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Resource Productivity and Resource Use Efficiency of Sugarcane in South-Goa district of Goa State

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ABSTRACT

The study was attempted to examine the relationship of the yield of the sugarcane and various inputs used in its production by the sugarcane farmers in South-Goa district of Goa State during the year 2020-21. In all, 48 sugarcane growers were randomly selected from 16 villages of two tehsils in South-Goa district. Cross sectional data were collected from sugarcane growers with the help of pretested schedule by personal interview method. Data were related to sugarcane outputs and inputs like machine labour, manure, fertilizers, irrigation and family human labour as resources. Cobb Douglas production function was fitted to the data. The regression co-efficient of irrigation under sugarcane was 0.091 followed by that of machine labour (0.068). In next order, regression coefficient of area was 0.651 followed by phosphorus (0.047). Regression co-efficient of potash, plant protection and family human labour were positive but non-significant. Regression co-efficient of setts was negative and non-significant. Marginal product of area under sugarcane was 257.32 q followed by that of plant protection (15.092 q) and machine labour (3.557 q). MVP to price ratio with respect to plant protection was 11.77 followed by area under sugarcane (1.79), machine labour (1.76), phosphorus (1.50), potash (1.42), irrigation (1.27). Hence, preference might be given to increase plant protection on priority basis in sugarcane cultivation. Optimum resource use of area under sugarcane was 0.75 ha, irrigation was 1781.84 m^3 and that of phosphorus and potash was 41.02 and 37.74 kg, respectively.

Key words : Sugarcane, resource productivity, resource use efficiency, optimum resource use

INTRODUCTION

India is second largest producer of sugar after Brazil accounting 16% of world population (Nasim Ahmed et al., 2018). Sugarcane (*Saccharum officinarum* L.) is globally an important source of commercial crop accounting nearly 70% t of the world sugarcane production (Singh *et al.,* 2018). The sugarcane cultivation and sugar industry in India play a vital role towards socio-economic development in the rural areas. It mobilizes rural resources in generating higher income and employment opportunities (*www.phytojournal.com*).

Sugarcane is an important cash crop cultivated in Goa. In Goa, sugarcane is presently grown on an area of approximately 912 ha. The annual production of cane in Goa is about 49108 t with an average productivity of 53-55 t/ha. Goa has a sugar factory with a crushing capacity of 1.75 to 2.00 lakh t of cane annually (Book of Agricultural Statistics Goa, 2020). Thus, the present availability of cane meets less than half of the requirement of the sugar factory. This deficit is met by bringing cane from neighbouring states, which is not only uneconomical but detrimental to the interest of local growers. Thus, there is tremendous scope to produce the cane locally by adopting improved technology. Further, there is a scope for bringing additional area under this cash crop especially in command areas of Salaulim and Anjunem irrigation projects.

In general, proper land preparation is very essential for proper establishment and growth of the sugarcane crop. Plough the field to a depth of 1.5 to 2 feet deep with the help of a tractor and expose it to hot sun for a fortnight. Thereafter, crush the soil clumps so as to make it soft and friable. Both wet and dry methods of planting can be adopted for growing cane. Wet planting is mostly done in low to medium fertile soils. In this method, the furrows are thoroughly irrigated and treated sets are placed 3-5 cm deep ensuring that all

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the eye buds face upwards. The simple technique is to place the thumb on the middle bud and press the set in the wet furrow ensuring that the other two buds remain sideways facing upwards. In highly fertile soils, dry method of planting can be adopted. The sets are planted in dry furrows at specified distances and covered with soil up to half the depth of furrow and the field is then irrigated. Subsequent earthing-up operations during top dressing of fertilizers in the ridges becoming furrows which serve for irrigation.

