

## Technical Efficiency of Temple Owned Lands in Tamil Nadu, India

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### ABSTRACT

The paper attempts to study the efficiency of crop production and resource use efficiency on temple tenants and owner farms in Tirunelveli District of Tamil Nadu. A sample of 90 temple tenants and 50 owner farmers from two *taluks* of Tirunelveli District, namely, Shencottah and Tenkasi were selected for the study. The reference period of the study was 2002-2003. The efficiency analysis with the stochastic frontier production function has shown, and a resource use efficiency analysis implied that there was ample scope to increase the productivity of the temple tenants and owner farmers by adopting appropriated technologies as well as the optimum allocation of the available resources. Efficiency of the farmers could be supported by technical efficiency, the results of which had indicated that owner farmers were more efficient than the temple tenants. This reveals that there is wider scope for further improvement in the technical efficiency of the temple owned lands.

**Keywords:** Productivity, Resource use efficiency, Stochastic frontier production function.

### INTRODUCTION

Tamil Nadu comprises a land of ancient, big temples and mutts. There are many temples in the state, which have cultivable land and also urban lands to a limited extent, donated to them for earning income to meet their maintenance expenses. These temple owned lands are leased to the cultivators and the rent received from them is the major source of revenue to the temples. But the purpose is not served by this because the rent collection is poor. The Hindu Religions and Charitable Endowment (HR and CE) Department is in overall charge of maintaining records and administering the temple owned lands.

These institutions own nearly 191,583 hectares of land (HR and CE, 2003-04). There are several cases where temples are not in a position to file cases against the defaulters. Again, in many cases the existing tenants were not the original lessees. These constitute the adminis-

trative problems affecting such temple own lands.

The ownership rights of lands held by institutions like temples and trusts play a crucial role in the determination of productivity and production in agriculture, on the one hand, and landlessness among the tillers of the soil on the other. It has been widely argued that the exemptions given to religious institutions under the purview of the Land Ceiling Acts have enabled many landlords in Tamil Nadu to escape from the full effect of the Land Ceiling Legislation. It has also been argued that this loophole of exemption has presented landlordism and sub-infeudation in Tamil Nadu (Sivaprakasam, 2003).

If the productivity of temple lands is really low, that will lead to low income-low investment—a low yield-cycle. If the cycle is allowed to persist, it becomes a social waste of the scarce land. If it is not really low, then the statement of the lessee should be contested and proved wrong. In either case, an economic

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analysis of temple owned land is the only way to find a remedy.

The increase in production is possible only through improvement in crop productivity. Productivity can be increased through one or a combination of its determinants—the technology, the quantities and all the types of resources used and the efficiency with which the resources are used. Of the various determinants, improvement in the efficiency of the resources already at the disposal of the farmers is of great concern. In this context, technical efficiency in the production of a temple owned lands assumes paramount importance. As far as technical efficiency in crop production is concerned, there are two possibilities. The policy makers can either attempt to enhance the uptake of improved technologies relevant particularly to the small-scale agricultural production by improving research and development processes, or they can take steps which would enable the farmers to improve technical efficiency in temple owned lands. Although the farmer probably requires a long time and considerable funds for such efforts, they are likely to yield long run benefit. Beyond this, raising technical efficiency offers more immediate goals at modest costs, if it can be shown that substantial inefficiencies are presented in agricultural production. The present study is based on an analysis of technical inefficiencies in the production of a paddy crop by the farmers. Therefore, an attempt has been made in this paper to investigate farm-specific technical efficiency for temple owned lands and owner operated lands in Tamil Nadu. The study also seeks to investigate the influence of some farmer-specific variables on the technical inefficiency of paddy production. This information may help policy makers to formulate appropriate policies to improve technical efficiency of temple owned lands.

## MATERIALS AND METHODS

### Analytical Tools

#### Stochastic Frontier Production Function

Aigner *et al.* (1977) developed a stochastic frontier model. This model was employed to

measure technical efficiency between the temple and owner operated lands. This will be useful for comparing the resource use efficiencies between the two groups of farms. The concept of a production frontier is the same as that of production that describes the greatest possible output from a given combination of inputs, i.e., it is a 'production frontier'. Therefore, failure to operate on the production function represents technical inefficiency.

The measurement of inefficiency is the main motivation of the study of frontiers. Farrell (1957) in his seminal paper elaborated the concept of technical efficiency which involves a firm's ability to obtain the maximum output from a given set of inputs or resources. If a firm uses the best practices/method and could achieve the maximum output with a given inputs and technology, it is likely to be superior to another firm, that does not achieve the same output with the similar bundle of inputs and technology. The estimation of production frontier has proceeded along two general paths: a deterministic frontier forces all observations to be on or below the production frontier so that all the deviations from the frontier are attributed to inefficiency; and the other represents the usual random noise. The advantage of deterministic frontiers is that the farm-specific efficiency and random error can be separated.

