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Factors Affecting Production of Important Pulse Crops in Rajasthan: A Cobb Douglas Analysis

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ABSTRACT

Background: Pulses are one of the most important food crops grown globally owed to their higher protein content. It also accounts for larger financial gains of the agricultural sector by amounting for a large part of the exports. The present study was carried out to determine the factors affecting production of pulse crops in Rajasthan.

Methods: This paper based on secondary data collected over the years *i.e.* from 2000-01 to 2017-18. The Cobb-douglas production function was used to the observation for the estimation of elasticity of selected variables contributing to the production of pulses in Rajasthan state, Cobb douglas type production function was employed to assess the effects of seed, fertilizer, manure, human labour, irrigation, bullock labour and plant protection measures on pulses production.

Result: The results from the study have shown that fertilizer and plant protection measures were positively significant while the variable corresponding to irrigation water was negatively significantly affecting the gram production. The variables such as seed and irrigation water were found positive and significant, while plant protection measures had significant negative effect on black gram production. Only two variables namely, fertilizer and irrigation water were found positively significant out of estimating production function of green gram.

Key words: Growth, Production, Significant and pulses.

INTRODUCTION

India is the largest producer and consumer of a wide variety of pulses in the world, dominated by tropical and subtropical crops such as chickpea, black gram, red gram, green gram and lentil are high in protein, fiber, vitamins and also high quality carbohydrates, minerals and vitamins suppliers. Compared with cereals, pulse-supplied carbohydrates are released slowly and thus have a high benefit in maintaining optimum levels of blood sugar and retaining energy after meals for a long time Ayalew *et al*. (2015). The Production of pulses has virtually stagnant with production and area over the last 25 years (450kg/ha) in Rajasthan. The reason beyond for this is that pulses are mainly grown on marginal soil as a residual crop, after diverting better irrigated soils for higher yields - higher input crops such as wheat and mustard.

Rajasthan occupies huge geographical area of 342.7 lakh hectares is the largest state of India covers nearly 10.4 per cent geographical area of the country. The state with its Agriculture is reflected to be the main stay of rural crowds in this state. Agriculture and allied activities account for nearly one fourth of the Gross State Domestic Product (GSDP) against 14 per cent at National Level. Agriculture is rain-fed in most parts of the state and prone to high production risks. In order to satisfy the requirements of the farms as well as the community, farmers in the state have evaluated various combinations of crops, livestock, horticulture and forestry, *etc*. Production of cereals, oilseeds, vegetables, pulses, fruits, milk and other commodities be fitting to diverse agro-climatic situations has been a matter of great concern for the rural people.

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With the decline in the share of agriculture in the GDP, Indian economy has faced structural changes. Even though a fall in its share from 55.11 per cent in 1950-51 to 13.90 per cent in 2017-18 (Hazari 2015). Despite two big reasons the importance of agriculture has not diminished. First, the country achieved self-sufficiency in food grain production at the macro level, but still is a food deficit country acing massive challenges of high prevalence of malnourished children and high incidence of rural poverty. There is a high demand on agriculture to produce more and double the farmer’s income. Second, the rural workforce ‘s reliance on agriculture for jobs did not decline in relation to its sectorial contribution to GDP. As a result, the income gap between the agricultural and non-agricultural sectors has increased (Chand and Chauhan, 1999). The experiences of developed countries have shown that there has been a transition of labour-power from agriculture to non-agricultural generally and in particular to the manufacturing sector. This had brought improved agricultural production growth and higher incomes Gollin *et al.* (2002). Under these situations, higher growth in agriculture assumes huge importance and is a matter of worry for policy makers and research scholars in current times.

The basic challenge every farmer facing in agriculture is to increase output and minimize the cost. For this, one must know how efficiently the farmers are currently using the inputs, identify the inputs that are inefficiently used and then measures can be suggested to efficiently use such inputs to increase production and also to minimize cost Chand *et al*. (2007). In order to identify the efficient use of inputs production function analysis is the relevant technique. The production function analysis gives an explicit idea regarding the use of inputs and their influence on output. The production function analysis determines the productivity levels of different inputs and assesses the contribution at margin to the output. To know input - output relationship among the farmers contacted in the present study, Cobb-Douglas production function technique is employed. The use of Cobb-Douglas production function in agriculture production economics is due to (1) computational manageability with this algebraic form and (2) the information regarding returns to scale which it provides and theoretical fitness to agriculture. The Cobb-Douglas production function has been estimated using least square method of regression Douglas *et al.* (2002).

MATERIALS AND METHODS

Selection of study area, crops and data collection

Whole Rajasthan state has been purposively selected for the study. Rajasthan is known as ”Land of Kings” and India’s largest state by area (342,239 square kilometres) and occupies 10.4 per cent area of the total geographical area of India. The climate of Rajasthan is generally arid or semi-arid. Agriculture is the main occupation in Rajasthan. Agriculture production mainly depends upon South-East monsoon rains. The rainfall behaviour generally remains abnormal being irregular, uneven and uncertain, scanty with drought period and occasional local floods.

