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Resource productivity and resource use efficiency in soybean production

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ABSTRACT

Soybean [*Glycine max* (L.) Merrill] is the world's natural source of protein. Soybean is the most important oilseed crop of the world. Soybean is grown successfully in various agro-climatic conditions. Investigation was carried out for the year 2007-08 in order to study the marginal productivity and economic efficiency in soybean production in Latur district of Marathwada region of Maharashtra. The cross sectional data were collected from 180 soybean growers. Cobb-Douglas production function was fitted to the data in soybean production. Results revealed that, partial regression coefficients of phosphorus (0.081) and plant protection (0.055) were positive and significant at 1 per cent level of significance. Similarly partial regression coefficients of machine labour (0.427) and nitrogen (0.028) were positive and significant at 5 per cent level of significance. It could be inferred that, if one per cent increased in use of phosphorus, plant protection, machine labour and nitrogen, it would lead to increased the soybean production by 0.081, 0.055, 0.427 and 0.028 per cent, respectively. Thus, it implied that, there was scope to increase these resources in soybean production. The value of coefficient of multiple determination (R^2) was 0.94.

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Key words : Soybean, Resource productivity, Production function, Optimum resource

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is the world's natural source of protein. Soybean is grown successfully in various agro-climatic conditions. It is grown in temperate region. It is also grown well in sub-tropical and tropical regions. Though, soybean is a legume crop, yet it is widely used as oilseed crop. Due to very poor cookability on account of inherent presence of trysin inhibitor, it cannot be utilized as pulse crop. In India, farm business is the basic business but due to lack of management, it is not much profitable. Farm business management has assumed greater importance not only in developed and commercial agriculture all around the world but also in developing and subsistence type of agriculture. A farm manager must not only understand different methods of agriculture production, but he must allocate scarce production resources in the farm business. Farm management is concerned with resource allocation. Farmer has set of farm resources such as land, labour, seed, fertilizers, irrigation and so on that are relatively scarce. By managing these scarce resources farmer can achieve the maximum production. According to Kunte *et al*. (2009) about 92 per cent of variation in the production of soybean can be due to the selected resources. It was observed that human labour, bullock labour, manures, fertilizers and working capital were positively influencing soybean production.

MATERIALS AND METHODS

Multistage sampling design was used to selection of district, tehsils, villages and soybean growers. In the first stage, Latur district was purposely selected because of highest area under soybean crop as compared to other districts of Marathwada region of Maharashtra State. In the second stage Latur and Renapur tehsils were selected on the basis of highest area under soybean crop. In the third stage, 12 villages were selected from two tehsils. In the fourth stage, from each of selected villages, 15 soybean growers were randomly selected. In this way, 180 soybean growers were selected for the present study. Data were collected from them with the help of pretested schedule by personal interview method. Data pertained to production of soybean from each soybean grower and use of resources namely area under soybean, hired human labour, bullock labour, machine labour, nitrogen, phosphorus, manure and family labour for the year 2007-08. With the help of correlation matrix of the above variables, independent variables which were significant with respect to dependent variables were taken into consideration. Thus, these independent variables were included in both the linear and Cobb-Douglas production function. On the basis of goodness of fit (R^2) Cobb-

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Douglas production function was selected as follows. $\hat{Y} = aX_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.\ X_7^{b7}.X_8^{b8}.X_9^{b9}.e^u$.
where, $\hat{Y}$ = Estimated production of soybean in q per farm, a = Intercept of production function, b_1 = Partial regression coefficients of respective variables (i = 1,2,3,…9), X_1 = Area of soybean in hectare, X_2 = Hired human labour in man day per farm, X_3 = Bullock labour in pair day per farm, X_4 = Machine labour in hour per farm, X_5 = Nitrogen in kg per farm, X_6 = Phosphorus in kg per farm, X_7 = Manures in q per farm, X_8 = Plant protection in liter per farm, X_9 = Family labour in man days per farm, e^u = Error Term. The function is transferred into lon-linear form. Log Y = $\log_a + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6 + b_7\log X_7 + b_8\log X_8 + b_9\log X_9$ + ulog e.