The key factor of the stochastic production frontier is that the disturbance term is composed of two parts. One is symmetric and the other one-sided. The symmetric component captures the random effects outside the control of the decision maker including the statistical noise contained in every empirical relationship (such as poor input performance, bad weather, input supply breakdown etc.) and the one-sided component that captures deviations from the frontier due to inefficiency.

The following equation denotes the production frontier in the matrix form.

$$Q_i = Q(X_{ki}, \beta) e^{\sum_i} \quad i = 1, 2 \dots n \quad k = 1, 2 \dots K$$

Where  $Q_i$  is the output of the  $i^{\text{th}}$  farm;  $X_i$  is the vector of  $K$  inputs of the  $i^{\text{th}}$  farm,  $\beta$  is the vector of parameters to be estimated and  $\sum_i$  a farm specific error term.

The stochastic frontier is called a 'composed model' because the error term is composed of two independent elements, namely:

$$\Sigma \hat{v}_i = V_i - U_i \quad i = 1, 2, \dots, n$$

The term  $V_i$  is the symmetric component and permits random variations in output due to factors like weather and plant diseases. It is assumed to be identically and independently distributed as  $V_i \approx N(0, \delta^2 V)$ . A one-sided component ( $U_i \geq 0$ ) reflects technical efficiency relative to the stochastic frontier  $Q_i = Q(X_{ki}, \beta) e^{v_i}$ . Thus  $U_i = 0$  for any farm lying on the frontier, while  $U_i > 0$  for any farm lying below the frontier. Hence, expression  $U_i$  represents the amount by which the frontier exceeds realized output, assuming that  $U_i$  is identically and independently of  $V_i$ , is half-normal. This  $U_i$  takes the value zero when the farm produces on its outer-bounded production function (realizing all the technical efficiency potential) and is less than zero when the farm produces below its outer-bounded production function (not realizing fully its technical efficiency potential). This might happen due to number of factors, such as risk aversion, self-satisfaction, information problems, which may prevent the farm achieving its fully potential.

Density functions can be written as,

$$\delta_u(U_i) = \frac{1}{\delta_u \sqrt{\frac{1}{2\pi} \left( \frac{-1}{2u^2} \right)}} \quad \text{if } U_i \geq 0$$

$$= 0, \text{ otherwise}$$

$$\text{It follows that } \delta^2 = V(\Sigma \delta^2) = \delta_v^2 + \delta_u^2$$

Further defining  $\lambda = \delta_v / \delta_u$  (i.e.), ratio of asymmetric error term to symmetric error term.

## Model Specification

Given the data and the nature of the problem, a production function of the Cobb-Douglas type was used in this study, bearing in mind the appropriateness of the function to a study of this nature. The production function fitted to the data in this study was of the form:

$$Y = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} U_i$$

where,

$Y$  = Paddy output ( $\text{kg ha}^{-1}$ )

$X_1$  = Quantity of seeds ( $\text{kg ha}^{-1}$ )

$X_2$  = Quantity of urea ( $\text{kg ha}^{-1}$ )

$X_3$  = Quantity of phosphorus ( $\text{kg ha}^{-1}$ )

$X_4$  = Quantity of potassium ( $\text{kg ha}^{-1}$ )

$X_5$  = Labour (man days  $\text{ha}^{-1}$ )

$b_0, b_1, b_2, b_3, b_4$ , and  $b_5$  = Regression coefficients

$U_i$  = Error term.

The Cobb-Douglas function form is generally preferred for assessing technical efficiency because of its well-known advantages. Its purpose is to show what output of a given product will be achieved by an efficient combination of factors. As far as an example, one may need the difference in the amount of labour used per unit of land. In principle, confining the analysis to this functional form can sometimes be restrictive. However, it is possible to estimate the stochastic frontier using the Maximum Likelihood Estimation (MLE) Method.

Aigner *et al.* (1977) suggested that MLE of the parameters of model could be obtained in terms of parameterization.

$$\delta^2 = \delta_v^2 + \delta_u^2 \text{ and } \lambda = \delta_v / \delta_u$$

One advantage of estimating the frontier function is that it is possible to find out whether the farmer deviation of yield from frontier yield is mainly because he did not use best practice techniques or is due to external random factors. Thus, one can say whether any of the differences between actual yield obtained and frontier yield occurred accidentally or not.  $\gamma$  is an indicator of the relative variability of  $U_i$  and  $V_i$  that differentiates that actual yield from the frontier. There are two interesting points above  $\gamma$ .

