Original Research Article

A Comparative Economic Analysis of Resource use efficiency between insured and non-insured sugarcane farms in Tamil Nadu

Abstract

Sugarcane is a significant commercial crop that plays an important role in India's agro-industrial economy. This study was conducted on 120 sugarcane farmers which includes 60 insured and 60 non-insured farmers in the study area. Based on the nature of the data, the Cobb-Douglas production function was used to estimate resource use efficiency in sugarcane cultivation. The results revealed that the return to scale for insured and non-insured farmers were 1.43 and 1.16 respectively, indicating increasing returns to scale for both groups. The coefficients of multiple determination (R^2) were 70per centand 75 per cent for insured and non-insured farmers respectively, explaining the variation in output by independent variables such as seed rate, farmyard manure, human labour, machine labour, and fertilizers. The marginal value productivity of farmyard manure and machine labour were considerably high for insured farmers, while only machine labour showed high MVP for non-insured farmers. This indicates that there is further scope for increasing investment in these inputs to realize higher returns, particularly for insured farmers. The study also found significant differences in resource use efficiency between insured and non-insured farmers, suggesting the potential benefits of crop insurance in optimizing resource use.

Keywords : Resource ,efficiency, sugarcane, insured, non insured

1. INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) plays an important role in India's agriculture landscape, occupying about 2.57 per cent of the total cropped area. It is a vital cash crop with significant global and economic importance. Sugarcane is the leading source of sugar and biofuel in the world and plays an important role in both food security and renewable energy production (FAO,2021). Sugarcane is a widely cultivated cash crop in tropical and ~~sub-tropical~~sub-tropical regions of the world (Panwar 2015). India is the world's ~~second~~-2nd largest producer after Brazil followed by China Thailand and Pakistan.In India sugarcane has been cultivated in an area of 5.8 ~~Million hectares~~mha with the production of 4905.3 ~~lakh tonnes~~lt (Ministry of Agriculture and Farmers welfare,2023).According to the season and crop report of Tamil Nadu (2022-23), Sugarcane is grown in an area of 1,58,977 hectares with production of 1,76,58090 tonnes. Resource use efficieny in sugarcane cultivation varies across different regions and farm

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types.Studies on resource use efficiency are important as that may lead to Economic stability, Environmental conservation, Soil health protection and so on. To improve resource use efficiency and profitability, researchers recommend ensuring the availability and affordability of inputs, implementing modern agro-machinery, and providing subsidies (Pandey *et al.*, 2020; Bey et al., 2022).This study analyses the resource use efficiency between insured and non-insured sugarcane farmers. This helps in making policy decisions and extension programs aimed at boosting productivity and sustainability in India's sugarcane sector.

1.1Selection of Study Area

In the selection of the study area,a Multistage purposive sampling method was followed. The study was purposively conducted in the Kallakurichi district of Tamil Nadu which has the largest area under Sugarcane crop. Kallakurichi district has a total Sugarcane area of 25,731 ha with production and productivity of 2,885,636 tonnes and 112.15 tonne/ha.756 hectares of land has been covered under sugarcane crop insurance in the district in the year 2022-23 which is the largest among all other districts in Tamil Nadu. The survey was conducted in the Rishivandiyam Block and Thirukovillur Block of Kallakurichi district. A total of 120 samples were collected consisting of 60 insured and 60 non-insured sugarcane farmers.

2. METHODOLOGY

The data collected from the sample farmers were ~~analyzed and~~analyzed ~~estimated~~and estimatedwithcertain statistical techniques

2.1 Cobb-Douglas production function

Production functions show a technical relationship between input and output in a production process.Cobb-Douglas production function was used to assess resource use efficiency following the methods mentioned byBhosale (2003).

The Cobb-Douglas function generally can be presented as

$$Q = AX^{b}$$

Where A is a positive constant term and b is a positive fraction.

