An Economic Analysis of Technical Efficiency of Paddy Cultivation of Erode District in Tamil Nadu

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Abstract

The study made an attempt to identify the socio-economic characteristics of paddy cultivating farmers of various size groups selected from the sample, to examine the resource use pattern of paddy cultivating farmers of varying size groups, and to evaluate the farm level technical efficiencies in the production of paddy in Thadappalli ayacut of Erode District in Tamil Nadu. The study was confined to a sample of 150 paddy farmer households selected from 5 villages of Thadappalli ayacut in Erode District. A simple percentage, the stochastic production frontier function model of the Cobb-douglas type used to find the results. The findings of the study have policy implications since they not only provide empirical efficiency indicators that can be used to plan farm production, but they also assist us identify the potential for crop production improvement across diverse farming systems based on efficiency. The study's findings also provide insight into long-term productivity improvement approaches that do not require more resources. Given that education has a considerable impact on technical efficiency, efforts should be made to popularise both formal and informal education among farmers in the area.

Keywords: Paddy, Thadappalli Ayacut, Cost & Returns, TE, OLS, Stochastic Frontier Function

Introduction

Efficiency measurement (technical, allocative, and economic) has remained a focus of research in both developed and developing countries. Efficiency measurement is significant because it is a component for productivity growth, especially in emerging agricultural economies where resources are limited and chances for developing and implementing improved technologies are limited (Ali and Chaudhry, 1990). These studies benefit these economies by establishing the extent to which productivity may be increased by increasing a neglected source, namely efficiency, with the existing resource base and technology. As a result, they may be able to assist in deciding whether to enhance efficiency initially or develop a new technology in the short term. Several studies that investigated the relationship between farm size and output in Indian agriculture have been conducted since the late 1950s, relating to the enduring view in literature that farmers practising traditional agriculture are 'poor but efficient,' and the resulting emphasis on increased investments in developing new and more productive techniques. Since the 1960s, regional variations, as well as input-output relationships and businesses, have been taken into account (Saini, 1969; Sahota, 1968; Hopper, 1965).

These investigations were carried out in order to assess, recommend, and create appropriate productive approaches that result in increased resource efficiency.

They were unable to distinguish causes of inefficiency due to the biological nature of agricultural production from farm-specific differences in the use of available technology because they represented the sample farms' production process on an input-output space (production function) with a given technology. Since the 1970s, efficiency assessments have been undertaken in Indian agriculture, despite conceptual problems and analytical discrepancies(Huang and Bagi, 1984; Kalirajan, 1981; Junankar, 1980; Sidhu, 1974; Lau and Yotopoulos, 1971;Alam, Siwar and Talib, 2010; Tadesse and Krishnamoorthy, 1997; Suresh and Keshava Reddy, 2006; Bhagat, Singh and Vishwavidyalaya, 2007; Ajit Singh, H L Singh and V S Chaudhary, 2013; Agarwal, Yadav and Mondal, 2018; Meenasulochani et al., 2018; Paul, 2019; Sharma et al., 2019; Thayaparan and Jayathilaka, 2020; K.S.R., Paul, 2020); in fact, the latter two measured relative technical efficiency using shadow profit function. With particular reference to rice farming, the studies by Shanmugam and Palanisami (1993) in Tamil Nadu, Datt and Joshi (1992) in Uttar Pradesh, and Jayaram et al. (1992) in Karnataka are among the prominent works. Despite being based on deterministic or probabilistic estimations of the frontier production function, these studies found that paddy fields in the different states had a mean technical efficiency of 75 percent, 66 percent, and 74 percent, respectively.