Terms and concepts were used in the investigation explained as follows. Human labour were measured in man days. One man day consisted with 8 hours. Labour cost was evaluated at the rate of Rs.100 for per day for male and Rs.50 per day for female. The female labour was converted into man days to multiplying to number of female with 0.50. Hired bullock labour was charged at the rate of Rs.150 per day for one pair of bullocks. Machine labour in case of owned machine was evaluated as per the hired charges prevailed in the village and in case of hired machine, as per the actual amount paid. The value of purchased seeds was considered as the prevailing of price in the locality at the time of sowing of the crop. The rate prevailing in the market for nitrogen, phosphorus and potash was Rs.11.30/kg, Rs.20.00/kg and Rs.8.50/kg, respectively. One cart load of manure was considered as 3 quintals and its prevailing price was Rs.150 per cart load. Plant protection includes the actual cost incurred on purchase of insecticides, pesticides, fungicides and their procurement. For present study plant protection was Rs.250 per liter. Cobb-Douglas production function allows either constant, increasing or decreasing marginal productivity. The MP equation is MP = bi $\overline{Y}/\overline{X}$, where, bi is partial regression coefficient of particular variable. $\overline{Y}$ = geometric mean of dependent variable, $\overline{X}$ = geometric mean of particular independent variable. The MVP of various input worked out by the formula MVP=bi $\overline{Y}$ py / $\overline{X}$, where Py is price of soybean per quintal. Resource use efficiency refers to the ratio of MVP with respect to a particular resource to acquisition price of that resource.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussion have been presented under the following sub heads:

Estimates of Cobb-Douglas production function in soybean production:

Partial regression coefficients with respect to various explanatory variables were calculated with 't' values and are presented in Table 1. It was observed that, partial regression coefficients of plant protection (0.055) and phosphorus (0.081) were positive and significant at 1 per cent level of significance. While partial regression coefficients of machine labour (0.427) and nitrogen (0.028) were also significant at 5 per cent level of significance. It was inferred that, if one per cent increased in use of phosphorus, plant protection, machine labour and nitrogen over the geometric means, it would lead to increase soybean production by 0.081, 0.055, 0.427 and 0.028 per cent, respectively. Likewise partial regression coefficients with respect to bullock labour (0.182) and family labour (0.039) were positive but non-significant. On the contrary, partial regression coefficient with respect to hired human labour was found negative and non-significant. The coefficient of multiple determination (R^2) was 0.94, which indicated 94 per cent of variation in soybean production was explained due to variation in all independent variables. F' value was 320.08 which was highly significant. It was clear that each explanatory variable on its own was not very important but together they explained significantly part of variation in soybean production.

Marginal products of explanatory variables :

It was observed from the Table 1 that, marginal productivity with respect to area was the highest as 2.323 quintals followed by machine labour (0.167 q), plant protection (0.163 q), family labour (0.093 q) and so on. It inferred that, if area under soybean increased by one hectare at its geometric mean level, it would lead to increase the soybean production with 2.323 quintals. Similarly per unit of machine labour, plant protection and family human labour increased, it would cause to increase the production of soybean with 0.167q, 0.163q and 0.093q, respectively.

Resource use efficiency of explanatory variables :

In regard to resource use efficiency, it was evident that, use of family human labour in soybean production indicated the highest MVP to price ratio (1.69) followed by plant protection (1.18), nitrogen (1.12) and manure (1.12) which were greater than unity. It implied that, there was scope to increase these resources in soybean

Table 1 : Estimates of Cobb-Douglas production function in soybean production on overall farm

	Independent variable	Partial regression coefficient (bi)	Standard error (SE) of bi	't' value	Geometric mean of input (Xi)	Marginal product (q)	Marginal value product (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use
1.	Area of soybean (ha/farm)	0.157	0.333	0.471	2.53	2.323	4215.38	4475.60	0.94	-
2.	Hired human labour (man day/farm)	-0.011	0.008	-1.375	147.04	-0.011	-1.81	100	-0.01	-
3.	Bullock labour (Pair day/farm)	0.182	0.096	1.895	31.40	0.089	161.50	150	1.07	-
4.	Machine labour (hour/farm)	0.427	0.181	2.359*	39.16	0.167	303.04	300	1.01	39.72
5.	Nitrogen (kg/farm)	0.028	0.013	2.153*	54.62	0.007	12.70	11.30	1.12	69.15
6.	Phosphorus (kg/farm)	0.081	0.019	4.263**	105.24	0.012	21.77	20	1.08	113.03
7.	Manure (q/farm)	0.038	0.025	1.520	18.82	0.031	56.25	50	1.12	-
8.	Plant protection (lit/farm)	0.055	0.019	2.894**	5.21	0.163	295.78	250	1.18	6.13
9.	Family labour (man day/farm)	0.039	0.027	1.444	6.43	0.093	168.76	100	1.69	-

Intercept (log a) : 0.162
R^2 : 0.94
'F'-value : 320.08
n : 180

Note : Geometric mean (Y) of soybean production was 37.44 q per farm and price was Rs.1814.63/q
* and ** indicate significance of values at P=0.05 and 0.01, respectively

production. The present findings are consonance with the results obtained by Bansode (2008), Bhagwat (2008) and Jadhav (2008) regarding significance of nitrogen, phosphorus and plant protection.

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