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Resource Use Efficiency of Sugarcane Cultivation in Tamil Nadu

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As sugarcane is one of the largest raw material sources for the sugar industries, an attempt was made with an objective to study the resource efficiency of the crop in Tamil Nadu. It was observed that the total cost of cultivation of sugarcane worked out to be Rs.116347 per ha. The operational cost accounted for 80.62 per cent of the total cost. The cost of human labour alone accounted for 36.30 per cent of the total operational cost as it involved labour intensive operations like earthingup, trashing and de-trashing, cutting of canes, and transport of cane to sugar factory. Production function analysis revealed that labour hours, organic manure and fertilizers applied, and the value of plant protection chemicals were the significant variables that influenced the productivity of sugarcane. The net income realized from sugarcane was Rs.42395 per ha and it may be concluded that the cultivation of sugarcane is a more profitable and there exists a huge scope for increasing the productivity by efficiently managing all these resources.

Key words: Resource Use Efficiency, Sugarcane, Production function.

The post green revolution period has witnessed impressive structural changes taking place in Indian agriculture (Vyas, 2004). The crop production has also undergone a significant shift from food grains to non-food grains. Use of inputs such as fertilizers, pesticides, HYV seeds and farm implements has been stepped up many folds. As far as Sugarcane cultivation in India is concerned, the area has increased from 2.4 million ha during 1960-61 to 4.2 million ha during 2009-10. The production of cane has more than doubled during the same period from 110 to 278 million tonnes. This was due to the increase in productivity from 46 to 66 tonnes per ha from 1960-61 to 2009-10 (http:///indiabudget.nic.in)

In Tamil Nadu, sugarcane is cultivated in 2.93 lakh ha with 297.45 lakh tonnes of production during 2009-10 (DES, Chennai). The average productivity of cane was 101 tonnes per hectare in the same year. It occupied third position in terms of area next only to paddy and groundnut. In this study an attempt was made to estimate the growth rate, economics and resource efficiency of sugarcane cultivation in Tamil Nadu.

Materials and Methods

The primary data were collected from Villupuram, Erode, Cuddalore, Thiruvannamalai, Dharmapuri, Namakkal, Vellore districts of Tamil Nadu state. These districts share more than 63 per cent of the sugarcane area cultivated in Tamil Nadu.

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The total area cultivated in these districts is 1.26 lakh ha.(Season and crop report 2009-10, DES, Chennai) . 300 sample farmers were selected for the study from these seven districts. The study was conducted during the year 2010-11. The data on cost of cultivation and marketing costs were collected based on a pre tested questionnaire. The collected data was subjected to simple percentage analysis and production function analysis to draw meaningful inferences from the raw data. As the tabulated and consolidated result doesn't exhibit linearity, in their character, Cobb-Douglas production function was employed to estimate the resource use efficiency. The data was used for estimating economics of sugarcane cultivation, cost and returns and resource use efficiency. The economics of sugarcane cultivation, cost and returns, resource use efficiency were estimated using the tabulated data. The secondary data was collected from the various issues of Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi and Directorate of Economics and Statistics, Government of Tamil Nadu, Chennai and other policy notes of both central and state governments.

Results and Discussion

Growth rate in area, production and productivity of sugarcane

The growth rate in area, production and productivity of sugarcane for the period 1970-71 to 2009-2010 was analyzed in terms of pre (1971-91)

Table 1. Area, production and productivity in sugarcane

Year	Area (lakh ha)			Production (million tonnes)			Productivity (tonnes/ha)		
	Mean	CV (%)	CGR	Mean	CV (%)	CGR	Mean	CV (%)	CGR
India									
1971-1991a	30.36	23.28	0.48	172.68	37.86	0.61	56.34	12.74	0.14
1992-2009b	41.80	9.05	0.34	281.03	13.31	0.18	67.16	8.49	-0.02
1971-2009c	35.64	12.59	0.46	222.69	15.65	0.47	61.333	5.17	0.08
Tamil Nadu									
1971-1991a	1.79	41.27	5.36	1.89	47.82	7.78	104.56	14.42	0.09
1992-2009b	2.97	11.21	0.79	3.20	16.89	0.15	107.70	15.64	-0.05
1971-2009c	2.33	23.26	3.61	2.49	28.36	4.19	106.01	12.27	0.02