On the other hand, despite the widespread use of efficiency measures in Indian rice farms, only a handful of these studies have examined the same across size groups and agro-ecological regions (zones) at the same time. Furthermore, there is little agreement among the studies available on the age-old topic about efficiency disparities between small and large farms. Previously, it was thought that due of the increased cost of hired labour, output per hectare on large farms was lower when using traditional labor-intensive equipment. Nonetheless, the gradual adoption of technology has opened up new productivity potential for vast farms (Singh, 1992). As a result of their greater capital position, as well as institutional, extension, and financing advantages, large farmers can use labor-saving equipment to replace manpower, making them more efficient than small farms. According to the research, even among farms of equal size and other production characteristics, many factors explain variances in efficiency. When ecological (environmental) considerations are included in, the discussion will become much more intense. This is a pressing issue at the moment, as environmental concerns are at the heart of long-term growth. As a result, the current study is an attempt to look into an economic analysis of the technical efficiency of paddy production in the Erode District of Tamil Nadu.

The Problem

Since the mid-sixties, India's agriculture has seen significant growth in the post-independence period. The use of new HYV seeds, irrigational avenues, use of modern inputs like fertiliser, herbicides, and insecticides, tractors, pump sets, and other machineries in crop production are the most significant of these improvements. Another redeeming characteristic of the Indian agricultural system is the evolution of organisational and institutional systems for production, input compositions, and distribution of the whole package of inputs available. Furthermore, it is also true that the advances in agricultural productivity over the last two decades were mostly due to better utilisation of available infrastructure and an increase in yield per acre, which enabled India reach food grain self-sufficiency. The reasons attributed to these events are believed to be technological breakthroughs along with farmer perceptions about the use of modern inputs, available extension, and their impact on the productivity network. These changes in crop production and method, however, are not universal across crops, farms, and areas in the country. It has not only widened regional differences, but it has also resulted in an uneven distribution of rewards among different size groups of farmers across areas. This disparity in growth is mostly attributable to the fact that the areas under diverse agricultural crops have responded to technological and economic changes in these regions in different ways. As a result, the difficulties affecting a country's cropping system are numerous, attracting the attention of experts and policymakers. The technological challenges and efficiency metrics of farms included in the country's cropping system are among the main issues debated in the current era of agriculture development. Farmers' only option is to increase crop production through adoption of improved technology and efficient use of available resources, as rising population and income increase demand for crop products. Because there is no room for expanding land frontiers due to the trend of diverting agricultural land to non-agricultural uses, the only option available to farmers is to increase crop production through adoption of improved technology and efficient use of available resources. Agricultural output, on the other hand, is heavily influenced by agro-climatic conditions as well as technology at the regional level, with varying amounts of input utilisation having an impact on farm productivity. A yield gap can occur when resources are used inefficiently or ineffectively. As a result, examining differences in potential and actual yields at the farm level for a given technology and resource endowment of farmers across regions is critical in order to gain a better understanding of the productivity gap at a time when major changes in macro-policy are taking place in the context of India's economic liberalisation. The present study on an economic analysis of technical efficiency of paddy cultivation of erode district in tamil nadu is an attempt on this direction.

Objectives

The study made an attempt to identify the socio-economic characteristics of paddy cultivating farmers of various size groups selected from the sample, to examine the resource use pattern of paddy cultivating farmers of varying size groups, and to evaluate the farm level technical efficiencies in the production of paddy in Thadappalli ayacut of Erode District in Tamil Nadu.

