.002404), fertilizer (0.401212), irrigation (0.00479), Seed input (0.024688) and Plant protection Chemical (0.023498) indicated over utilization of these resources in chick-pea cultivation. Use of these resources should be curtailed down for maximization of profit. From the above discussion, variation in the resource productivities as well as in their use efficiency in chick-pea cultivation was noticed [14].

4. CONCLUSION

It is seen that at overall level the ratio of MVP/PX is less than unity in case for all. The resources showed excess utilization of these resources. Use of these resources should be curtailed down for maximization of profit. From the above discussion, variation in the resource productivities as well as in their use efficiency in chick-pea cultivation was noticed. It is seen that at overall level the ratio of MVP to MFC is less than unity for land (0.336692) followed by human labor (0.002404), fertilizer (0.401212), irrigation (0.00479), Seed input (0.024688) and Plant protection chemical (0.023498) indicated over utilization of these resources in chick-pea cultivation. Use of these resources should be curtailed down for maximization of profit. From the above discussion, variation in the resource productivities as well as in their use efficiency in chick-pea cultivation was noticed [15].

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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