Note: CV: Coefficient of variation; CGR: Compound Growth Rate ; a. Pre liberalization period; b. Post liberalization period; c Overall period

and post liberalization period (1992 -09) for India and Tamil Nadu separately and is presented in Table 1. In India, the area under sugarcane has registered dramatic increase over the decades and it was 3.04 million ha during pre liberalization period and 4.18 million ha during post liberalization period. The growth rate of area under sugarcane was 0.48 and 0.34 percent for the same periods, respectively. The overall growth rate of area under sugarcane was 0.46 per cent for the period from 1970-71 to 2009-2010. Similarly, the growth rate of production was 0.61 and 0.18 per cent during 1971- 91 and 1992-2009 respectively. The overall growth rate of production was 0.47 per cent for the period from 1970-71 to 2009-10. The positive growth rate in area and production might be attributed to the fact that more emphasis was laid on expanding irrigation potentials in the Five Year Plans. The productivity of sugarcane during pre liberalization period was 56.34 tonnes per ha and it was 67.16 tonnes per ha during post liberalization period. The growth rate in yield was 0.14 and - 0.02 per cent during 1971-91 and 1992-2009 respectively. The overall growth rate of productivity was 0.08 for the period from 1971 to 2009. The growth rate of yield during post liberalization period has registered a negative growth rate, which might be due to monsoon failure in important sugarcane growing states.

In the case of Tamil Nadu, the area under sugarcane during pre liberalization period was 1.79 lakh ha and it was 2.97 lakh ha during the post liberalization period. The growth rate of area under sugarcane was 5.36 and 0.79 per cent for the same period. It showed a very minimal growth rate of area under sugarcane during the post liberalization period, which is mainly due to monsoon failure during this period. The growth rate of production of sugarcane was 7.78 and 0.15 per cent during pre and post liberalization period respectively. The productivity of sugarcane was 106.01 tonnes per ha during the period of 1971-2009 which is much higher than the national average productivity. The growth rate of productivity was 0.09 and -0.05 percent during pre and post liberalization period respectively. It showed that a low growth rate in production and productivity of sugarcane was observed during the post liberalization period, which might be due to the monsoon failure during this period.

Economics of sugarcane cultivation

The comparative economics of cost of production of sugarcane worked out for Tamil Nadu and is presented in Table 2. It was observed from the table that the total cost of cultivation of sugarcane was Rs.116347 per ha. The operational cost accounted for 80.62 per cent of the total cost. The cost of human labour alone accounted for 36.30 per cent of the total operational cost since it involves labour intensive operations like earthingup, trashing and de-trashing, cutting of canes, and transport to sugar factory. Moreover, the sugarcane growers often constrained by the inadequate supply of labour particularly during the peak seasons which adds to high cost of cultivation.

Table 2. Economics of Sugarcane Cultivation in Tamil Nadu during 2009-10

Details of inputs	Cost per ha in Rs.	Percentage to Total Cost
Labour wages	42267	36.30
Animal charges	533	0.46
Machine hire	5474	4.70
Value of Seed	14230	12.22
Value of Farm Yard Manure	2054	1.76
Value of fertilizers	7164	6.15
Value of Plant Protection chemicals	706	0.61
Miscellaneous Expenditure	18	0.02
Marketing Expenses	11366	9.76
Interest on working capital @ 12 p.a.	10057	8.64
Total Operational cost	93869	80.62
Fixed cost	22567	19.38
Total cost of Cultivation	116437	100.00
Gross Return in Rs.	176311	
Profit over operational cost in Rs.	82442	
Profit over total costs in Rs.	59874	
Cost of Cultivation in Rs. per ha	116437	
Cost of production per qtl	112	
Average yield per ha in qtls	1041	

The next position was occupied by the cost of planting material and was estimated as 12.22 percent. The net profit over total cost of cultivation was Rs. 59874. The average productivity of cane was 1041 qtl per ha and the cost of production of cane was Rs.112 per qtl.