Materials and Method

Selection of Sample Households

The district of Erode in Tamil Nadu was chosen for the study because of the importance of agriculture as a source of livelihood for a large population and the potential for this study to be reproduced in other parts of the state. As a result, the district is the study's universe. The Erode district has two revenue divisions: Erode and Gobichettipalayam. The Gobichettipalayam revenue division was chosen for the study because of its unique agro-climatic characteristics, the amount of land irrigated by canals, cropping patterns, irrigation intensity, and other socioeconomic factors. On a bigger scale, the River Bhavani is the single most important river irrigating the district. Thadappalli, Arakkan Kottai, Kalingarayan, and Lower Bhavani are the four ayacuts. Thadappalli ayacut was purposefully chosen for this study out of the four ayacuts because of its significance over other project sites in paddy cultivation for a lengthy period of time. Five villages were chosen at random, with each community located on the outskirts of the Thadappalli ayacut in question. A full census of all households in the selected villages was carried out in order to determine their occupational pattern, level of operational holdings, cropping pattern, area under paddy cultivation, and other socio-economic characteristics relevant to the study. A total of 150 farmer households farming paddy in an area of 50% or more of their total cropped area were chosen from the 5 villages, ensuring that all sample villages were represented equally. Following that, post-stratification was used to divide the farmers into four major size groups. As a result, the sample is chosen using a two-stage stratified random sampling process. The current study is limited to 150 paddy producing farmer households drawn from five villages in the Thadappalli ayacut area of Tamil Nadu's Erode District.

Analytical Methodology

The socio-economic variables, as well as the cost and returns of sugarcane growing for the selected sample farmers, were determined using a basic percentage analysis. In recent years, the Stochastic Frontier Production Function (Aigner) has been the most prevalent approach for estimating technological efficiency. The stochastic frontier (Bhende and Kalirajan) has been represented using a two-component composite error term. A symmetric component allows for random fluctuation in the frontier across businesses, capturing the effects of measurement error, statistical noise, and random shocks outside the farms control. Firm-specific impacts like as slackness in output owing to labour shirking, which are under the control of the businesses and influence their degree of technical efficiency, are captured by a one-sided component. The empirical model utilised for analysis in this study is divided into two parts. The first stage involves estimating farm-specific technical efficiency ratings using a stochastic production function, of the following type;

ln (Yi) = Xi α + Vi – Ui -------------------- (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, σv2)] 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, σv2)]. 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 ith farm is derived as: TEi = exp (-Ui)

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

Fu (u) = 1/ √ ½*π). 1/ σu . exp.[-u2/2 σu2] for u ≤ 0 --------------(2)

= 0 otherwise

Fv (v) = 1/√ ½*π).1/σv.exp.[-v2/2 σv2] for - ∞≤u≤∞ ------------- (2a)

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

Fv (y) = π .1/ √ ½*π) . 1/σ . exp. {(u+v)2 / 2 σ2}.

1- f{((u+v) / σ) (γ/ 1+ γ))] ----------------------(3)

Where,

σ2 = σu2 +σv2 ----------------------------------(4)

γ = σu2 / σ2 , 0 ≤ γ ≤ 1 -------------------------- (4a)

Finally, γ is given by

σui= - σuσv/ σ[{φ (.)/1-φ (.)}-{((u+v)/σ)√(γ /1- γ)))] ------------------- (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 (paddy / in quintal / acre)
X1 = seed rate in kg/acre
X2 = Area under crop (in acres)
X3 = Family labour (male + female) man-days/acre.
X4 = Hired labour used in man-days/acre
X5 = Cost on machine hours used in Rs. / acre
X6 = Quantity of chemical fertilizer used in kg/acre
X7 = Cost on pesticide components (in Rs./acre)

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;

TEij = α + α1 (X1) + α2 (X2) + α3 (X3) + α4 (X4) + ei

Where,

TEij = level of technical efficiency estimated through MLE
X1 = Farm size
X2 = Age
X3 = Educational status
X4 = Family Size
α1………α4 = regression co-efficients
ei = error term
α = constant

Results and Discussion

The results of the study are presented in three main parts viz., (i) socio-economic characteristics of the sample paddy farmers, (ii) Estimated Cost and Returns of paddy Cultivation and (iii) Technical Efficiency of Paddy Production in Thadappali ayacut of Erode District.

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 Thadappali ayacut 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 Paddy farmer households of different farm size groups classified through post stratification method.