METHODOLOGY

Multistage sampling design was adopted for selection of district, tehsils, villages and agrarian farms (Sulaiman *et al.*, 2015). In the first stage, the South-Goa district was purposively selected because of agrarian farming. In the second stage, Sanguem and Quepem tehsils were selected on the basis of higher area under sugarcane fields (Saravanan and Parvati, 2015). In the third stage, eight villages were selected from the each of tehsils on the basis of higher area under sugarcane fields**.** From Sanguem tehsil villages selected were, namely, Bhati, Cotarli, Kale, Netravali, Rivona, Uguem, Vadem and Xeldem, while from Quepem tehsil were, namely, Avadem, Balli, Barlem, Dhadem, Malkarne, Mirabag, Pirla and Quitol. In the fourth stage, three sugarcane farmers were randomly selected from each of the villages depending upon holdings. In this way, from 16 villages, 48 farmers were selected for the present study (Mishra *et al.*, 2021).

Cobb-Douglas production function was fitted to the data to estimate resource use efficiency with respect to each of the explanatory variables. The fitted equation for a number of independent variables was:

$$Y = aX_1^{b1} \times X_2^{b2} \times X_3^{b3} \text{----------} X_n^{bn}.e^u$$

In this function: 'Y' was dependent variable, 'Xi' were independent resource variables, 'a' was the constant representing intercept of the production function and 'bi' were the regression coefficients of the respective resource variables. The regression coefficients obtained from this function directly represented the elasticities of production, which remained constant throughout the relevant ranges of inputs. The sum of coefficients was 'bi' indicating the nature of returns to scale. This function was transformed into a linear form by logarithmic transformation. After logarithmic transformation, this function was expressed as:

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

For fitting the production function, eight input variables were considered as important factors by considering the problem of multicollinearity in estimating production function. Multi-collinearity referred to situation where because of storing interrelationship among the independent variables, it became difficult to estimate their separate effects on the dependent variables. Some of the independent variables were not important just because the standard errors were high. It might be due to the presence of multicollinearity. The consequences of multicollinearity were (a) the sampling variances of the estimate coefficients increased as the degree of collinearity increased between the explanatory variables, (b) estimated coefficients became very sensitive to small changes in data that was addition or deletion of a few observations producing a drastic change in some of the estimates of the coefficients. The equation fitted was of the following form:

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8}$$

Where,

Y = Estimated yield of the crop in quintals per farm
a = Intercept of production function
bi = Partial regression coefficients of the respective resource variable (i = 1, 2, 3....8)
X_1 = Area of the crop (hectare/farm)
X_2 = Hired human labour (hour/farm)
X_3 = Bullock labour (pair/farm)
X_4 = Machine power (hour/farm)
X_5 = Sets (No./farm)
X_6 = Phosphorus (kg/farm)
X_7= Potash (kg/farm)
X_8 = Plant protection (l/farm)
X_9 = Irrigation (cubic meter/farm) and
X_{10} = Family labour (man-day/farm).

The marginal value produce of resource indicated the addition of production for a unit increase in the 'i'th resource with all resources fixed at their geometric mean levels. The MVP of various inputs was worked out by the following Pawar *et al.* (2015).

MVP = Py [(biY)/(X)]

Where,

bi = Partial regression coefficient of particular independent variables

Y BAR = Geometric mean of dependent variable

X BAR = Geometric mean of particular independent variable

Py = Price of dependent variable

RESULTS AND DISCUSSION

The results revealed that regression coefficient with respect to area under sugarcane; bullock labour was 0.651 and 0.068 which were positive and significant at 5% level, respectively (Table 1). It was clear that regression coefficient of irrigation was 0.091 which was highly significant at 1%. On the contrary, regression coefficient of hired human labour was 0.269 which was negative but significant at 5% level as per Nasim Ahmed *et al.* (2018). The coefficient of determination was 0.701 which showed 70.10% variation in sugarcane production due to variation of all independent variables. Return to scale was 0.546 which was decreasing return to scale. It was clear that there was scope to increase irrigation, area under sugarcane and bullock labours in sugarcane production on agrarian farm because these variables were positive and significant, while use of hired human labour could be reduced because it was negative and significant. These results are in concurrence with results obtained by Amjad and Abbas (2017) regarding elasticity of production with respect to bullock labour.

