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Resource-use Efficiency of Sugarcane Production in Gobichettipalayam Taluk of Erode District of Tamil Nadu: An Economic Analysis

A.Saravanan

[1]*Assistant Prof., Dept of Economics, J.K.K.Nataraja College of Arts & Science, Komarapalayam-638183, Namakkal Dt., TN.*
saravananchamp@gmail.com

Abstract

Objective: To identify the socio-economic characteristics of sugarcane farmers, to analysis the cost and returns of sugarcane production, to examine the resource use pattern of sugarcane cultivating of varying farm size and to evaluate the farm level technical efficiencies in the production of sugarcane in Gobichettipalayam taluk of Erode District in Tamil Nadu.
Methods/Statistical analysis: The study was confined to a sample of 150 sugarcane farmer households selected from six villages of Gobichettipalayam taluk of Erode District in Tamil Nadu, India. A simple percentage analysis was employed to identify the socio-economic characteristics and cost and returns of sugarcane cultivation for the selected sample farmers. The Stochastic Production Frontier Function model of the Cobb-Douglas type used incorporates a model for the technical inefficiency effects.
Findings: The study found that the majority of farmers belonged to nuclear family; their family size had 2-4 members; their age had 40–60 years and had a small family monthly income of Rs.15,000 to Rs.30,000. The educational status of the farmers was secondary level. The output elasticities of sugarcane with respect to area under crop, seed, family labour and machine hours were worked out to 0.2689, 0.2341, 0.1923 and 0.0698 respectively. The estimated value of σ_u^2 and σ_v^2 were 0.0824 and 0.0217 respectively. A high value registered for γ (0.7916) indicated the presence of significant inefficiencies in the production of sugarcane among the farmers. The study concluded that the majority of the sugarcane farmer's still employ low level of modern technology in sugarcane cultivation. Also, most of the sugarcane farmers are middle-aged, non-literate males; this had greatly contributed to inefficiency in sugarcane production among the sugarcane farmers.
Application/Recommendation: The central and state governments should invest more in functional agricultural extension services to enhance efficient use of available productivity increasing inputs. Farmer should be provided with minimum support price for their produce to make them survival assured. The agricultural department officials may give training and suggestion to the farmers regarding the use of recommended dose of fertilizer and pesticide and to reduce the harvesting cost of sugarcane, machinery with high technology may be used with increased numbers.

Keywords: Sugarcane, Cost & Returns, TE, OLS, Stochastic Frontier Function

1. Introduction

Sugarcane (*Saccharum officinarum*) is one of the most important crops in the world because of its strategic position and immense uses in the daily life of any nation as well as for industrial uses aimed at nutritional and economic sustenance. Sugarcane contributes about 60% of the total world sugar requirement while the remaining 40% came from sugar beet. It is a tropical crop that usually takes between 8 – 12 months to reach its maturity. Matured cane may be green, yellow, purplish or reddish considered ripe when sugar content is at its maximum [1]. The world area and production of sugarcane in 2015 were 26943 million hectares and 1911180 million tonnes respectively. Brazil, India, China, Thailand, Pakistan, Cuba, Mexico, Thailand, Colombia, Australia and Indonesia are the leading countries in sugarcane production. Brazil, India and China are the leading countries in sugarcane production, producing over half of the total world sugarcane production [2]. Sugarcane is produced in tropical and temperate zones. It is the second important commercial crop in India and is grown in about 5 million hectares, production of about 27 million tonnes of sugar, contributing direct and indirect employment to 40 million farmers, besides providing employment to 3-5 lakhs skilled and unskilled workers in the manufacturing of Sugar, [3]. Even