Q and X are the variables, the relationship between which are examined by the equation. However, in order to specify the equation, the above implicit equation must be explicitly expressed by taking the log transformation of both sides as shown below:

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$$LnQ=ln\beta_0+\beta_1 lnX_1+\beta_2 lnX_2+\beta_3 lnX_3+\beta_4 lnX_4+\beta_5 lnX_5+\beta_6 lnX_6 +u$$

Where,

Y- Yield (Rs/ha) from a production activities as an output

X_1= Quantity of Seed material (Kgs/ha)

X_2 = Quantity of Farm Yard Manure (tonnes/ha)

X_3= Human labour (Man days/ha)

X_4 = Machine labour (Hrs /ha)

X_3 = Quantity of Nitrogen (Kgs/ha)

X_4 = Quantity of Phosphorous (Kgs/ha)

X_5 = Quantity of Potassium (Kgs/ha)

X_6= Cost of Plant Protection chemicals (Rs/ha)

β_0 = regression constant

$\beta_1 - \beta_6$ are the parameters (coefficients) to be estimated

u is the error term which is assumed to be normally distributed with mean zeros and constant variance. In this equation, the natural logarithm of the respective variables was included.

The level of resource use efficiency was calculated using following formula

$$RUE=MVP/MFC$$

Where,

r = Efficiency ratio

MVP = Marginal Value Product; which is the value of incremental unit of output resulting from the additional unit of inputs added.

MFC = Marginal Factor Cost which is equal to one since both dependent and explanatory variables are converted to monetary value; and is defined as the increase in the cost of inputs due to purchase of additional unit of inputs.

Now, $MVP=b_i*Y_i / X_i$

b_i= Estimated regression coefficient of input Xi

Y_i= Geometric mean value of output.

X_i= Geometric mean value of i^{th} resources used.

Decision rule:

r= 1; Efficient use of resource

r>1; Underused of the resource

r<1; Overused of the resource

3. RESULTS AND DISCUSSION

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Table 1.Regression Estimates of Production Function for SugarcaneCultivation in the study area

S.No	Variables	Insured Farmers		Non Insured Farmers	
		Co efficient	t- value	Co efficient	t- value
1	Constant	0.19	0.42	0.15	-1.51
2	Seed rate (kg/ha)	0.08	1.08	0.03	0.77
3	Farmyard Manure (tonnes/ha)	0.25	2.03	0.03	1.04
4	Human Labour (Mandays/ha)	0.25**	2.80	0.30**	2.77
5	Machine Labour (hrs/ha)	0.20***	3.92	0.15*	2.29
6	N (Kgs/ha)	0.30**	2.68	0.40**	3.73
7	P (Kgs/ha)	0.15	1.47	0.12**	2.02

8	K (Kgs/ha)	0.08	1.48	0.07	1.47
9	Plant Protection chemicals(Rs/ha)	0.03	1.72	0.06	1.14
10	R2	70		75	
11	Adjusted R2	69		72	
12	F- Value	32		36	
	N	60		60	

(*** Significant at 1 percent level, ** Significant at 5 percent,*significant at 10 percent level)

From the Table 1, It could be inferred that the coefficient of multiple determination (R) of insured and non-insured farmers were found to be 0.70, 0.75, indicating that 70 & 75 per cent of the variation in the model was explained by the chosen independent variables, respectively.

In case of the Insured farmers, Nitrogen fertiliser , human labour used in the production process were found to have a significant and positive influence on yield at 5 per cent level where as the Machine Labour used for cultivation was found to be positive and significant at 1 per cent level of significance. Thus, the regression coefficients implied that one per cent increase in Nitrogen fertiliser from its mean level would increase the yield of Sugarcane by 0.30 percent. Similarly, if there is 1 per cent increase in variables namely, machine power, human labour would increase the yield of sugarcane by 0.25 and 0.20 per cent respectively.The sum of elasticity of regression coefficient was worked out to be 1.43 which indicated an increasing return to scale for insured farmers. This implies that one per cent increase in all the inputs for Sugarcane cultivation simultaneously would increase the paddy yield by 1.43 per cent.

Similarly, in case of non insured Sugarcane farmers, the coefficients of human labour, nitrogen, phosphorus were found to influence the sugarcane yield significantly at 5 % level and found positive. It could be inferred from the results that one per cent increase in the human labour, nitrogen, phosphorus, would increase the yield from its mean level by 0.30, 0.40,0.12, per cent, respectively. The sum of elasticity of regression coefficients was worked out to 1.16 which implied an increasing return to scale for non- insured farmers. Resource use efficiency of Sugarcane farms in the study area was estimated by using the marginal value product and marginal input cost of the output and inputs used in the production process.