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

Socio-Economic Characteristics		N	%
Type of family	Nuclear	104	69.33
	Joint	46	30.67
	Total	150	100.00
Family Size Group	Below 2	31	20.67
	2 – 4	75	50.00
	Above 4	44	29.33
	Total	150	100.00
Age group	Below 40	44	29.33
	40 – 60	68	45.33
	Above 60	38	25.33
	Total	150	100.00
Family Monthly Income	Below Rs.15000	56	37.33
	Rs.15000 – Rs.30000	58	38.67
	Above Rs.30000	36	24.00
	Total	150	100.00
Educational status	Illiterate	34	22.67
	Primary Level	39	26.00
	Secondary Level	61	40.67
	Higher Secondary & above level	16	10.67
	Total	150	100.00
Farm Size in acres	<2.5	39	26.00
	2.5-5.0	47	31.33
	5.0-7.5	36	24.00
	Above 7.5	28	18.67
	Total	150	100.00

Source: Survey data

Table 1 shows that the majority of the 150 sample Paddy farmer households chosen for the study belonged to a nuclear family; their family size ranged from 2-4 individuals; their age ranged from 40 to 60 years; and they had a little family monthly income of Rs.15,000 to Rs.30,000. The farmers' educational attainment was limited to a secondary level.

Estimated Cost and Returns of Paddy Cultivation

Table-2 shows the anticipated cost and revenue details of paddy production based on farm level data received from the sample farmers of Thadappalli ayacut in Erode District.

Table 2: Estimated Cost and Revenue Particulars of Paddy Cultivation in Thadappalli Ayacut Areas of Erode District

Cost / Revenue particulars	Farm Size in acres				Total
	<2.5	2.5-5.0	5.0-7.5	Above 7.5	
Average area under crop in acres	1.22	2.96	5.89	10.11	6.73
Cost of Seed	556	418	381	430	359
	(3.90)	(4.07)	(4.06)	(5.31)	(4.85)
Cost of Family Labour	7273	4306	3164	2100	2411
	(50.97)	(41.94)	(33.69)	(25.93)	(32.58)
Cost of Hired Labour	2562	2102	2552	2634	2054
	(17.96)	(20.48)	(27.17)	(32.53)	(27.76)
Cost of Machine hours	1488	1323	1353	1307	1161
	(10.43)	(12.89)	(14.41)	(16.14)	(15.69)
Cost of Chemical Fertilizer	1314	1405	1286	1201	981
	(9.21)	(13.69)	(13.69)	(14.83)	(13.26)

Cost of Pesticide in Rs.	1075	712	655	426	434
	(7.53)	(6.94)	(6.97)	(5.26)	(5.86)
TVC	14268.00	10266.00	9391.00	8098.00	7400.00
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
DIRTI-5	3510	3600	3710	4210	3710
TC	17778.00	13866.00	13101.00	12308.00	11110.00
TR	12730	11369	14162	12851	11430
Net Revenue (TR-TC)	-5048.00	-2497.00	1061.00	543.00	320.00
Revenue over total Variable cost (TR-TVC)	-1538.00	1103.00	4771.00	4753.00	4030.00
Sample observations (in No's)	39	47	36	28	150

Source: Survey data (Figures in parentheses indicate percentage)

The per acre cost and revenue particulars of the selected sample paddy cultivating farmers of Thadappalli ayacut in Erode District were shown in table-2. The average farm size for the land groups of 2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres, and >7.5 acres was calculated to be 1.22, 2.96, 5.89, and 10.11 acres, respectively. The average farm size was calculated to be 6.73 acres when all sizes of farms were included. The area under paddy, the cost of seed, the cost of family labour, the cost of hired labour, the cost of machine hours used, the cost of chemical fertiliser, and the cost of pesticide were all essential factors in determining paddy production economics in the area. Family labour (imputed) costs should account for 32.58 percent of the overall cost for the average paddy producing farmer in the area, followed by paid labour (27.76 percent). To put it another way, paddy cultivating is a labor-intensive occupation that heavily relies on human labour. It's possible that the higher amount of family labour is attributable to their excessive reliance on farm operations. or a lack of available or affordable hired labour in the area. The cost of machine hours utilised for cultivation accounted for 15.69% of the overall cost, demonstrating that modern agricultural equipment were used in crop production. Other key factor inputs that have a direct impact on crop output are chemical fertiliser and pesticide cost.