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though, sugarcane cultivation occupies only 2 percent of the total cultivable area of the country; it contributes 7 percent of the total value of the agricultural crop in the country. Moreover, the area under sugarcane cultivation in the country has gone up from 1.18 million hectares (1930-1931) to 5 million hectares (2010-2011); while cane production has gone from 37 million tonnes to 340 million tones with an average productivity of 628.10 quintals per hectare in the corresponding period. Tamil Nadu is one of the major sugarcane growing states in India, contributing 6.41 percent of national sugarcane and producing 8.32 percent national sugarcane production in 2011-12. Tamil Nadu is also leading producers of sugar in the country and its contribution is about 7 percent of country's total sugar production. As on 31.5.2011, there are 46 sugar mills in Tamil Nadu of which 16 sugar mills are in cooperative sector, 3 in public sector and 27 in private sector [4]. At present 44 sugar mills are functioning and the remaining 2 mills viz., Madura Sugars and Arunachalam Sugar Mills Ltd., are not functioning. This implies that the economy of the farmers as well as prosperity of the state is highly influenced by the earnings from this crop enterprise.

Today, production of sugarcane crop is complex process and depends on use and combination of different inputs such as labour, land, capital, management practices and other various factors. The variations in use and combination of various factors of production affect the sugarcane yield. These combinations are considered as technology. Farmers experience difference in sugarcane yield that is the result of using varying level and combination of inputs. Furthermore, there is a broad gap in the yields of farmer's field and experimental stations showing the suboptimal use of inputs. Technical efficiency studies the conversion of various physical inputs such as labour inputs, land inputs and other semi finished goods and raw materials into outputs. Thus, the present study on Resource-use Efficiency of Sugarcane Production in Gobichettipalayam taluk of Erode District of Tamil Nadu: An Economic Analysis is an attempt on this direction.

2. Objectives

The objectives of the present study are to identify the socio-economic characteristics of sugarcane farmers, to analysis the cost and returns of sugarcane production, to examine the resource use pattern of sugarcane cultivating of varying farm size, to evaluate the farm level technical efficiencies in the production of sugarcane in Gobichettipalayam taluk of Erode District and to suggest the suitable recommendation and policy measures to improve the sugarcane production in Erode district of Tamil Nadu.

3. Materials and Methods

3.1 Sampling Area

Erode District in Tamil Nadu is one of the major sugarcane growing districts in the state. Sugarcane is grown up as a major field crop by majority of the farmers in the district and had a maximum area of canal irrigated sugarcane cultivation. Therefore, this district forms the universe of the study.

3.2 Primary Data

The primary data on various aspects were collected from the Gobichettipalayam taluk of Erode districts through personal survey method with the help of structured interview schedule. The data pertained to the agriculture year 2014-15.

3.3 Sampling Size

For the purpose of the study, multistage random sampling technique was adopted in designing sampling frame for the study [5]. In the first stage, Erode district have 14 blocks, of which Gobichettipalayam taluk was purposively selected on account its commendable position in sugarcane cultivation. Similarly, in the second stage, Gobichettipalayam taluk has 60 revenue villages, out of which 6 villages were selected at random. In the third stage, 150 sugarcane farmers from 6 villages were chosen at random, giving equal representation to all sample villages. Thus, total sample size constitutes 150 sample sugarcane farmers selected from six villages of Gobichettipalayam taluk of Erode district. Post stratification was made to classify the farmers into four groups viz., less than 2.5, 2.5 - 5, 5.0 -7.5 and above 7.5 acres respectively.

3.4. Analytical Methodology

A simple percentage analysis was employed to identify the socio-economic characteristics and cost and returns of sugarcane cultivation for the selected sample farmers. In order to the estimation of technical efficiency, the

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Stochastic Frontier Production Function [6] is the most popular approach considered in recent years. The stochastic frontier [7] has been modeled with a composite error term, comprising two components. A symmetric component permits random variation of the frontier across firms and captures the effects of measurement error other statistical noise and random shocks outside the farms control. A one sided component captures firm-specific effects such as slackness in production due to labour shirking, which are under the control of the firms and influence their level of achievement of technical efficiency. For the present analysis, the empirical model used for analysis consists of two stages. In the first stage, farm specific technical efficiency scores are estimated using stochastic production function, of the following type;

$$\ln (Yi) = Xi\,\alpha + Vi - Ui \quad \text{---------- (1)}$$

Where Y is the dependent variable (output) and Xi are the independent variables viz., area under crop, seed, family labour, hired labour, machine hours, chemical fertilizer and pesticide cost. In this model, the dependent variable is bounded by the stochastic variable, Vi – Ui. The random error, Vi can be positive or negative and so the stochastic outputs vary about the deterministic part of the frontier model.

