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Research Article

Resource use efficiency in sugarcane production in Konkan region (M.S.)

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SUMMARY : The functional analysis was carried out to know the contribution of independent variables in yield of sugarcane. From the estimated Cobb-Douglas production function (log linear production function), it was observed that, in suru sugarcane co-efficient of determination (R^2) was 0.9113 indicating 91 per cent of variation and in ratoon sugarcane co-efficient of determination (R^2) was 0.9344 indicating that, 93 per cent of the variation in the yield explained by identified input variables included in the function. The expenditure on manures, plant protection, potassium and nitrogen in suru sugarcane cultivation and plant protection and manures to be curtailed considering their excess utilization in ratoon sugarcane cultivation. Whereas, MVP to FC ratios was more than unity for phosphorus and nitrogen, human labour, irrigation indicated under utilization of these resources in sugarcane cultivation which underlines scope of expanding the use of these inputs.

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KEY WORDS :
Resource use efficiency MVP, MFC ratio, Allocative efficiency

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BACKGROUND AND OBJECTIVES

Considering the importance of sugarcane in economy of farmers, state and country the present study was conducted in Sindhudurg district of Maharashtra state, since this district is witnessing development rapidly as a sugarcane producers from the non-traditional areas of the state. The study was conducted to know the per hectare cost of production and profitabilty of sugarcane.The results of economics of sugarcane cultivation would help to the cane growers for taking decisions, regarding investment in scarce resources such as land, labour and capital for cost minimization and profit maximization by keeping their resource use efficiency optimally. In view of this study on resource use efficiency in sugarcane production in Konkan region (M.S.) was undertaken.

RESOURCES AND METHODS

The present study was carried out in Vaibhavwadi and Kankavali tahsils of Sindhudurg district as area under sugarcane cultivation was maximum in these two tahsils. The final sample consisted of 20 villages and 100 sugarcane cultivators. The sugarcane cultivators were classified into two groups on the basis of type of sugarcane grown *i.e.* i) suru sugarcane (57 cultivators) and ratoon sugarcane (74 cultivators). The data related to the agricultural year 2012-2013 were collected by personal interviews with the sugarcane cultivators.

Functional analysis :

The Cobb-Douglas (1928) production function (non- linear production function) was used to determine the resource use efficiency. The functional analysis was carried out by using the following from of equation.

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} \text{---} X_n^{bn} . e^u$$

In this functional from 'Y' is dependent variable, 'X_i' are independent resource variables,

'a' is the constant representing intercept of the production function and X_i^{bi} are the regression co-efficient of the respective resource variables.

The equation fitted was of the following type.

$$Y = aX_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.e^{u}$$

where,

Y = Estimated yield of the crop in tons
a = Intercept of production function
bi = Partial regression co-efficient of the respective resource variable (i=1, 2, 3, 4, 5, 6, 7)
X_1 = Human labour in man day
X_2 = Manures in tons
X_3 = Nitrogen in kg
X_4 = Phosphorus in kg
X_5 = Potash in kg
X_6 = Irrigation in number
X_7 = Plant protection chemicals in lt/kg.

Marginal product (MP) :

The Cobb-Douglas production function allows constant, increasing or decreasing marginal productivity. The marginal product equation used is as follows :

$$MP = \frac{dy}{dx} = baX^{b-1} = \frac{bax^{b}}{X} = bi\frac{\overline{Y}}{\overline{X}}$$

Marginal value product (MVP) :

The marginal value of productivity of resource indicates the addition of gross value of production for a unit increase in the 'i' resources with all resources fixed at their geometric mean levels. The MVP of various inputs is worked out by the following - formula :

$$MVP = bi\frac{\overline{Y}}{\overline{X_i}}Py$$

where,

bi =Partial regression co-efficient of particular independent variable

$\overline{X_i}$ = Geometric mean of particular independent variable.

$\overline{Y}$ = Geometric mean of dependent variable.

Py = Price of dependent variable.

Marginal factor cost (MFC) :

MFC = Price per unit of the input.

OBSERVATIONS AND ANALYSIS

The distribution of sample farmers according to season of sugarcane crop grown is given in Table 1.

The total sample of 100 sugarcane farmers was selected from the Sindhudurg district. of the total sample 44 per cent farmers were cultivating suru type of sugarcane and 56 per cent farmers were cultivating ratoon type crop, indicating that some of the farmers were cultivating both the type of crop.

Table 1: Classification of sample farmers according to type of sugarcane crop (n=100)

Sr. No.	Particulars	Number of farmers	Percentage
1.	Suru sugarcane	57	43.51
2.	Ratoon sugarcane	74	56.49

Per hectare physical input utilization in sugarcane cultivation :

The per hectare physical input utilization for sugarcane cultivation is given in Table 2.