Where  $\delta_v^2$  tends to zero, it implies that  $U_i$  is the pre-dominant error over  $\gamma = 1$ . This means that the farmer's yield difference from the increasing feasible yield is mainly because he did not use best practice techniques. When  $\delta_u^2$  tends to zero, it implies that the symmetric error term  $V_i$  is the predominant error, and  $\gamma$  will be tending to zero. This means that the farmer's yield differences from the frontier yield is mainly because of either statistical error or external factors not under his control. MLE Method may obtain direct estimates of the stochastic production frontier model. In this study, the MLE Method is used for esti-

**Table 1.** Sample mean of resources used by the farmers.

S. No.	Particulars	Temple tenants (TT) paddy II	Owner operated farm (OF) paddy II
1	Seeds (kg ha <sup>-1</sup> )	34.9	41.0
2	Urea (kg ha <sup>-1</sup> )	192.3	261.1
3	Phosphorous (kg ha <sup>-1</sup> )	42.4	92.2
4	Potassium (kg ha <sup>-1</sup> )	72.2	111.6
5	Labour (man days ha <sup>-1</sup> )	48	72

mation as used by Olsen *et al.* (1980), Aigner *et al.* (1997), Kutaula (1993) and Arindam Banik, (1994).

### Assumptions Used in the Present Stochastic Frontier Model

In the present study, the following assumptions were made which underline the specification of a stochastic frontier. The frontier is stochastic in nature due to factors beyond human control and with a symmetrical distributed error term present; it is responsible for capturing the impacts of outside random effects and observation and measurement error on the dependent variable and other statistical noise. Variations in the technical efficiency of individual firms are due to factors completely under the control of farmers.

### The Data

In Tamil Nadu, two districts namely Thanjavur and Tirunelveli have more acreage of tem-

ple lands when compared to other districts of the state. We deliberately selected Tirunelveli District as a study area because, in southern Tamil Nadu, the District has more acreage under temple lands and in order to get the sufficient number of respondents having temple tenants. A total of 28,364.28 hectares belonging to temple lands is in Tirunelveli District. Of this, 17,144.44 hectares are wetlands, 9,781.16 hectares are dry lands and 1,452.68 hectares are *rainfed* lands. In the study area, out of 11 *taluks*, two *taluks*- Tenkasi and Shencottah- were selected randomly. From the selected two *taluks*, nine villages were selected randomly from Shencottah (five) and Tenkasi (four); 10 temple tenants were selected randomly from each village, and this constituted 90 temple tenants. In order to compare the temple tenants with owner operated farms, 50 owner-farmers were selected randomly from eight villages (each five) and the last 10 from one village. The total sample constituted 90 temple tenant farmers and 50 owner farmers, thus raising the total sample to 140. The data pertaining to the years 2002-03 were gathered.

**Table 2.** Stochastic frontier production function-paddy I.

S. No.	Explanatory variables	Parameter values	Standard Error
1	Constant	8.5843**	1.0171
2	Seeds (kg ha <sup>-1</sup> )	-0.1122*	0.5143
3	Urea (kg ha <sup>-1</sup> )	-0.1191	0.1652
4	Phosphorous (kg ha <sup>-1</sup> )	-0.0683	0.0387
5	Potassium (kg ha <sup>-1</sup> )	0.03686	0.1083
6	Labour (man days ha <sup>-1</sup> )	0.6669	0.0510
7	$\delta^2 u$	0.00017	
8	$\delta^2 v$	0.00139	
9	$\lambda = \delta u / \delta v$	0.3497	
10	$\theta = \delta^2 u / (\delta^2 u + \delta^2 v)$	1.0014	
11	$MTE = 1 - \delta u / (2/\pi)^{1/2}$	0.9674	

\*\* and \* Significant at the 1% and 5% level.

## RESULTS AND DISCUSSION

The mean inputs used by the temple tenants of paddy II and the owner farmers of paddy II are presented in Table 1.

### MLE Estimates of Temple Tenants: Paddy I

The results of the Maximum Likelihood Estimates are presented in Table 2.