Vi is the symmetric random error term distributed independently and identically [N (o, σ_v^2)] and captures errors beyond the farmers control. Ui is the one sided production, distributed independently and identify with non-negative truncation of the normal distribution [N (o, σ_v^2)]. If the farm is inefficient (efficient), the actual output produced is less than (or equal to) the potential output. Therefore, the ratios of actual output and potential ouput can be treated as a measure of technical efficiency. Using the above equation I, the technical efficiency (TE) of the i^{th} farm is derived as: $TE_i = \exp(-Ui)$

The technical efficiency of the i-th farmer ($TE_i = \mu_i$) is derived from the density function of u and v which can be written as

$$F_u(u) = 1/\sqrt{½*\pi}).\ 1/\sigma_u .\ \exp.[-u^2/2\,\sigma_u^2] \text{ for } u \le 0 \quad \text{----------(2)}$$

$$= 0 \text{ otherwise}$$

$$F_v(v) = 1/\sqrt{½*\pi}).\ 1/\sigma_v .\ \exp.[-v^2/2\,\sigma_v^2] \text{ for } -\infty \le u \le \infty \quad \text{----------(2a)}$$

The density function of y is the joint density function of (u+v) and is given by

$$F_v(\gamma) = \pi .1/\sqrt{½*\pi}) .\ 1/\sigma .\ \exp.\{(u+v)^2 / 2\,\sigma^2\} .$$

$$1- f\{((u+v)/\sigma)(\gamma/1+\gamma))] \quad \text{----------(3)}$$

Where,

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \quad \text{----------(4)}$$

$$\gamma = \sigma_u^2 / \sigma^2,\ 0 \le \gamma \le 1 \quad \text{----------(4a)}$$

Finally, γ is given by

$$\sigma^{ui} = -\sigma_u \sigma_v / \sigma\ [\{\phi(.)/1-\phi(.)\}-\{((u+v)/\sigma)\sqrt{(\gamma/1-\gamma)})\}] \quad \text{----------(5)}$$

where ϕ (.) and ϕ (.) are standard density and distribution functions, respectively. The variables specified for estimation of Technical Efficiency for the individual farms and crops based on Cobb-Douglas type was;

y = output of crops (sugarcane / in quintal / acre)

X_1 = seed rate in kg/acre

X_2 = Area under crop (in acres)

X_3 = Family labour (male + female) man-days/acre.

X_4 = Hired labour used in man-days/acre

X_5 = Cost on machine hours used in Rs. / acre

X_6 = Quantity of chemical fertilizer used in kg/acre

X_7 = Cost on pesticide components (in Rs./acre)

3.4.1 Determinants of Technical Efficiency

As crop output is conditioned by the factors like rainfall, incidence of disease & pest, soil fertility and other socio-economic factors, a simple linear regression technique of the following type was used to identify the factors that influence the technical efficiency of the selected farmer households. The technical efficiency scores generated by the frontier are regressed on the independent variables as follows;

$$TE_{ij} = \boldsymbol{\alpha} + \boldsymbol{\alpha}_1 (X_1) + \boldsymbol{\alpha}_2 (X_2) + \boldsymbol{\alpha}_3 (X_3) + \boldsymbol{\alpha}_4 (X_4) + e_i$$

Where,

TE_{ij} = level of technical efficiency estimated through MLE

X_1 = Age

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X_2 = Educational status
X_3 = Farm size
X_4 = Family Size
α_1……α_4 = regression co-efficients
e_i = error term
α = constant

