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AN ECONOMIC EFFICIENCY OF TAPIOCA PRODUCTION IN ERODE DISTRICT OF TAMILNADU

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Abstract

The study's main goals are to identify the sample farmers' socioeconomic characteristics, study cost and return per acre, and analyze the economic efficiency of tapioca farming in Tamil Nadu's Erode region. During 2019-20, primary data were collected from 150 farmers at random in five villages in Erode district using a personal survey method and a scheduled interview schedule. The socio-economic variables, as well as the cost and returns of tapioca production for the selected sample farmers, were determined using simple percentage analysis. The Stochastic Frontier Production Function is employed in the estimate of technical efficiency. According to the findings, the cost of manufacturing tapioca differed depending on the farmers. The costs of renting land, labour, artificial and organic fertilizers, and seeds were the most significant. Farmers' ongoing employment of this approach, according to the report, contributes to their technical inefficiency. Seed companies and farmer organizations should work together directly. The value chain for tapioca needs to be reinforced.
Keywords: Tapioca, Efficiency, Stochastic Frontier Production Function, DIRTI-5

INTRODUCTION

Tapioca (Manihot esculenta Crantz) is a perennial dicotyledonous shrub with an edible starchy root that belongs to the Euphorbia family of botanical groupings. Cassava, bitter cassava, manioc, and "mandioca" are some of its names. It is a member of the root and tuber family, which stores edible material in the tuber and is part of the food group that primarily provides energy in the form of carbohydrates in the human diet. Tapioca, in addition to being consumed by people, is traded internationally in a variety of forms, including dried shavings, pellets, flour, and starch, contributing to the economies of exporting countries. Tapioca leaves are also high in protein (14-40 percent dry matter), minerals, vitamin B1, B2, C, and carotene and can be eaten. Cassava's growth qualities make it a good crop for food security, particularly because of its capacity to grow in situations that are adverse for other crops, such as periods of inconsistent rainfall. Tapioca has been dubbed the "perfect crop for climate change" because of its tolerance to unfavourable environmental circumstances. Tapioca, which is thought to be a South American crop, is now grown throughout the majority of tropical countries, which are the most environmentally favourable for its cultivation. Nigeria is the world's fastest-growing country, accounting for half of all land and production. Crops are grown in India's southern peninsular region, particularly Kerala, Tamil Nadu, and Andhra Pradesh, which account for 93 percent of the country's land and 98 percent of its production. In India, tapioca is grown on 0.21 million hectares, with a total yield of 7.74 million tonnes. This tuber crop is largely cultivated in Tamil Nadu (64%), Kerala (32%) parts of Andhra Pradesh (1.5%), Nagaland (1.2%) and Assam (0.5%). Tamilnadu State stands first (64%) in respect of tapioca production and also processing of tapioca into starch & sago. Tapioca is being cultivated in major 14 districts including Namakkal (21%), Dharmapuri (19%), Salem (15%), Villupuram (14%), Trichy (9%), Erode (5%) and Thiruvannamalai (5%) in an area of 1.21 lakh hectare.

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2. Review of literature

Ebukiba, Elizabeth (2010) investigated the economic analysis of cassava production in the local government of Nigeria's Akwa Ibom state. According to the findings, there is a need to improve resource allocation for farmers in the research area, which may be accomplished through effective training and education of farmers on resource allocation to attain the desired optimality.

Tirlapur et. al. (2015) investigated resource usage efficiency in Dharwad district's major cultivating crops. Chickpea growers overused machine hours, seed, plant protection agents, and fertilisers, while underusing farm yard manure and human labour, according to the findings. They came to the conclusion that the inefficient and poor utilisation of resources was the primary cause of the agricultural sector's slow growth.

Sowjanya et al. (2016) investigated Redgram's resource efficiency and marketing. According to the findings, the MVP to MFC ratio was positive, indicating that these resources were underutilised. Because resources should be used more efficiently to achieve the best results. The logical zone for Redgram manufacturing suggested decreasing returns to scale.

Akerele EO., et al. (2018) conducted research in Ogun State, Nigeria's Yewa North Local Government Area. Cassava farming is generally advantageous regardless of farm size, according to the study, although the farmer's sex, household size, and degree of education have a substantial favourable impact on farmers' production. As a result, it is advised that the government establish a sufficient number of credit institutions that are well-equipped and motivated to assist small farmers by making loans accessible to them.