The regression co efficient was required for the estimation are derived from the Cobb Douglas Production function using OLS estimates.

Table 2. Estimates of Resource use efficiency of Sugarcane Farms in the study area

Variable	Insured		Non Insured	
	Regression Co efficient	**MVP/MFC**	**Regression Co efficient**	**MVP/MFC**
Seed rate	0.08	0.38	0.03	0.12
Farmyard Manure	0.25	2.70	0.03	0.16
Human Labour	0.25**	0.8	0.30**	0.95
Machine Labour	0.20***	21.5	0.15*	18.5
Nitrogen	0.30**	0.15	0.40**	0.92
Phosphorus	0.15	0.28	0.12**	0.13
Potassium	0.08	0.05	0.07	0.03
Plant Protection chemicals	0.03	0.00	0.06	0.000

(*** Significant at 1 percent level, ** Significant at 5 percent,*significant at 10 percent level)

Decision rule for resource use efficiency states that if the ratio of MVP and MFC is more than 1 then the resource is being underutilised by the farmers for the Production process, if the ratio is equal to 1 then the resources are properly utilised and if the ratio is more than 1 then it states that the resources are underutilised by the farmers in the production process.

From the Table 2, it could be inferred that among the insured farmers resource use efficiency of inputs like Farm yard manure, Machine labour are more than 1 that states that these resources were underutilised by the sugarcane farmers in the study area in the crop production. Seed rate, Human Labour, Nitrogen, Phosphorus, Potassium and Plant Protection Chemicals are less than 1 which means that these inputs were over utilised by the farmers.

Among the non insured farmers, it is found that ratio of MVP/MFC of the variable Machine Labour is more than 1 which means that this input was underutilised and the inputs such as Seed rate, Farm Yard Manure, Human Labour, Nitrogen, Potassium, Phosphorus are less than 1 which states that these resources were over utilised in the production process of sugarcane in the study area.There exists a significant difference in resource use efficiency of inputs between the insured and non insured farmer. Inputs such as farm yard manure and machine labour show resource use efficiency ratio more than 1 among the insured farmers, which states that underutilization of these resources. Conversely, other inputs such as seed rate, human labour, nitrogen, phosphorus, potassium and plant protection chemicals have ratios less than 1 indicating overutilization of these resources Among non insured farmers, only machine labour appears underutilized with a ratio more than 1,while seed rate, farm yard manure, human labour ,Nitrogen,Phosphorus, Potassium shows ratio less than 1,indicating overutilization of resources .Similar findings were found in a study conducted by Anitha et al.,(2019) on Resource use efficiency in sugarcane production in Tirunelveli district of Tamil Nadu that 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 underutilized. Their study also shows a differences in resource use patterns that followed but they didn't compare between insured and non insured farmers. Their study emphasized the need for better resource management practices and targeted interventions to improve overall efficiency in sugarcane cultivation, echoing the implications of the current analysis.

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4. CONCLUSION

This study on the resource use efficiency in sugarcane farming provides valuable insights into input utilization patterns among the farmers.The results shows that there is a need for both efficient practices and improvement across various inputs such as fertilizers,water,machinery and labour.There is a notable difference in resource use efficiency between insured and non insured farmerswhich suggests that risk management strategies influence input allocation decisions. The findings highlight the overutilization of certain inputs, particularly chemical fertilizers and Labour, while others like farm yard manure and mechanization are underutilised. These inefficiencies impact farm profitability as well as environmental sustainability. These results help farmers maximise their input use, policymakers develop focused initiatives and agricultural agencies provide specialize advice. The study also laid a foundation for further research into factors influencing resource use efficiency and the role of

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precision agriculture in promoting sustainable farming practices.Enhancing resource use efficiency in sugarcane cultivation is important for improving the sector's resilience, sustainability and competitiveness. By optimizing input utilization,the sugarcane industry can better support India's food security and sustainable agricultural development goals.

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