Table 1. Socio-Economic Characteristics of the Sample Farmer Households

Socio-Economic Characteristics		Farm Size Group (in acres)				Total
		Less than 2.5	2.5 - 5.0	5.0-7.5	More than 7.5	
Type of family	Nuclear	43 (41.35)	29 (27.88)	18 (17.31)	14 (13.46)	104 (100.00)
	Joint	13 (28.26)	12 (26.09)	11 (23.91)	10 (21.74)	46 (100.00)
	Total	56 (37.33)	41 (27.33)	29 (19.33)	24 (16.00)	150 (100.00)
Family Size Group	Below 2	12 (38.71)	8 (25.81)	7 (22.58)	4 (12.90)	31 (100.00)
	2 – 4	31 (41.33)	21 (28.00)	12 (16.00)	11 (14.67)	75 (100.00)
	Above 4	13 (29.55)	12 (27.27)	10 (22.73)	9 (20.45)	44 (100.00)
	Total	56 (37.33)	41 (27.33)	29 (19.33)	24 (16.00)	150 (100.00)
Age group	Below 40	12 (27.27)	15 (34.09)	9 (20.45)	8 (18.18)	44 (100.00)
	40 – 60	31 (45.59)	14 (20.59)	13 (19.12)	10 (14.71)	68 (100.00)
	Above 60	13 (34.21)	12 (31.58)	7 (18.42)	6 (15.79)	38 (100.00)
	Total	56 (37.33)	41 (27.33)	29 (19.33)	24 (16.00)	150 (100.00)
Family Monthly Income	Below Rs.15000	18 (32.14)	10 (17.86)	11 (19.64)	17 (30.36)	56 (100.00)
	Rs.15000 – Rs.30000	31 (53.45)	10 (17.24)	12 (20.69)	5 (8.62)	58 (100.00)
	Above Rs.30000	7 (19.44)	21 (58.33)	6 (16.67)	2 (5.56)	36 (100.00)
	Total	56 (37.33)	41 (27.33)	29 (19.33)	24 (16.00)	150 (100.00)
Educational status	Illiterate	14 (41.18)	9 (26.47)	6 (17.65)	5 (14.71)	34 (100.00)
	Primary Level	11 (28.21)	10 (25.64)	10 (25.64)	8 (20.51)	39 (100.00)
	Secondary Level	25 (40.98)	20 (32.79)	7 (11.48)	9 (14.75)	61 (100.00)
	Higher Secondary & above level	6 (37.50)	2 (12.50)	6 (37.50)	2 (12.50)	16 (100.00)
	Total	56 (37.33)	41 (27.33)	29 (19.33)	24 (16.00)	150 (100.00)

Source: Survey data (Figures in parentheses indicate percentage)

4. Results and Discussion

The results of the study are presented in three main parts viz., (i) socio-economic characteristics of the sample sugarcane farmers, (ii) Estimated Cost and Returns of Sugarcane Cultivation and (iii) Resource Use Efficiency of Sugarcane Production in Gobichettipalayam taluk of Erode District.

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4.1. Socio-Economic Characteristics of the Sample Farmer Households

This part is mainly devoted for the study of the socio-economic characteristics of the selected sample sugarcane farmer households in Gobichettipalayam taluk of Erode District. The important socio-economic characteristics chosen for analysis in the study are type of family, family size, age, educational status and monthly income of the family among sample sugarcane farmer households of different farm size groups classified through post stratification method.

From table 1, it is observed that out of the 150 sample sugarcane farmer households selected for the study, the majority of them belonged to nuclear family; their family size had 2-4 members; their age had 40–60 years and had a small family monthly income of Rs.15,000 to Rs.30,000. The educational status of the farmers was secondary level.

4.2. Estimated Cost and Returns of Sugarcane Cultivation

The estimated cost and returns of sugarcane cultivation pertaining to the different farms level data collected from the sample farmers of six villages in Gobichettipalayam taluk of Erode District is furnished from table 2.