Resource Use Efficiency

As indicated by the scatter diagram for individual variables identified, a Cobb-Douglas production function was fitted. The relationship between the dependent variable (the output) and the independent

variable (the inputs) is exhibited in the following form.

$$\ln yld = a1 + a_2\ln X_1 + a_3\ln X_2 + a_4\ln X_3 + a_5\ln X_4 + a_6\ln X_5 + a_7\ln X_6 + a_8\ln X_7 + a_9\ln X_8 + a_{10}\ln X_9$$

where,

Yld = Yield/output per ha.

X_1 = Labour hours use per ha.

X_2 = Animal power use per ha.

X_3 = Machine power use per ha.

X_4 = Farm yard manure use in quintals per ha

X_5 = Setts use in quintals per ha.

X_6 = Nitrogen use in kgs per ha.

X_7 = Phosphorous use in kgs per ha

X_8 = Potassium use in kgs per ha.

X_9 = Use of PP chemicals in Rs. per ha.

a_1 to a_{10} are the parameters to be estimated

The results obtained from the production function analysis of the data are presented below in

Table 3. Results of Cobb-Douglas Production Function Analysis

Variables	Coefficient	t Statistics	Mean values
Intercept	2.4640	3.5356	
Labour hours	0.3697*	6.4839	3074.78
Animal hours	0.0063	0.5662	21.14
Machine hours	0.0154	0.5397	9.94
Sets in quintal	0.0696	0.7009	103.91
FYM in quintal	0.2101*	4.1123	40.80
N kg	0.1439*	2.8140	191.28
P kg	0.060**	1.8538	94.01
K kg	0.0519*	3.1261	115.05
PP value in Rs.	0.1301*	2.3469	514.66
R^2	0.7689		

Table 3. The estimated R square was 0.7689 which indicated that nearly 77 per cent of the variations in the output of the crop were explained by the included independent variables. The labour hours, organic manure and fertilizers applied, and the value of plant protection chemicals were significantly contributing variables for the production of sugarcane crop. One percent increase in the labour hours would increase the yield by 0.36 per cent from the mean level, keeping all other inputs at constant levels.

Efficient use of labour in the field operations like weeding, detrashing etc. would definitely pave way for increased yields in sugarcane cultivation. i. e. one percent increase in the use of labour force would increase the yield of sugarcane by nearly 0.40 percent keeping all other variables at their mean levels. In the same manner, one percent increase in the application of FYM would increase the yield by 0.21 per cent and nitrogen application by 0.14 per cent. The use of machine power is not significantly contributing to the yield levels in this labour intensive crop.

The parameters estimated in this type of production function are the elasticities of the inputs used in the production of crops. The elasticities estimated when summed up horizontally would result in the economies of scale. The sum value of the estimated parameters was 1.06 in the analysis which would mean constant returns of scale in sugarcane production. The inference drawn is that the inputs if used more efficiently and appropriately would definitely result in higher productivity and there by the gross income or return or the profit end up on a higher side.

Conclusion

The study revealed that the growth rate of area and production of sugarcane was positive and increased during the post liberalization period in India and Tamil Nadu. However, the productivity of sugarcane showed a negative growth rate in India and Tamil Nadu during the post liberalization period, which might be due to monsoon failure during the period. The net income realized from sugarcane was Rs.42395 per ha and the cultivation of sugarcane is more profitable. The constant returns to scale indicated that there lies better opportunities for the farmers to increase resource use efficiency so as to increase their yield levels and there by the income levels to lead a better life. Finally it could be concluded that there exists a huge scope for increasing the productivity by efficiently managing all these resources (inputs) i.e. resource use efficiency

Policy Implications

- Technologies should be developed for more mechanization of farm operations in the cultivation of sugarcane in areas like tilling the soil, making ridges and furrows, harvesting the cane etc. to increase the use of machine power.
- Integrated nutrient management and integrated pest management technologies should be still popularized to increase the resource use efficiency of inputs like organic fertilizers, chemical fertilizers and plant protection chemicals.

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