The present investigation was based on cost of cultivation scheme running in the department of Agricultural Economics and Management, Rajasthan College of agriculture, Udaipur. The crops included namely Gram, Green gram and Black gram, which are under the cost of cultivation scheme, were selected for the present study. The study was rely on secondary data. During the study we have examined factors responsible for temporal changes in production for the period 2000-01 to 2017-18. The data on crop inputs included human labour (man days/ha), bullock labour (pair days/ha), machine labour (man days/ha), seed (kg/ha), manure (tonne/ha), fertilizer (kg/ha), insecticides (kg/ha) and irrigation (Rs/ha).

Research method

A Cobb-Douglas production function models the relationship between production output and production inputs (factors). It is used to calculate ratios of inputs to one another for efficient production and to estimate technological change in production methods. The Cobb-Douglas production Function is employed to assess the effects of various inputs seed, fertilizer, manure, irrigation, plant protection, human and bullock labour of temporal change in production of pulse crops.

The model

The following model of Cobb-Douglas production function was used in the study (Chaudhry and Khan 2009).

$$Y = A\, X_i^{b1}\, X_i^{b2}\, X_i^{b3}\, X_i^{b4} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots X_n^{bn}$$

Where,

Y = Production (kg/ha)

X_i = Seeds, plant nutrients, plant protection chemicals, human and bullock labour *etc*. (in physical/value units per hectare)

A = Scale parameter

b = Production elasticity

X_1 = Seed

X_2 = Fertilizer

X_3 = Manure

X_4 = Human labour

X_5 = Bullock labour

X_6 = Irrigation

X_7 = Plant protection measures.

The aims of this study determine the factor affecting to production and the relative importance of each factor in increasing production. Hence, relying on scientific research, we can expect an improvement in the productivity and performance of the agricultural units. The overall goal of the study is to estimate the crop production yield, determining the elasticity of production, measuring the effect of factor in production Sekhar *et al.* (2018).

RESULTS AND DISCUSSION

Production function estimates for gram

Chickpea (gram) is major pulse crop in India contributed about 49 per cent of total production. Madhya Pradesh is the highest producer of gram contributing around 35 per cent in the national production, followed by Rajasthan and Maharashtra. Rajasthan contributes 13.19 per cent of total gram production in India Gajbhiye *et al.* (2010).

The Cobb-Douglas production function was fitted to the observation for the estimation of elasticity’s of important variables contributing to the production of gram in Rajasthan state (Table 1). The Cobb-Douglas production function is employed to assess the effects of various inputs seed, fertilizer, manure, irrigation, plant protection measures, human and bullock labour of temporal change in production of important crops. The value for the coefficient of multiple determination (R^2) for gram crop was 0.71, which suggested

Table 1: Cobb-Douglasproduction function estimates for gram crop.

Particulars	Regression coefficient	Value of coefficient
Constant	A	8.21
Seed (kg) X_1	b_1	0.12 (0.34)
Fertilizer (kg) X_2	b_2	0.12**(0.14)
Manure (kg) X_3	b_3	-0.11(0.11)
Human labour (hrs.) X_4	b_4	0.08(0.49)
Bullock labour (Pair hrs.) X_5	b_5	-0.14(0.07)
Irrigation (X_6)	b_6	-0.06*(0.12)
Plant protection measure (X_7)	b_7	0.57*(0.04)
R^2		0.71

** and * significant at 1 and 5 per cent level of significance, respectively. Figures in the parenthesis indicates standard error of respective coefficients.

Table 2: Cobb-Douglas production function estimates for urad crop.

Particulars	Regression coefficient	Value of coefficient
Constant	A	9.27
Seed (kg) X_1	b_1	0.28*(0.86)
Fertilizer (kg) X_2	b_2	0.04(0.21)
Manure (kg) X_3	b_3	0.28(0.11)
Human labour (hrs.) X_4	b_4	0.04(0.18)
Bullock labour (Pair hrs.) X_5	b_5	-0.01(0.13)
Irrigation (X_6)	b_6	0.13*(0.09)
Plant protection measure (X_7)	b_7	-0.28*(0.20)
R^2		0.75

** and * significant at 1 and 5 per cent level of significance, respectively. Figures in the parenthesis indicates standard error of respective coefficients.

that the seven resources included in the production function jointly explained as medium as 71 per cent of total variation in gram production in Rajasthan state. It was concluded among the different variables under study that fertilizer (X_2) and plant protection measures (X_7) were positively significant and could increase the production by employing more units of these inputs in producing the gram crop in Rajasthan state. The variable irrigation water was negatively significantly affected gram production.

The negative sign of irrigation water signals that this input has been over utilized or underutilized in gram crop cultivation. The coefficients of fertilizer and plant protection measures were 0.12 and 0.57, respectively. These coefficients can be interpreted as fallow: one percent increase in fertilizer and plant protection would lead to 0.12 and 0.57 per cent increase in gram production, respectively. While 1 per cent increases in irrigation water is lead to 0.06 per cent decrease in the gram production. Seed and human labour were found positive and non - significant factors to contribute for production for gram crop. While bullock labour and manure was found to be negatively contributing factor but insignificant. Similar finding were observed by (Yuan 2011) in sector of agriculture in North China.