Table 2. Estimated Cost and Return of Sugarcane Cultivation (Per Acre) in Gobichettipalayam taluk of Erode District

Variables	Farm Size Groups (in acre)				All Farms
	Below 2.5	2.5-5.0	5.0-7.5	Above 7.5	
N	**56**	**41**	**29**	**24**	**150**
Average area under Sugarcane crop in acre	1.71	3.89	6.31	9.10	4.38
Cost on Seed	6187.96 (14.66)	6207.99 (16.21)	6178.14 (15.72)	6165.56 (16.32)	6182.64 (15.86)
Imputed Cost on Family Labour	8125.95 (19.25)	6251.87 (16.33)	5652.50 (14.38)	2189.54 (5.80)	5005.37 (12.84)
Cost on Hired Labour	15872.93 (37.61)	14781.63 (38.60)	15671.20 (39.88)	17142.75 (45.38)	15974.19 (40.99)
Cost on Machine hours	5704.71 (13.52)	5661.29 (14.79)	5674.73 (14.44)	5641.42 (14.93)	5664.74 (14.54)
Cost on Chemical Fertilizer	5807.70 (13.76)	4840.13 (12.64)	5631.97 (14.33)	6157.89 (16.30)	5640.19 (14.47)
Cost on Pesticide	506.44 (1.20)	547.30 (1.43)	488.11 (1.24)	482.84 (1.28)	503.40 (1.29)
Total Variable Cost (TVC)	**42205.69** (100)	**38290.21** (100)	**39296.66** (100)	**37780.00** (100)	**38970.53** (100)
DIRTI-5	2002.36	1304.55	781.54	638.33	1038.53
Total Cost (TC)	**44208.04**	**39594.76**	**40078.20**	**38418.33**	**40009.06**
Total Return (TR)	70972.25	86333.23	70585.79	72986.50	75266.95
Net Return (TR-TC)	**26764.21**	**46738.47**	**30507.59**	**34568.17**	**35257.89**
Return over Variable Cost (TR-TVC)	28766.57	48043.02	31289.14	35206.50	36296.42

Source: Survey Data, Figures in parentheses indicate percentages

From the table 2 showed that the cost and return particulars of the selected sample sugarcane cultivating farmers of Gobichettipalayam taluk in Erode District. The mean size farms for <2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres and >7.5 acres of land group was worked out to 1.71 acres, 3.89 acres, 6.31 acres and 9.10 acres respectively. Taking into account all size groups of farms, the average size was worked out to 4.38 acres. The area under sugarcane, cost of seed, imputed cost of family labour, cost of hired labour, cost of machine hours used, cost of chemical fertilizer and cost of pesticide were the important constituents determining the economics of sugarcane production in the area. Of which, the average sugarcane cultivating farmer in the area ought to spent an average of about more than 40 percent of the total cost towards cost of hired labour followed by Cost on seed (15.86 percent), 14.54 percent of the total cost on machine hours used, 14.47 percent of the total cost on chemical fertilizer, 12.84 percent (appropriate cost) on family labour and only 1.29 percent on pesticide, realised a total return of Rs.75266.95 per acre. In other words, sugarcane cultivation being a labour intensive occupation depend much on hired labour. Higher proportion of hired labour might be due to their moderate dependency in farm activities in the region. The cost on

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machine hours used for cultivation have showed an average of about 15 percent of the total cost, indicating the use of modern agricultural implements in crop production. Chemical fertilizer and cost of pesticide are the other important factor inputs which have direct effect on crop production. In other words, an average farmer in the category of less than 2.5 acres of sugarcane cultivation spent 13.76 percent of his total cost on chemical fertilizer, while 16.30 percent was recorded for the farms of more than 7.5 acres, indicating the fact that due to the poor economic background, the small farmers were constrained to spend more on fertilizer, this is not so for the bigger sized farms. From the point of view of pesticide use, higher proportion of cost was accounted for farms of the below 5 acres; while it was on the reverse for farms of above 5 acres. In other words, the proportion of fertilizer cost tended to increase with farm size, while the proportion of pesticide cost tended to diminish with farm size. The net return worked out for different size group of farms cultivating sugarcane in the area tended to increase with farm size upto 7.5 acres; showed a marginal decline for farms of above 7.5 acres. However, from the point of view of the return over variable cost, all farms group were witnessed with positive odds. Thus to conclude, an average sugarcane cultivating farmer in the area spent 15.86 percent, 12.84 percent, 40.99 percent, 14.54 percent, 14.47 percent and 1.29 percent respectively on cost of seed, family labour, hired labour, machine hours used, chemical fertilizer and pest management; and received a net revenue of Rs.35,257.89/- per acre.