Table 2 : Per hectare physical input utilization in sugarcane cultivation

Sr.No.	Particulars	Suru (n=57)	Ratoon (n=74)
1.	Hired labour (days)		
	Male	103.81	61.24
	Female	80.89	70.88
	Total	184.70	132.12
2.	Family labour (days)		
	Male	59.74	31.68
	Female	40.18	29.58
	Total	99.92	61.26
3.	Total labour (days)		
	Male	163.55	92.92
	Female	121.07	100.46
	Total	284.62	193.38
4.	Bullock labour (pair days)	14.13	6.19
5.	Planting material(tonne)	2.59	-
6.	Manures (tonne)	2.65	2.55
7.	Fertilizers (kg.)		
	N	342.54	327.49
	P	166.32	165.34
	K	164.37	154.05
8.	Plant protection (lt.)	2.59	2.48

It is observed from the Table 2 that, for suru sugarcane cultivation per hectare total human labour used were 284.62 days, of which 163.55 days were male labour and 121.07 days were female labour while in ratoon sugarcane cultivation per hectare total human labour used were 193.38 days, of which 92.92 days were male labour and 100.46 days were female labour. Per hectare bullock labour used were 14.13 days in suru sugarcane cultivation while 6.19 days in ratoon sugarcane cultivation.

The per hectare quantity of planting material used was 2.59 tonne in suru sugarcane cultivation. Manures are an

important input for sugarcane cultivation used to the extent of 2.65 tonne per hectare in suru sugarcane while 2.55 tonne per hectare in ratoon sugarcane cultivation. The per hectare quantity of fertilizers used in suru sugarcane cultivation was 342.54 kg of N, 166.32 kg of P and 164.37 kg of K while in ratoon sugarcane cultivation it was 327.49 kg of N, 165.34 kg of P and 154.05 kg of K.

It is also observed from the Table 2 that, in suru sugarcane cultivation use of hired labour (184.70 days) was very much higher than family labour (99.92 days), whereas, in case of ratoon sugarcane cultivation again use of hired labour (132.12 days) was very much higher than family labour (61.26 days). Per hectare plant protection chemical used in suru sugarcane cultivation was 2.59 lt while in ratoon sugarcane cultivation it was 2.48 lt.

Resource productivities of inputs in sugarcane cultivation: Suru and ratoon :

The result of functional analysis for suru sugarcane farms is given in the Table 3.

It is observed from the Table 3 that, the co-efficient of determination (R^2) was 0.91 indicating that, 91 per cent of the variation in the yield was explained by variables included in the function. The sum of elasticity co-efficient was 1.24, which

Table 3 : Regression co-efficients of independent variables in estimated Cobb-Douglas type of production function in sugarcane cultivation: suru and ratoon

Sr.No.	Variables	Estimated regression co-efficient	
		Suru	Ratoon
1.	Human labour (days) (X_1)	0.0801* (6.45)	0.0814 (7.05)
2.	Manures (tonne) (X_2)	-0.3849 (-30.98)	-0.3912 (-33.87)
3.	Nitrogen (kg.) (X_3)	0.2372 (19.09)	0.2411 (20.87)
4.	Phosphorus (kg.) (X_4)	0.7800 (62.77)	0.7929** (68.66)
5.	Potassium (kg.) (X_5)	0.1577 (12.69)	0.1603 (13.88)
6.	Irrigation (No.) (X_6)	0.1699* (13.67)	0.0644* (5.58)
7.	Plant protection (lt.) (X_7)	0.2026** (16.30)	0.2059** (17.83)
8.	Intercept (a)	0.9294 (74.79)	1.4152 (122.55)
9.	R^2	0.9113	0.9344
10.	Sum of elasticities (ġ bi)	1.2426	1.1548

(Figures in parenthesis indicate standard errors to total) * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 4 : Marginal value product and resource use efficiency for sugarcane farms: suru

Sr. No	Variables	Marginal physical product (MPP)	Marginal value product (MVP)	Marginal factor cost (MFC)	MVP /MFC ratio	Remark
1.	Human labour (days) (X_1)	4.8484	11636.16	400	29.0904	Under utilization
2.	Manures (tonne) (X_2)	0.0939	225.36	1500	0.15024	Excess use
3.	Nitrogen (kg.) (X_3)	-46.42	-111408	6	-18568	Excess use
4.	Phosphorus (kg.) (X_4)	55.23	132552	8	16569	Under utilization
5.	Potassium (kg.) (X_5)	-6.3478	-15234.7	24	-634.7791	Excess use
6.	Irrigation (No.) (X_6)	0.7997	1759.34	170	10.34	Under utilization
7.	Plant protection (lt.) (X_7)	-0.0284	68.16	570	0.11957	Excess use

Table 5 : Marginal value product and resource use efficiency for sugarcane farms: ratoon