In other words, an average farmer cultivating 2.5 acres of paddy paid 9.21 percent of his entire expenditure on chemical fertiliser, compared to 14.83 percent for farms larger than 7.5 acres, demonstrating that large farmers are compelled to spend more on fertiliser, whereas smaller farmers are not. In terms of pesticide use, farms with less than 2.5 acres accounted for a larger proportion of cost, whereas farms with more than 2.5 acres accounted for a lower proportion of cost. In other words, as farm size increased, the proportion of fertiliser costs increased, while the proportion of pesticide costs decreased. The net revenue calculated for various size groups of farms farming HYV paddy in the area tended to increase with farm size up to 7.5 acres; however, farms larger than 7.5 acres showed a marginal reduction. The lower net revenue for farms of less than 5 acres may be related to the greater use of family labour and pesticides compared to other farms, as well as the higher capital cost authorised. However, all farms, with the exception of the 2.5-acre group, had favourable odds in terms of return over variable cost. To summarise, an average paddy cultivating farmer in the area spent 4.85 percent, 32.58 percent, 27.76 percent, 15.69 percent, 13.26 percent, and 5.86 percent on seed, family labour, hired labour, machine hours, chemical fertiliser, and pest management, respectively, and received a net revenue of only Rs.320/- per acre.

Technical Efficiency in Paddy Production

Table-3 provides an overview of the input and output characteristics of chosen farmer families of varied sizes in the Thadappalli ayacut in Erode District prior to the discussion on technical efficiency of farm groups.

Table 3: Average Levels of Input Use and Output Per Acre by Farm Size Group

Particulars	Farm Size in acres				
	<2.5	2.5-5.0	5.0-7.5	>7.5	All
Area under crop (in acres)	1.22	2.96	5.89	10.11	6.73
Seed (in kg)	41	30	29	32	27
Family labour (man-days)	74	76	52	52	59
Hired labour (man-days)	27	30	31	31	31
Machine hours	11	19	13	13	12
Chemicals fertilizer (in kg)	188	193	201	199	175
Pesticide components (in Rs.)	1075	913	897	911	844
Production (quintals)	19	19	20	18	17
Sample size (N)	39	47	36	28	150

According to the statistics in table 3, the average size of paddy farms in the Thadappalli canal area is 1.22 acres, 2.96 acres, 5.89 acres, and 10.11 acres for farms of 2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres, and above 7.5 acres, respectively. The average size of a farm growing paddy in the Thadappalli canal area was calculated to be 6.73 acres when all farm groups were combined. Because family labour appeared to be an important component of agricultural productivity, particularly for small and medium-sized farms, the percentage of family labour used by each category of farms was calculated separately. Family labour appeared to be a key source of agricultural production for all sizes of farms in the Thadappalli canal area, with each farm using 74 days, 76 days, 52 days, and 52 days, respectively. Taking all farm size groupings into account, an average paddy cultivating farmer in the Thadappalli canal area used 59 man-days per acre in family labour. Smaller farms used more family labour per acre of paddy cultivation than larger farms, leading to the conclusion that smaller farms in the region are still handled as family farms, and so economic viability of crop production among small farms is mainly missing in the Thadappalli region. Family labour force participation was found to be lower on farms with more than 5 acres of rice cultivation than on farms with fewer than 5 acres of paddy cultivation. This could be because their reliance on hired labour was rather large, as shown in the table. In other words, the utilisation of family labour per acre for paddy cultivation in the Thadappalli ayacut area was shown to decrease with farm size, whereas hired labour in the Thadappalli region increased. Despite the fact that there were minor discrepancies in farm size groupings, the average machine hours used per acre paddy cultivation in Thadappalli was calculated to be 12 hours, from ploughing to harvest. In the Thadappalli ayacut region, the quantity of plant nutrients in the form of NPK compounded fertiliser applied per acre was observed to rise with farm size. To put it another way, an average farmer in Erode District’s Thadappalli region utilised 175 kg of NPK compounded fertiliser (per acre) on paddy. In the Thadappalli ayacut region, the proportion of cost incurred for pesticide components was calculated to be higher in farms with less than 5 acres, whereas a declining tendency was found with increasing farm size. In the Thadappalli ayacut region, farms with 5.0-7.5 acres of paddy producing land produced the highest per unit paddy output.