4.3. Resource Use Efficiency of Sugarcane Production

4.3.1. Average Levels of Input Use and Output per Acre

Prior to the discussion on the technical efficiency of farm groups, an overview of the input and output characteristics of the selected farmer households of varying size groups between the two taluks under reference is furnished in table 3.

Table 3. Average Levels of Input Use and Output per Acre by Sample Farm Size Group

Particulars	Farm Size Group				
	Less than 2.5	2.5-5.0	5.0-7.5	More than 7.5	All
Average area under Sugarcane	1.71	3.89	6.31	9.10	4.38
Seed Cane in Pieces (No's)	22999.81	22875.21	24062.39	24645.46	22736.73
Family labour (man-days)	27.60	29.00	26.98	24.19	22.39
Hired labour (man-days)	173.64	176.39	176.47	189.51	173.62
Machine hours	2.47	2.31	2.21	3.08	2.96
Chemicals fertilizer (in Rs.)	5005.00	5058.04	5262.98	5375.67	4845.04
Pesticide components (in Rs.)	151.99	152.93	155.69	158.41	147.63
Cane Output (tonnes)	38.38	38.32	40.28	40.85	39.43
Capital Cost (DIRTI-5) (in Rs.)	1246.18	1163.39	1095.68	1146.34	1077.05
Farm specific variables					
Age	51.04	52.02	53.24	58.89	50.90
Education Status	5.46	5.86	6.06	6.04	5.56
Farm size	1.67	3.83	6.51	9.77	4.09
Family Size	3.72	4.14	4.09	4.78	3.91

Source: Survey data.

From the data furnished in table 3, it is observed that the average size of farms cultivating sugarcane in the Gobichettipalayam taluk were worked out to 1.71 acres, 3.89 acres, 6.31 acres and 9.10 acres respectively for the farms of less than 2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres and more than 7.5 acres. Taking into account all farm groups together, the average size of farm cultivating sugarcane in the Gobichettipalayam taluk was worked out to 4.38 acres. In other words, based on the mean level data, it is observed that the area under the reference sugarcane was positively associated with the size of land holdings. As hired labour seemed to be an important constituent in agricultural production, especially for the small and medium size group of farms, the proportion of hired labour utilized by each group of farms was worked out separately. Observation clearly showed that hired labour seemed to be an important source of crop production for all size group of farms and each farm in Gobichettipalayam taluk utilized 174 days, 177 days, 176 days and 190 days respectively. By taking all farm size groups together; an average

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sugarcane cultivating farmer in the Gobichettipalayam taluk has utilized 175 man-days per acre through hired labour sources. In the case of farms with more than 7.5 acres of sugarcane cultivation, the hired labour force participation was found to be higher than the farms of less than 2.5 acres of sugarcane cultivation. This might be due to the fact that their dependence on hired labour was relatively high as evidenced in table. In other words, the family labour use per acre for sugarcane cultivation in Gobichettiplayam taluk was found decreased with farm size, while an increasing trend was witnessed in the case of hired labour. The machine hours used per acre sugarcane cultivation was worked out to an average of 3 hours, starting from ploughing to harvest in the taluk, inspite of the fact that marginal differences and witnessed between groups. The quantity of plant nutrients in the form of NPK compounded fertilizer used per acre was found increased with farm size in the taluk. In other words, an average farmer in the Gobichettipalayam taluk in Erode District had used 4845.04 of NPK compounded fertilizer (per acre) respectively on sugarcane. The proportion of cost incurred for pesticide components was worked out to be more in farms with below 5 acres, while increasing trend was observed with increasing farm size in the taluk.

4.3.2. Average Production Function

Prior to the examination of the levels of technical efficiency between sample farms, an attempt has been made in the study to estimate the average output response to the changes in inputs at the existing state of technology. The Cobb-Douglas Production Function using Ordinary Least Square (OLS) technique was attempted to estimate the output elasticities with respect to the key inputs in the production of sugarcane in Gobichettipalayam taluk of Erode District in Tamil Nadu. The output elasticities based on the OLS estimates of the Cobb-Douglas production function for sugarcane is presented in table 4.

