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Research Article

Resource productivity and resource use efficiency in maize production

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SUMMARY : Investigation was carried out during the year 2010-11. About 60 maize growers were randomly selected from Kannad and Sillod tehsil of Aurangabad district of Maharashtra. Cross sectional data were collected from maize growers with the help of pretested schedule by personal interview method. Data were related to maize output and inputs like area under maize, hired human labour, bullock labour, machine labour, seed, manure and use of nitrogen, phosphorus, potash and family labour as resources. Cobb Douglas production function was fitted to the data. The results revealed that, regression coefficient of area under maize was (0.279) followed by bullock labour (0.103) and machine labour (0.082) which were positive and highly significant at 1 per cent level. Regression co-efficient of manure (0.162) was positive and significant at 5 per cent level. A regression co-efficient of phosphorus was negative but significant at 1 per cent level. Marginal product of area under maize was 15.776 q followed by bullock labour (0.927 q), machine labour (0.848 q) and so on. MVP to price ratio with respect to bullock labour was 3.26 followed by that of manure (2.88). Hence, preference might be given to increase the use of bullock labour on priority basis in maize production.

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BACKGROUND AND OBJECTIVES

Maize (*Zea mays L.*) is one of the most important cereals of the world and provides more human food than any other cereal. The origin of maize is Central Mexico in America. It contributes about 20 per cent world's total cereal production. In the United States of America, it is simply known as corn.

Maize is emerging as an important cereal crop in the world after wheat and rice. Maize grain contains about 10 per cent protein, 4 per cent oil, 70 per cent carbohydrates 2.3 per cent crude fibre, 10.4 per cent albuminoides and 1.4 per cent ash. Maize grain has significant quantities of vitamin A, nicotinic acid, riboflavin and vitamin E.

The climate of Aurangabad district is favourable for maize production. Hence, maize is predominant crop in cropping pattern of farmer in the district. The district has medium to heavy soils. The average rainfall of district is 734 mm. In maize production, area under maize, human labour, bullock labour, machine labour, seed, manure, nitrogen, phosphorus, potash and family labour are the important resources. In production process, some of the resources are either over utilization or under utilization. By keeping in view the resource management in maize production, the present investigation has been undertaken to determine the resource use efficiency in maize production.

RESOURCES AND METHODS

Multistage sampling design was used in selection of district, tehsil, villages and maize growers. In first stage, Aurangabad district was selected purposively. In the second stage, Kannad and Sillod tehsils were selected on the basis of higher area under maize. In the third stage, from each selected tehsil five villages were selected on the basis of higher area under maize production. The selected villages in Sillod tehsil were namely Andhari, Ghatnandra, Kerhala, Modha bk and Shivana, where as Kannad tehsil, Chincholi, Javkheda bk., Karanjkhed, Nachanvel and Pishor. The cross sectional data were collected from 60 maize growers with the help of pre-tested schedule for the year 2010-2011. The data were related to output as well as use of resources namely area under maize, human labour, bullock labour, seed, manure and fertilizer and so on. Cobb-Douglas production function was fitted to the data to estimate resource productivity with respect to each of the explanatory variables. The fitted equation was as follows.

$$Y = a\, X_1^{b1}\, X_2^{b2}\, X_3^{b3} \ldots\ldots\ldots X_n^{bn}\, e^u$$

In this functional form 'Y' is dependent variable, 'X_i' are independent resource variables, 'a' is the constant representing intercept of the production function and 'bi' are the regression coefficients of the respective resource variables. The regression coefficients obtained from this function directly represent the elasticities of production, which remain constant throughout the relevant ranges of inputs. The sum of coefficients that is 'bi' indicates return to scale. This function can easily be transformed into a linear form by making logarithmic transformation. After logarithmic transformation of this function is,

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + \ldots\ldots + b_n \log X_n + u \log e$$

The equation fitted was of the following formula.

$$Y = a\, X_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.X_7^{b7}.X_8^{b8}.X_9^{b9}$$

where,

Y = Estimated maize production in quintals per farm

a = Intercept of production function, bi = Partial regression coefficient of the respective resource variable (i=1, 2,…,9), X_1 = Area under maize in hectares per farm, X_2 = Human labour in man days per farm , X_3 = Bullock labour in pair days per farm, X_4 = Machine labour in hours per farm, X_5 = Seed in kg per farm, X_6 = Manure in quintals per farm, X_7 = Nitrogen in kg per farm, X_8 = Phosphorus in kg per farm X_9 = Potash in kg per farm.