Prior to comparing the levels of technical efficiency between sample farms, the study attempted to estimate the average output response to changes in inputs at the current technological state. In the Thadappalli ayacut area of Erode District in Tamil Nadu, the Cobb-Douglas Production Function was used to estimate the output elasticities with respect to the primary inputs in paddy production using the Ordinary Least Square (OLS) technique. Table-4 shows the output elasticities for paddy based on OLS estimates of the Cobb-Douglas production function.

Table 4: OLS Estimates of the Production Function for Paddy

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Intercept	6.310	1.010	.273	6.249	.000
Area under crop	8.374**	4.323	.607	1.937	.054
Seed	7.002*	1.480	.274	4.730	.000
Family labour	2.589*	.824	.179	3.142	.002
Hired labour	1.110*	.359	.120	3.093	.002
Machine hours used	1.045	.649	.054	1.611	.108
Chemical fertilizer	4.916*	.809	.291	6.075	.000
Cost on Pesticide Components	.669	.733	.045	.913	.362
R2	0.894				
F	251.034				
N	150				

The estimated regression co-efficients of the variables pertaining to the data on the Thadappalli ayacut in Gobichettipalayam taluk provided in table-4 clearly reveals that these variables explained a significant proportion of variability in paddy yield as measured by the R2 of 0.894 for Thadappalli ayacut in Gobichettipalayam taluk of Erode District in Tamil Nadu. The output elasticities assessed for area under crop, seed, family labour, hired labour, and chemical fertiliser used were 8.374, 7.002, 2.589, 1.110, and 4.916, respectively, and statistically significant at the 1% and 5% levels. By fitting a Stochastic Frontier Production Function to chosen farms participating in sugarcane output from the Thadappalli ayacut in Gobichettipalayam taluk of Erode District in Tamil Nadu, the Technical Efficiency of sugarcane production was evaluated. Table-5 shows the MLE estimations for sugarcane in the Gobichettipalayam taluk of Erode District with respect to Thadappalli ayacut.

Table 5: Estimated Parameters of the Stochastic Frontier Production Function for paddy Cultivation

Variables	Co-efficient	't'	Sig.
Intercept	5.370	2.388	0.018
Area under crop	0.551**	2.528	0.013
Seed	0.122***	1.696	0.092
Family labour	0.099*	2.666	0.009
Hired labour	0.479**	2.331	0.021
Machine hours	0.006	0.181	0.857
Chemical fertilizer	0.917*	9.732	0.000
Pesticide components	0.041	0.814	0.417
σ^2	0.096		
σu^2	0.074		
σv^2	0.022		
γ	0.780		
log likelihood	13.305		
N	150		

The estimated regression co-efficients of the variables pertaining to the data on the Thadappalli ayacut in Gobichettipalayam taluk provided in table-4 clearly reveals that these variables explained a significant proportion of variability in paddy yield as measured by the R2 of 0.894 for Thadappalli ayacut in Gobichettipalayam taluk of Erode District in Tamil Nadu. The output elasticities assessed for area under crop, seed, family labour, hired labour, and chemical fertiliser used were 8.374, 7.002, 2.589, 1.110, and 4.916, respectively, and statistically significant at the 1% and 5% levels. By fitting a Stochastic Frontier Production Function to chosen farms participating