Table 4. OLS Estimates of the Production Function for Sugarcane Cultivation

Variables	Co-efficient	t	Sig.
Intercept	5.312	2.695	.011
Area under crop	0.526*	3.021	.002
Seed	0.236**	2.186	.026
Family Labour	0.069***	1.479	.065
Hired Labour	0.046	1.098	.232
Machine Hours used	0.491*	2.734	.007
Chemical Fertilizer	0.011	0.198	.724
Cost on Pesticide Components	-0.102	-0.729	.342
R	0.915		
R^2	0.838		
Adjusted R^2	0.830		
F	105.023*		.000
N	150		

Source: Survey Data.

The estimated regression co-efficient of the variables pertaining to the data on Gobichettipalayam taluk furnished in table 1 clearly reveals that R^2 a significant proportion of variability in the yield of sugarcane was explained by these variables as measured by the R^2 of 0.838 for Gobichettipalayam taluk of Erode District in Tamil Nadu. The estimated output elasticities with respect to area under crop, seed, family labour, and machine hours used were estimated to 0.526, 0.236, 0.069 and 0.491 respectively and statistically significant at 1 percent, 5 percent and 10 percent level.

4.3.3. Technical Efficiency

The Technical Efficiency of selected farms involved in sugarcane production from the Gobichettipalayam taluk of Erode District in Tamil Nadu was estimated for sugarcane production by fitting a Stochastic Frontier Production Function. The MLE estimates obtained for sugarcane with respect to Gobichettipalayam taluk of Erode District is furnished in Table 5.

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Table 5. Estimated Parameters of the Stochastic Frontier Production Function for Sugarcane Cultivation

Variables	B	t	Sig.
Intercept	8.9956	3.312	0.005
Area under crop	0.2689**	2.546	0.021
Seed	0.2341*	5.178	0.001
Family Labour	0.1923*	4.259	0.002
Hired Labour	0.1487	1.421	0.321
Machine Hours used	0.0698***	1.867	0.079
Chemical Fertilizer	0.0198	0.542	0.513
Cost on Pesticide Components	0.0512	1.341	0.641
σ_v	0.1473		
σ_u	0.2871		
σ^2	0.1041		
σ_v^2	0.0217		
σ_u^2	0.0824		
γ	0.7916		
Log Likelihood	75.1437		
N	150		

Source: Survey Data

The maximum likelihood estimates of the stochastic frontier production based on the sample farm level data pertaining to Gobichettipalayam taluk indicates the fact that four input variables viz., area under sugarcane crop, seed, family labour and machine hours used were registered with a priori signs and statistically significant at 1 percent, 5 percent and 10 percent level. In other words, the output elasticities of sugarcane with respect to area under crop, seed, family labour and machine hours were worked out to 0.2689, 0.2341, 0.1923 and 0.0698 respectively. Though, use of hired labour, chemical fertilizer and cost of pesticide have positive impacts on sugarcane output, the estimates were not statistically significant. The estimated value of σ_u^2 and σ_v^2 were 0.0824 and 0.0217 respectively. A high value registered for γ (0.7916) indicated the presence of significant inefficiencies in the production of sugarcane among the farmers of the Gobichettipalayam taluk. In other words, 79 percent of the difference between the observed and frontier output among farms was mainly due to the inefficient use of resources which are under the control of the sample farmers in the area.

4.3.4. Efficiency Scores

In order to find out the extent of farm level inefficiencies witnessed for sugarcane cultivating farmers of Gobichettipalayam taluk of Erode District, technical efficiency scores were worked out through the maximum likelihood estimates of the frontier production function. The frequency distribution of the estimated technical efficiencies for sugarcane cultivating sample households by farm size group as well as for the farm as a whole for Gobichettipalayam taluk in Erode District is presented in Table 6.