Marginal produce means it is production of sugarcane due to added unit of independent variables. In other words, it can be known as per unit resource productivity. It was observed that resource productivity of area under sugarcane was 257.32 q/ha. Marginal produce of irrigation was 0.011 q/cubic meter of water. Marginal produce of use of bullock labour was 2.271 q/pair-day. When addition of one hectare area under sugarcane to its geometric mean (0.42 ha), it would cause to give 257.32 q of added production of sugarcane due to added unit of hectare. One more added unit of irrigation in the form of one cubic meter could give 0.011 q of additional production of sugarcane (Singh *et al.,* 2018).

Resource use efficiency can be expressed as relationship between marginal value produce and price of input (Choudhri *et al.,* 2020). In regard to significant variables, marginal value produce to price ratio of irrigation was 1.27. Similarly, marginal value produce to price ratio of area under sugarcane was also 1.79. Then marginal value produce to price ratio of bullock labour was 1.41.

It was obvious that in existing condition other things remaining same, there was scope to increase area under sugarcane up to 0.75 ha. It was observed that there was also scope to increase use of irrigation up to 1781.84 cubic meters (Rout *et al.,* 2017). It was clear that in sugarcane cultivation, irrigation was found to be very important resource on agrarian farm. The results revealed that optimum resource use of area under sugarcane was 0.75 ha.

Table 1. Estimates of Cobb-Douglas production function in sugarcane production on agrarian farm

Independent variable	Partial regression coefficient (bi)	Standard error (SE)	't' value	Geometric mean (Xi)	Marginal produce (q)	Marginal value produce (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use (Xi)
1. Area under sugarcane (ha/farm)	0.651	0.301	2.161*	0.42	257.32	59183.60	33071.34	1.79	0.75
2. Hired human labour (manday/farm)	0.269	0.122	-2.211*	31.30	-1.427	-328.21	180.00	-1.82	-
3. Bullock labour (pairday/farm)	0.068	0.029	2.345*	4.97	2.271	522.41	370.00	1.41	7.02
4. Machine labour (hour/farm)	0.129	0.175	-0.737	6.02	3.557	818.19	465.00	1.76	10.59
5. Setts (No/farm)	-0.242	4.882	-0.049	409.08	-0.098	-22.59	2.00	-11.29	-
6. Phosphorus (kg/farm)	0.047	0.027	1.741	27.39	0.284	65.52	43.75	1.50	41.02
7. Potash (kg/farm)	0.028	0.029	0.966	26.62	0.175	40.16	28.33	1.42	37.74
8. Plant protection (l/farm)	0.020	3.033	0.001	0.22	15.092	3471.12	294.88	11.77	2.59
9. Irrigation (m3/farm)	0.091	0.033	2.756**	1402.31	0.011	2.48	1.95	1.27	1781.84
10. Family human labour (manday/farm)	0.023	1.851	0.012	4.50	0.848	195.15	180.00	1.08	4.86

Geometric mean of (Y) sugarcane production was 166.01 q/farm and price was Rs. 230/q.

Optimum resource use of bullock labour and irrigation was 7.02 pair days and 1781.84 cubic meters of water, respectively. Other than positively significant variables, few of the resources can be optimized (Saravanan, 2016). Irrespective of significant variables, marginal value produce to price ratio of plant protection was the highest as 11.77. It inferred that this resource was highly underutilization. Hence, expenditure on plant protection can be increased on priority basis in sugarcane production on agrarian farm. On the contrary, marginal value produce to price ratio of sugarcane sets was 11.29. In other words, the expenditure on sets could be reduced because this resource was overutilization.

CONCLUSION

Regression coefficient of irrigation under sugarcane was 0.091 followed by that of machine labour (0.068). In next order, regression coefficient of area was 0.651 followed by phosphorus (0.047). Regression coefficient of potash, plant protection and family human labour were positive but non-significant. Regression coefficient of setts was negative and non-significant. Marginal product of area under sugarcane was 257.32 q followed by that of plant protection (15.092 q) and machine labour (3.557 q). MVP to price ratio with respect to plant protection was 11.77 followed by area under sugarcane (1.79), Machine labour (1.76), phosphorus (1.50), potash (1.42) and irrigation (1.27). Hence, preference be given to increase plant protection on priority basis in sugarcane cultivation. Optimum resource use of area under sugarcane was highest as compared to all the independent variables in the study analysis.

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