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Resource use efficiency in sugarcane production in Tirunelveli district of Tamil Nadu

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Abstract
Resource use efficiency of sugarcane cultivation estimated in Tirunelveli district with primary data. One block from the district has been selected considering area under sugarcane cultivation. Sugar factory in the study area promotes increase in the sugarcane cultivation. Cobb-Douglas production function is used to estimate the resource use efficiency. R^2 value is found to be 0.60 indicating 60% of variation in Sugarcane Yield. The result shows that Machine labour and Nitrogen shows positive and significant results. The MVP to MIC ratio of inputs such as Phosphorus and Urea are more than unity which means the resources were under-utilized. For other inputs MVP to MIC ratio such as Sugarcane setts, machine labour, human labour, irrigation, potash are less than unity which means resources are over utilized.

Keywords: Sugarcane, resource use efficiency, marginal value product (MVP), marginal input cost (MIC)

Introduction
Sugarcane (*Saccharum officinarum* L.) is globally an important source of commercial crop accounting nearly 70 per cent of the world sugarcane production (*Shiva Pujan Singh et.al)*. It is a source as raw inputs to other products manufacturing namely animal feed, antibiotics, particle board, and bio-fertilizer. It is a base material for bio-ethanol production. As cash crop, it ranks third in most cultivated crops after paddy and wheat. The performance of this crop has important bearing not only for the growth and development of agriculture and also the capacity utilization for growth of the industrial sector.

Brazil was the largest producer of sugarcane in the world followed by India, China, Thailand, Pakistan, and Mexico. The global demand for sugar is the primary driver of sugarcane agriculture. (http://eastafricaschoolserver.org/Wikipedia/wp/s/Sugarcane.htm)

India is world's biggest sugar consumer with a consumer base of more than billions of people. Sugar is the second largest processed product in India after cotton and textiles (http://www.economywatch.com/ sugar-industry.html). India is the only country that produces plantation white sugar unlike other countries which produce raw or refined sugar only. The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development in the rural areas. It mobilises rural resources in generating higher income and employment opportunities.

Uttar Pradesh is the largest sugarcane producing in India with production of 1,333 lakh tonnes and area of 21 lakh hectares of land followed by Maharastra, Tamil Nadu, Karnataka, Andhra Pradesh (including Telangana), Bihar, Gujarat, Haryana, Punjab, Uttarakhand (http://agritech.tnau.ac.in). Tamil Nadu is the third largest sugarcane producing state in India. All the districts of Tamil Nadu cultivate sugarcane except in Nilgiris and Kanyakumari.

Area, Production and Productivity of Sugarcane during the year 2012-2017 for India and Tamil Nadu were given below.

Table 1: Per cent share of area in Sugarcane:

AREA ('000 ha)			
Year	**India**	**Tamil Nadu**	**%**
2012-2013	4999	347.2	6.94
2013-2014	4993	313.3	6.27
2014-2015	5067	263.1	5.19
2015-2016	4927	252.3	5.12
2016-2017	4436	218.2	4.92

Source: www.indiastat.com (Author's calculation)

Table 2: Per cent share of production in Sugarcane

Production ('000 tonnes)			
Year	**India**	**Tamil Nadu**	**%**
2012-2013	341200	33919.2	9.94
2013-2014	352142	32454.1	9.21
2014-2015	362333	28092.8	7.75
2015-2016	348448	25494.1	7.31
2016-2017	306069	18987.56	6.20

Source: www.indiastat.com(Author's calculation)

Table 3: Per cent share of productivity in Sugarcane

Productivity (kg/ha)			
Year	**India**	**Tamil Nadu**	**%**
2012-2013	68254	97688	143.3
2013-2014	70522	103575	146.8
2014-2015	71511	166788	233.2
2015-2016	70720	101059	142.9
2016-2017	69001	86995	126.07

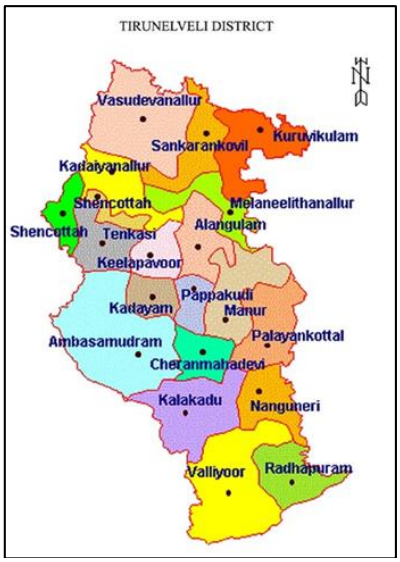
Source: www.indiastat.com(Author's calculation)

Objective

The objective of the study is to analyse the Resource use efficiency of sugarcane production in Tirunelveli district of Tamil Nadu, South India.