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Table 6: Technical Efficiencyby Farm Size Groups for Paddy

Levels of Technical Efficiency (percent)	Farm size group				Total
	<2.5	2.5-5.0	5.0-7.5	Above 7.5	
<60	3	3	6	3	15
	7.69%	6.38%	16.67%	10.71%	10.00%
60-70	2	6	4	6	18
	5.13%	12.77%	11.11%	21.43%	12.00%
70-80	15	17	15	8	55
	38.46%	36.17%	41.67%	28.57%	36.67%
80-90	16	20	10	8	54
	41.03%	42.55%	27.78%	28.57%	36.00%
>90	3	1	1	3	8
	7.69%	2.13%	2.78%	10.71%	5.33%
Mean TE	0.78	0.81	0.85	0.83	0.81
N	39	47	36	28	150

Table 6 shows that the average level of technical efficiency for the Thadappalli ayacut in Gobichettipalayam taluk farms was estimated to be 81 percent, indicating that paddy output can be increased by 10% by following better crop management practises without having to increase the level of input application. It was also discovered that 10% of the farmers in the area had efficiency levels of less than 60%, while 12 percent had efficiency levels of 60-70 percent, 36.67 percent had efficiency levels of 80-90 percent, and 5.33 percent had efficiency levels of >90 percent. The mean technical efficiency for farms of less than 2.5 acres, 2.5-5.0 acres, 5.0-7.5 acres, and more than 7.5 acres was calculated to be 0.78, 0.81, 0.85, and 0.83, respectively, with farmers in the 5.0-7.5 acres paddy cultivation group being more efficient than the other groups. This could be because the authors' observation of the optimal farm size fits under this group.

The frontier model's efficiency scores were regressed on the variables of education, farm size, age, and family size, as shown in table-7.

Table 7: Determinants of Technical Efficiency among Farms

Variables	Paddy	t	Sig.
Intercept	7.659	4.646	0.000
Farm size	0.980	4.141	0.000
Age	0.322	4.734	0.000
Education	0.206	4.817	0.000
Family size	0.159	3.835	0.000
R2	0.996		
N	150		

In terms of R2, the model explained the variation in technical efficiency on the sample farms, which ranged from 99 percent for paddy cultivating farmer households to 0 percent for other farmer households. All of the variables show positive signals, as expected. Farm size, age, education, and family size were all positively associated to technical efficiency in paddy cultivation in the Thadappalli ayacut of the Gobichettipalayam taluk, and all of the coefficients were statistically significant. Education appears to have influenced technical efficiency, as the presence of an educated adult in the family increases paddy output efficiency.

Conclusion and Suggestions

The findings of the study have policy implications since they not only provide empirical efficiency indicators that can be used to plan farm production, but they also assist us identify the potential for crop production improvement across diverse farming systems based on efficiency. The study's findings also provide insight into long-term productivity improvement approaches that do not require more resources. Given that education has a considerable impact on technical efficiency, efforts should be made to popularise both formal and informal education among farmers in the area.

According to the report, farmers should be paid a minimum support price for their produce in order to ensure their survival. There are steps that can be taken to protect the soil's health. Farmers will be able to actively engage in the soil fertility enhancement movement with the use of soil health cards. Farmers will benefit from the timely availability of loans at a reasonable interest rate. Through links with technology, markets, society, and the government, steps can be done to improve farmers' abilities as agricultural entrepreneurs. For the sustainable use of ground water and pollution prevention, a water literacy movement might be created and regulated. Steps could be done to ensure that all farmers are covered by crop insurance. Efforts can be made to ensure that agricultural products are sold at a profit. Officials from the agriculture department may provide farmers with training and advice on how to apply recommended fertiliser and pesticide doses. High-tech machinery may be utilised in greater numbers to minimise the cost of paddy and sugarcane harvesting. Subsidies for fertiliser and pesticide should be provided to farmers. The government should take tough measures against those who pollute the water and air.

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