From the Table 6, it is observed that the average level of technical efficiency was estimated to 75 percent for the Gobichettipalayam taluk farms, indicating the fact that the sugarcane output can be raised by 20 percent by following better crop management practices without having to increasing the level of application of inputs. It was also observed that 20 percent of the farmers in the area operated at the efficiency levels of <70 percent; while 43.33 percent were between 70-80 percent and 36.67 percent were >80 percent. The mean technical efficiency for farms of less than 2.5 acres, 2.5-5.0, 5.0-7.5 and more than 7.5 acres had been worked out to 0.7576, 0.7629, 0.7276 and 0.7585 respectively, of which the farmers in the size group of less than 2.5 acres of sugarcane cultivation in the area were termed as more efficient than the other groups. This might be due to the fact that the author's observation of optimum size of farm falls on these category.

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Table 6. Technical Efficiency by Farm Size Groups for Sugarcane Cultivation

Levels of Technical Efficiency (Per cent)	Farm size group				
	<2.5	2.5-5.0	5.0-7.5	Above 7.5	All
<70	11 (19.64)	6 (14.63)	8 (27.59)	5 (20.83)	30 (20.00)
70-80	23 (41.07)	18 (43.90)	13 (44.83)	11 (45.83)	65 (43.33)
>80	22 (39.29)	17 (41.46)	8 (27.59)	8 (33.33)	55 (36.67)
Mean TE	.7576	.7629	.7276	.7585	.7534
N	56	41	29	24	150

Source: Primary data Figures in parentheses indicate percentages

4.3.5. Determinants of Technical Efficiency

The efficiency scores generated by the frontier model were regressed on the variables viz., Education, Farm Size, Age, and Family Size, as furnished in Table 7.

Table 7. Determinants of Technical Efficiency

Variables	B	t	Sig.
Intercept	0.735	12.876	0.000
Age	0.217**	3.165	0.009
Educational status	0.111**	2.500	0.045
Farm size	0.183**	3.431	0.031
Family Size	0.194*	2.536	0.004
R^2	0.732		
Adj R^2	0.701		
N	150		

Source: Survey Data

The model explained the variation in technical efficiency on the sample farms interms of R^2 which ranges from 73 percent for sugarcane cultivating farmer households. As expected, all of the variables have positive signs. Age, Education, farm size and family size to sugarcane cultivation in the taluk were positively related with the technical efficiency and all of the coefficients were statistically significant. It can be inferred that the technical efficiency was influenced by education, as the presence of educated adult in the family adds to the efficiency in sugarcane output.

5. Conclusion and Recommendations

The overall results indicate that the majority of the sugarcane farmers still employ low level of modern technology in sugarcane cultivation. Also, most of the sugarcane farmers are middle-aged, non-literate males; this had greatly contributed to inefficiency in sugarcane production among the sugarcane farmers. To this end, there is a need for continuous research in understanding the differences observed, which in this study concerns the magnitudes rather than conflicts. Further limitation of the study is that the data used as shown in the yield curves tend to fluctuate considerably. This mean that yield of sugarcane was influenced by climate and soil parameters. Given the caution in interpreting the results, the following policy recommendations are suggested from the findings:

1. The government of Tamil Nadu should invest more in functional agricultural extension services to enhance efficient use of available productivity increasing inputs.
2. Farmer should be provided with minimum support price for their produce to make them survival assured.
3. Steps may be taken to conserve the soil health. Soil health cards will enable farmers to participate actively in the soil fertility enhancement movement.

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4. Timely availability of credit at an affordable rate of interest will help farmers to reduce distress.
5. Steps may be taken to build on the skills of farmers as agricultural entrepreneurs through links with technology, markets, society and the government.
6. A water literacy movement may be launched and regulated for sustainable use of ground water as well as for preventing pollution.
7. Steps may be taken to cover all the farmers under crop insurance.
8. Efforts may be taken for assured remunerative marketing for agriculture produce.
9. The agricultural department officials may give training and suggestion to the farmers regarding the use of recommended dose of fertilizer and pesticide.
10. To reduce the harvesting cost of sugarcane, machinery with high technology may be used with increased numbers.
11. Fertilizer and pesticide should be supplied to the farmers with subsidies.
12. Government should take stringent action against the polluter of water and air.

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