Ragavi et al. (2019) attempted to investigate the economic analysis of tapioca costs and profitability per hectare as well as the rate of return in Tamil Nadu's Namakkal area. Tapioca production grew dramatically as a result of enhanced productivity and yields, according to the study. The structure of tapioca resource usage varies by size group. Tapioca production costs varied according to the area of the land. Small farms had the highest per-hectare tapioca costs, whereas large farms had the lowest. Tapioca growers of various sizes had different costs of production. Large farms have the largest input rate, whereas small farms have the lowest.

Sood et. al. (2020) investigated pulse growth performance in Rajasthan. According to the findings, there was a good trend in the area under pulse cultivation, and the extension of the area increased the production of moong bean, chick pea, and urd bean in the study region.

3. Objective

The main aims of the study is to identify the socio-economic characteristics of the sample farmers, to study cost and return per acre and to analysis the economic efficiency of the tapioca cultivation in Erode district in Tamil Nadu.

4. Methodology

4.1. Sample Design and selection of data

The primary data on various aspects was acquired from the Nambiyur Taluk of Erode districts using a planned interview schedule and a personal survey method. The information was for the agricultural year 2019-20. The sample structure for the study was developed using a multistage random sampling technique for the study's aims. In the first stage, the Erode district has 10 taluks, out of this, Nambiyur Taluk is chosen specifically for his tapioca-growing abilities. Similarly, in the second stage, there are 32 revenue villages in Nambiyur Taluk, of which 5 revenue villages were chosen at random. In the third stage, 150 tapioca growers were chosen at random, ensuring that all five villages in which the sample was gathered were represented equally. As a result, 150 farmers were chosen from five villages in Erode district as part of the total sample size.

4.2. Analytical Methodology

The socio-economic variables, as well as the cost and returns of tapioca production for the selected sample farmers, were determined using simple 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. Asymmetric component allows for random fluctuation in the frontier across businesses, capturing the effects of measurement error, statistical noise, and random shocks outside the farm's control. Firm-specific impacts like slackness in output owing to labour shirking, which is under the control of the businesses and influences their degree of technical efficiency, are captured by a one-sided component. The empirical model utilized 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;

$$\ln (Y_i) = X_i \alpha + V_i - U_i \text{ --- } (1)$$

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

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

= 0 otherwise

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

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

$F_v(y) = \pi .1/\sqrt{½*\pi}) .\ 1/\sigma .\ \exp.\ \{(u+v)^2/2\ \sigma^2\} .\ 1- f\{((u+v)/\sigma)(\gamma/1+\gamma))]$ --- (3)

Where,

$\sigma^2 = \sigma_u^2 + \sigma_v^2$ --- (4)

$\gamma = \sigma_u^2/\sigma^2,\ 0 \leq \gamma \leq 1$ -- (4a)

Finally, γ is given by

$\sigma^{ui} = -\sigma_u \sigma_v/\sigma[\{\varphi(.)/1-\varphi(.)\}-\{((u+v)/\sigma)\sqrt{(\gamma/1-\gamma)}))]$ ----------------------- (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 (tapioca / in quintal / acre)
X_1 = Area under crop (in acres)
X_2 = cost of seed (in rs.)
X_3 = labour (male + female) man-days/acre.
X_4 = Cost on machine hours used in Rs. / acre
X_5 = Quantity of inorganic fertilizer used in kg/acre
X_6 = Cost on organic fertilizer used (in Rs./acre)

4.3. Determinants of Technical Efficiency

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

$TE_{ij} = \alpha + \alpha_1 (X_1) + \alpha_2 (X_2) + \alpha_3 (X_3) + \alpha_4 (X_4) + e_i$

Where,

TE_{ij} = level of technical efficiency estimated through MLE
X_1 = Farm size
X_2 = Family Size
X_3 = Age
X_4 = Educational status
$\alpha_1 \ldots\ldots\ldots \alpha_4$ = regression co-efficients
e_i = error term
α = constant

5. Results and Discussion

5.1. Socio-Economic Characteristics of the Sample Farmer Households

This section focuses on the socioeconomic characteristics of the selected sample Tapioca farmer households in Erode District's Nambiyur Taluk. Table 1 shows the major socioeconomic characteristics that were chosen for investigation in the study.