Production function estimates for black gram

Black gram (urad) is one of the important pulse crop grown throughout India. It is consumed in the form of 'dal' (whole or split, husked and un-husked) or perched. Urad differs from other pulses in its peculiarity of attaining a mucilaginous pasty character when soaked in water. It is consumed variety of ways across the north to south in preparation of different regular and popular like vada, idli, dosa, halwa, imrati in combination with other food grains. Also used as a nutritive fodder for miltch cattle. The main areas of production being Madhya Pradesh, Rajasthan, Uttar Pradesh, Punjab, Maharashtra, West Bengal andhra Pradesh and Karnataka. Rajasthan contributes 10.26 per cent of total black gram production in India Biswas *et al.* (2002).

For estimation of elasticity of important variables of black gram production in Rajasthan state Cobb-Douglas production function was used (Table 2). The Cobb-Douglas production function is employed to assess the effects of various inputs seed, fertilizer, manure, irrigation, plant protection measures, human and bullock labour of temporal change in production of important crops. The value for the coefficient of multiple determinations (R^2) for black gram crop was 0.75, which suggested that the seven resources included in the production function jointly explained as high as 75 per cent of total variation in black gram production in Rajasthan state. The variables such as seed and irrigation water were found positive and significantly effect on black gram production. This input indicates that the more seed and irrigation water use, the higher the black gram production. Similar finding were found by Ahmadzadeh *et al.* (2017) in sugar beet in Miandoab area. On the contrary plant protection measures had negative significantly effect on black gram production. The negative sign of plant protection measures signals that this chemical input has been over utilized in black gram disease control. The coefficients of seed and irrigation water were 0.28 and 0.13, respectively. The coefficients can be interpreted as fallow: one percent increase in seed and irrigation water would lead 0.28 and 0.13 per cent increase in black gram production, respectively. While 1 per cent increases in plant protection measures would lead to 0.28 per cent decrease in the black gram production. Fertilizer, manure and human labour were found positive and non significant factors to contribute for production for black gram crop. While bullock labour was found to be negatively contributing factor but insignificant.

Production function estimates for green gram

The Cobb-Douglas production function was fitted to the observation for the estimation of elasticity's of important variables contributing to the production of green gram in Rajasthan state (Table 3). The Cobb-Douglas production function is employed to assess the effects of various inputs seed, fertilizer, manure, irrigation, plant protection measures, human and bullock labour of temporal change in production

Table 3: Cobb-Douglas production function estimates for moong crop.

Particulars	Regression coefficient	Value of coefficient
Constant	A	0.15
Seed (kg) X_1	b_1	0.20(0.90)
Fertilizer (kg) X_2	b_2	0.25*(0.17)
Manure (kg) X_3	b_3	-0.09(0.07)
Human labour (hrs.) X_4	b_4	1.54(0.99)
Bullock labour (Pair hrs.) X_5	b_5	-0.0046(0.11)
Irrigation (X_6)	b_6	0.27*(0.13)
Plant protection measure (X_7)	b_7	-0.20(0.17)
R^2		0.79

** and * significant at 1 and 5 per cent level of significance, respectively. Figures in the parenthesis indicates standard error of respective coefficients.

of important crops. The value for the coefficient of multiple determinations (R^2) for green gram crop was 0.79, which suggested that the seven resources included in the production function jointly explained as high as 79 per cent of total variation in green gram production in Rajasthan state. According to Table 3 only two variables fertilizer and irrigation water found positively significant in the result of estimating of production function. Similar findings were reported by Sikdar *et al.* (2008) in boro rice in Bangladesh.

The sign of coefficients, of fertilizer and irrigation water were positive and significant. The coefficient of fertilizer and irrigation were 0.25 and 0.27, respectively. These coefficients can be interpreted as fallow: one per cent increase in fertilizer and irrigation water would lead to 0.25 and 0.27 per cent increase in production of green gram. The variable such as seed and human labour were found positive and non-significant factors to contribute for production for green gram crop. While manure, bullock labour and plant protection measures were found to be negatively contributing factor but insignificant. Green gram resulted that fertilizer and plant protection measures were positively significant while the variable irrigation water was negatively significantly affected green gram production Hassan *et al.* (2015).

CONCLUSION

The Cobb- Douglas production function used in gram resulted that fertilizer and plant protection measures were positively significant while the variable irrigation water was negatively significantly affected gram production. The value for the coefficient of multiple determinations (R^2) for gram crop was 0.71. The Cobb - Douglas production function was fitted for the estimation of elasticises of important variables contributing to the production of black gram in Rajasthan state. The value for the coefficient of multiple determinations (R^2) for black gram crop was 0.75. The variables such as seed and irrigation water were found positive and significant while plant protection measures had significant negative effect on black gram production. The value for the coefficient of multiple determinations (R^2) for green gram crop was 0.79. Only two variables fertilizer and irrigation water found positively significant in the result of estimating of production function on green gram.

Proper management of costly inputs needs strengthening the extension services. Judicious use of inputs like pesticides and fertilizers not only help in keeping low production costs but will maintain soil health and sustain productivity.

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