It can be seen from Table 2 that the variance of the one sided error term ( $\delta^2u$ ) and symmetric error term ( $\delta^2v$ ) were 0.0017 and 0.00139 respectively which implied that the symmetric error term was dominant which measured the shortfall in output from the maximum possible output. The ratio of one sided error term to symmetric error term ( $\lambda$ ) worked out at 0.3497, which implied that the standard error term of the one-sided error term was greater than the standard error of the symmetric error term. Estimation of the discrepancy parameter ( $\theta$ ) indicated that maximum per cent of the difference between the actual output and the maximum possible output were due to differences in the technical efficiency of farmers. The Mean Technical Efficiency (MTE) of 0.9674 indicated that the yield of the Paddy was 3.26 per cent less than the maximum possible output. Thus, it showed scope for further increase in the productivity of the average of temple tenant in paddy I with the existing level of input use in the study area.

## MLE Estimates of Owner Farms: Paddy I

The results of frontier regression are presented in Table 3.

It could be seen from Table 3 that the estimates of error variances  $\delta^2u$  and  $\delta^2v$  are 0.00815 and 0.00001 respectively. Therefore, it can easily be seen that the variance of the one-sided error term ( $\delta^2u$ ) is larger than the variance of symmetric error ( $\delta^2v$ ), and this implies that the one-sided error term was more dominant which measured shortfalls in output from the maximum possible yield. The ratio of the one-sided error term to the symmetric error term ( $\lambda$ ) worked out at 0.0902, which implied that the standard error of the one-sided error term was greater than the standard error of the symmetric error term. The estimates of the discrepancy parameters obtained  $\theta$  were 1.000 and this demonstrated that maximum percentage of the differences between the observed output and frontier output is due to the technical efficiency of farmers. The Mean Technical Efficiency (MTE) was 0.9926, which implied that the yield of paddy I was 0.74 per cent less than the maximum possible output on average. Thus, the analysis of technical efficiency revealed scope for increasing the productivity on average of paddy I at the existing level of input use for the farmers in the study area.

**Table 3.** Stochastic frontier production function-paddy I.

S.No.	Explanatory variables	Parameter values	Standard error
1	Constant	7.7872**	2.0617
2	Seeds (kg ha <sup>-1</sup> )	0.0565	0.1096
3	Urea (kg ha <sup>-1</sup> )	-0.1246	0.3126
4	Phosphorous (kg ha <sup>-1</sup> )	0.0983***	0.1443
5	Potassium (kg ha <sup>-1</sup> )	0.0247	0.0089
6	Labour (man days ha <sup>-1</sup> )	0.0736	0.3190
7	$\delta^2u$	0.00815	
8	$\delta^2v$	0.00001	
9	$\lambda = \delta^2u/\delta^2v$	0.0902	
10	$\theta = \delta^2u/(\delta^2u + \delta^2v)$	1.0000	
11	$MTE = 1 - \delta^2u/(2/\pi)^{1/2}$	0.9926	

\*\* and \*\*\* Significant at the 1% and 10% level.



## CONCLUSION

For the efficiency analysis with the stochastic frontier production function, resource use efficiency analysis implied that there was ample scope to increase the productivity of the temple tenants and owner farmers by adopting proper technology as well as the optimum allocation of the available resources. The efficiency of the farmers could be supported by technical efficiency, the results of which had indicated that owner farmers were more efficient than the temple tenants. This reveals that there is wider scope for further improvement in the technical efficiency of the temple owned lands.

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## کارایی فنی زمینهای کشاورزی شخصی در تامیل نادو هندوستان

ت. راجندران، ک. پالانیسامی، و م. ژگادسان

### چکیده

مقاله تلاش می کند که کارایی تولید محصولات و استفاده از منابع در زمینهای کشاورزی اجاره ای و زمینهای شخصی در بخش تیرونل ولی در منطقه تامیل مورد بررسی قرار گیرد. یک نمونه ۹۰ تایی از زمین های اجاره ای و یک نمونه ۵۰ تایی از زمینهای شخصی از بخشهای تیرونل ولی، شن کاه و تنکاسی برای این مطالعه انتخاب شده است. این مطالعه در دوره زمانی ۲۰۰۲-۲۰۰۳ صورت گرفته است. تجربه و تحلیل کارایی توسط تابع تولید تصادفی مرزی نشان می دهد که استفاده از تکنولوژی مناسب به اندازه تخصیص تهیه منابع موجود باعث افزایش بهره وری استفاده از منابع خواهد شد. کارایی کشاورزان می تواند به وسیله کارایی فنی تقویت شود. نتایج نشان داده است که کشاورزان شخصی از کشاورزانی که بر روی زمینهای اجاره ای کار می کنند از لحاظ اقتصادی کارا تر هستند. این نشان می دهد که پتانسیل زیادی برای بهبود بهتر کارایی زمینهای شخصی وجود دارد.