Sr. No.	Variables	Marginal physical product (MPP)	Marginal value product (MVP)	Marginal factor cost (MFC)	MVP /MFC ratio	Remark
1.	Human labour (days) (X_1)	0.2142	514.08	400	1.2852	Under utilization
2.	Manures (tonne) (X_2)	-0.0418	-100.32	1500	-0.0669	Excess use
3.	Nitrogen (kg.) (X_3)	1.9984	4796.16	6	799.36	Under utilization
4.	Phosphorous (kg.) (X_4)	9.1794	22030.56	8	2753.82	Under utilization
5.	Potassium (kg.) (X_5)	0.4869	1168.56	24	48.69	Under utilization
6.	Irrigation (No.) (X_6)	0.3056	733.44	170	4.2642	Under utilization
7.	Plant protection (lt.) (X_6)	0.0057	13.68	570	0.024	Excess use

was greater than one indicated increasing returns to scale. The regression co-efficient of human labour (X_1), manures (X_2), nitrogen (X_3), phosphorus (X_4), potassium (X_5), irrigation (X_6) and plant protection (X_7) were 0.08, -0.38, 0.23, 0.78, 0.15, 0.17 and 0.20, respectively.

The regression co-efficient of human labour (X_1) and irrigation (X_6) were positive and statistically significant at 5 per cent level of probability, while regression co-efficient of plant protection (X_7) was positive and statistically significant at 10 per cent level of probability. The regression co-efficient of nitrogen (X_3), phosphorus (X_4) and potassium (X_5) were positive but statistically non-significant. The regression co-efficient of manures (X_2) was negative but statistically non-significant.

It is also observed from the Table 3 that, the co-efficient of determination (R^2) was 0.93 indicating that, 93 per cent of the variation in the yield was explained by variables included in the function. The sum of elasticity co-efficient was 1.15, which was greater than one indicated increasing returns to scale. The regression co-efficient of human labour (X_1), manures (X_2), nitrogen (X_3), phosphorus (X_4), potassium (X_5), irrigation (X_6) and plant protection (X_7) were 0.08, -0.39, 0.24, 0.79, 0.16, 0.06 and 0.20, respectively. The regression co-efficient of irrigation (X_6) was positive and statistically significant at 5 per cent level of probability. The regression co-efficients of phosphorus (X_5) and plant protection (X_6) were positive and statistically significant at 10 per cent level of probability. Also, the regression co-efficients of human labour (X_1), nitrogen (X_3) and potassium (X_5) were positive but statistically non-significant. The regression co-efficient of manures (X_2) was negative and statistically non-significant.

Resource use efficiencies in sugarcane production: suru :

The allocative resource use efficiency in suru sugarcane production was calculated and results are presented in Table 4.

It is seen from the Table 4 that, in production of suru sugarcane MVP to FC ratio is less than unity for manures (0.15024) followed by plant protection (0.11957), potassium (-674.7791) and nitrogen (-18568) indicated excess utilization of these resources in suru sugarcane cultivation. The expenditure on manures, plant protection, potassium and nitrogen needs to be curtailed considering their excess utilization in suru sugarcane cultivation. Whereas, MVP to FC ratio was more than unity for phosphorus (16569) followed by human labour (29.0904), irrigation (10.34) indicated under utilization of these resources in suru sugarcane cultivation which underlines scope of expanding the use of these inputs.

Resource use efficiencies in sugarcane production: ratoon :

The allocative resource use efficiency in ratoon sugarcane production was calculated and results are presented in Table 5.

It is seen from the Table 5 that, in production of ratoon sugarcane MVP to FC ratio less than unity was for plant protection (0.024) followed by manures (-0.0669) indicated excess utilization of these resources in ratoon sugarcane cultivation. The expenditure on plant protection and manures to be curtailed considering their excess utilization in ratoon sugarcane cultivation. Whereas, MVP to FC ratio was more than unity for phosphorus (2753.82) followed by nitrogen (799.36), potassium (48.69), irrigation (4.2642) and human labour (1.2852) indicated under utilization of these resources in ratoon sugarcane cultivation which underlines scope of expanding the use of these inputs. Similar work related to the topic was also done by Prabhu *et al.* (2006); Hanumanikar *et al.* (2009a and b); Malarkodi *et al.* (2010); Patel and Supe (2011) and Rai *et al.* (2012).

Conclusion :

The functional analysis was carried out to know the contribution of independent variables in yield of sugarcane. From the estimated Cobb-Douglas production function (log linear production function), it was observed that, in suru sugarcane co-efficient of determination (R^2) was 0.9113 indicating 91 per cent of variation in the yield explained by identified input variables included in the function.

In ratoon sugarcane co-efficient of determination (R^2) was 0.9344 indicating that, 93 per cent of the variation in the yield explained by identified input variables included in the function.

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