OBSERVATIONS AND ANALYSIS

The findings related to elasticity of production, marginal production and resource use efficiency in maize production were obtained and are presented as follows.

Elasticity in maize production:

Regression coefficients with respect to various explanatory variables were calculated and are presented in Table 1. Regression coefficient of area under maize was 0.279 which was positive and highly significant at 1 per cent level. It inferred that when 1 per cent increases in use of area under maize over its geometric mean, it would lead to increase production of maize by 0.279 per cent. Similarly, regression coefficient of bullock labour and machine labour were 0.103 and 0.082, respectively which were positive and significant at 1 per cent level. Regression coefficient of manure was also positive and significant at 5 per cent level. Regression co-efficient of phosphorus was negative but significant at 1 per cent level. On the contrary, regression co-efficient of seed and nitrogen were negative and non significant. Co-efficient of multiple determination was 0.974, it means that there was 97.40 per cent effect of all independent variables together on maize production. Returns to scale was found to be 0.684. The results are in conformity with results obtained by Nagraj *et al.* (1998) and Chowdary (1986).

Marginal productivity in maize production:

With respect to resource productivity, marginal product

Table 1 : Estimates of cobb-douglas production function in maize production

Sr. No.	Independent variable	Regression coefficient (bi)	Standard error (SE)	't' value	Geometric mean (Xi)	Marginal product (q)	Marginal value product (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use
1.	Area under maize (ha/farm)	0.279	0.078	3.576**	0.75	15.776	15539.36	8497.12	1.83	1.37
2.	Human Labour (man day/farm)	0.275	0.561	0.490	55.19	0.211	207.83	150	1.38	76.58
3.	Bullock Labour (pair day/farm)	0.103	0.030	3.433**	4.71	0.927	913.09	280	3.26	15.37
4.	Machine Labour (hours/farm)	0.082	0.025	3.280**	4.10	0.848	835.28	350	2.39	9.78
5.	Seed (kg/farm)	-0.039	0.062	-0.629	14.32	-0.115	-113.27	80	-1.41	-
6.	Manure (q/farm)	0.162	0.069	2.347*	46.80	0.146	143.81	50	2.88	135.35
7.	Nitrogen (kg/farm)	-0.002	0.086	-0.028	78.64	-0.001	-0.98	13.04	-0.07	-
8.	Phosphorus (kg/farm)	-0.192	0.112	-2.865**	45.74	-0.178	-175.33	23.75	-7.38	-
9.	Potassium (kg/farm)	0.016	0.010	1.584	26.25	0.025	24.62	9.33	2.64	71.64

Intercept (log a) ------------ 2.372
F value ------------ 1.822

Note: Geometric mean of $(\overline{Y})$ maize production was 42.41 q per farm and price was Rs 985/q
R^2 ------------ 0.974
Return to scale(Σbi) -------- 0.684

* and ** indicate signification of values at P=0.05 and 0.01, respectively

of area under maize was 15.776 quintals, it means that when increase in maize area by one hectare over its geometric mean, there would be possibility to increase in maize production by 15.77 quintals. Marginal product of human labour was 0.211 quintals. Similarly marginal product of bullock labour, machine labour and manure was 0.927, 0.848 and 0.146 q, respectively. It implied that addition of one human labour would cause to give additional production of maize as 0.211 quintals followed by machine labour (0.848 quintal) and manure 0.146 quintal. Thus there was scope to increase use of area under maize, human labour, bullock labour, machine labour and manure in maize production. The results are in close correspondence with findings obtained by Tawale (2007).

Resource use efficiency in maize production:

In regards to resource use efficiency, MVP to price ratio with respect to bullock labour was highest as 3.26 followed by manure (2.88), potassium (2.64) and machine labour (2.39). It inferred that in maize production system, use of bullock labour was highly under utilization. Hence, preference might be give to increase bullock labour the priority basis in maize production. Similarly, use of manure and potassium could be increased in order to resource use efficiency in terms of money in maize production than important to be give for use of machine labour in maize production. It was observed that optimum use of area under maize was 1.37 hectares. Use of human labour and bullock labour could be increased upto 76.58 man days and 15.37 pair days. Use of manure could be extended upto 135.35 quintal, while use of potassium could be 71.64 kg as optimum resource use. These results are in agreement with the earlier results obtained by Joshi *et al*. (1998) and Gautam (1999).

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