Materials and Methods

The study deals with the Resource use efficiency of Sugarcane cultivation in Tirunelveli district of Tamil Nadu.



Blocks in Tirunelveli district

Vasudevanallur block was selected purposively on the basis of area in sugarcane cultivation. Primary data are collected randomly from 120 farmers cultivating Sugarcane in Vasudevanallur block.

Production functional analyses

Girei and Giroh (2013) [1], Jawanjal B.G *et.al* (2014) [2], Shiva Pujan Singh *et.al* (2018) [4], Umesh *et.al* (2017) [5] used the following methods to find out the Resource Use efficiency in Sugarcane cultivation. The Cobb-Douglas production function was used to determine the regression co-efficient. It is specified as

$$y = aX1^{b1}X2^{b2}X3^{b3}X4^{b4}X5^{b5} \ldots\ldots\ldots e^{u}$$

Y= yield (tonnes/acre)
X1= Sett rates (tonnes/ acre)
X2= Machine labour (in hours)
X3= Human labour (in man days)
X4= Nitrogen (kg / acre)
X5= Phosphorus (kg/ acre)
X6= Potash (kg/ acre)
X7= Irrigation (number of times)
a = intercept b1, b2= regression co-efficient.

Marginal Value product

With the estimated regression co-efficient, Marginal value product was computed. Marginal value product is equated with marginal cost of the individual input to find Resource use efficiency. The Marginal value product (MPP) of each input is calculated by multiplying the marginal physical product with unit price of dependent variable.

$$MVP = MPP \times P_y$$

$$\text{MPP of Xi input} = bi\ \frac{\overline{Y}}{\overline{Xi}}$$

Where,
MPP = Marginal Physical Product of i^{th} input.
bi= Regression co-efficient of i^{th} input.
$\overline{Y}$ = Output of the crop at its geometric mean level.
$\overline{Xi}$ = i^{th} independent variable at its geometric mean level.

When,
MVP = MFC, Efficient utilization
MVP < MFC, Over utilization
MVP > MFC, under utilization

Results and Discussion

The regression co-efficient were estimated to identify the significant variables. From the Table 4 it is noted that the co-efficient of multiple determination (R^2) value is found to be 0.6059 and the adjusted R^2 value is found to be 0.5813. It indicates that variable inputs have functional relationship with dependent variable contributed as 60.59 per cent of sugarcane cultivation. In log linear production, the co-efficient of input variables is representing the production elasticity of the resources used. The regression co-efficient for constant is positive and significant. The regression co-efficient are Machine labour (0.0086), Nitrogen (0.0603), sett (0.0772), Phosphorus (0.0186), Potash (-0.0029), Human labour (0.0162), Irrigation (-0.1929). From this Machine labour (0.0086) and Nitrogen (0.0603) are positive and statistically significant. This implies that 1 per cent increase in these variables would increase the yield of sugarcane cultivation.

Table 4: Regression co-efficient from the Cobb-Douglas production function

Variables	Co-efficient	Standard error
Constant	3.9786**	0.6895
Machine labour	0.0086*	0.0041
Sett	0.0772	0.0511
N	0.0603*	0.0274
P	0.0186	0.0342
K	-0.0029	0.0189
Human labour	0.0162	0.0128
Irrigation	-0.1929	0.1997

Source: Author's calculation
N=120 R^2 =0.6059 Adjusted R^2=0.5813
** Significant at 1% * Significant at 5%

Table 5: Marginal value productivities and input cost

Input	MVP	MIC	Efficiency ratio MVP/MC
Machine labour	132.64	800	0.165
Sett	2140.32	2800	0.76
N	122.84	5.4	22.74
P	52.03	7	7.43
K	-23.10	16.6	-1.39
Human labour	71.79	400	0.17
Irrigation	-473.37	100	-4.73

Source: Author's calculation

From the Table 5 it is shown that Marginal value product was calculated to find out the Resource use efficiency of sugarcane cultivation. The findings shows that MVP to MIC ratio is less than unity for Setts (0.764), Machine labour (0.1658), Human labour (0.1794), potash (-1.392), Irrigation (-4.733) indicates the over utilization of these resources. MVP to MIC ratio was more than unity for Nitrogen (22.749) and Phosphorus (7.433) indicates that the resources are under-utilized.

Conclusion

The functional analyses were carried out to know the contribution of independent variables in yield of sugarcane. From the estimated Cobb-Douglas production function, it is noted that the most of the resources are over utilized. The study recommends that the farmer should increase the quality of inputs supplied and suggest using improved varieties and adopting new technologies in order to get efficient yield.

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