Table 1: The Socio Economic Characteristics of sample Famers

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

Source: Survey data

Table 4.1 shows that the majority of the 150 tapioca farmer households included for the study belonged to a nuclear family; their family size was 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.

5.2. Estimated Cost and Returns of Tapioca Cultivation

Table-2 shows the expected costs and returns of tapioca growing for sample farmers in three villages in Erode District's Nambiyur Taluk.

Table-2: Estimated Cost of Cultivation of Tapioca Crop (Per Acre)

Cost / Revenue particulars	Amount in Rs.	%
Average area under crop in acre	5.23	
Cost of Seed	2953.60	5.38
Cost of Labour	18,450.00	33.60
Cost of Machine hours	2,400.00	4.37
Cost of Inorganic Fertilizer	8,590.00	15.64
Cost of Organic Fertilizer	6,750.00	12.29
TVC	39143.60	71.29
DIRTI-5	15,763.40	28.71
TC	54907.00	100.00
Yield (kg)	13,040.00	
Mean Output Price (Rs/Kg)	7	
Gross Return	91280.00	
Net Return	36,373.00	
Benefit Cost Ratio	1.66	
Cost of Production (Rs/Kg)	4.21	

Source: Primary Data

The cost and return particulars of the selected sample tapioca farming farmers of Nambiyur Taluk in Erode District were shown in table-2. The average farm size was calculated to be 5.23 acres. The area under tapioca, the cost of seed, the cost of labour, the cost of machine hours used, the cost of inorganic fertiliser, and the cost of organic fertiliser were all essential factors in defining the area's tapioca production economics. The average tapioca cultivating farmer in the area should spend more than 47 percent of the total cost on labour, followed by inorganic fertiliser (21.94 percent), organic fertiliser (17.24 percent), seed (7.55 percent), and machine hours (6.13 percent), resulting in a total return of Rs.91,280.00 per acre. The net return on tapioca production in the area was calculated to be Rs.36373.00 per acre.

5.3. Resource Use Efficiency of Tapioca Production

5.3.1. Average Production Function

The output elasticities with regard to the primary inputs in the production of tapioca in Nambiyur Taluk of Erode District in Tamil Nadu were estimated using the Cobb-Douglas Production Function utilising the Ordinary Least Square (OLS) technique. Table-3 shows the output elasticities for tapioca based on OLS estimates of the Cobb-Douglas production function.

Table–3: OLS Estimates of the Production Function for Tapioca Cultivation

Variables	Co-efficient	t	Sig.
Intercept	5.223	2.714	0.008
Area under crop	0.437*	3.04	0.001
Seed	0.147**	2.205	0.023
Labour	0.302***	1.498	0.062
Machine Hours used	0.402*	2.753	0.004
Inorganic Fertilizer	0.028	0.217	0.721
Cost on Organic Components	-0.111	-0.71	0.339
R	0.826		
R^2	0.749		
Adjusted R^2	0.741		
F	104.934*		0.000
N	150		

Source: Survey Data.

The computed regression co-efficients of the factors relevant to the data on Nambiyur Taluk shown in table-3 clearly show that these variables explained a considerable fraction of variability in tapioca production, as evaluated by the R2 of 0.749 for Nambiyur Taluk. The predicted production elasticities for area under crop, seed, labour, and machine hours consumed were 0.437, 0.147, 0.302, and 0.402, respectively, and were statistically significant at the 1%, 5%, and 10% levels.

5.3.2. Technical Efficiency

By fitting a Stochastic Frontier Production Function to chosen farms involved in tapioca production from the Nambiyur Taluk, the Technical Efficiency of tapioca production was evaluated. Table-4 shows the MLE estimates for tapioca in the Erode District's Nambiyur Taluk.

Table–4: Estimated Parameters of the Stochastic Frontier Production Function for Tapioca Cultivation

Variables	β	t	Sig.
Intercept	8.9066	3.331	0.004
Area under crop	0.1799**	2.556	0.018
Seed	0.1451*	5.188	0.001
Labour	0.1033*	4.269	0.002
Machine Hours used	0.0508***	1.877	0.076
Inorganic Fertilizer	0.0188	0.552	0.510
Cost on Organic Components	0.0422	1.351	0.638
σ_v	0.1443		
σ_u	0.2841		
σ^2	0.1031		
σ_v^2	0.0208		
σ_u^2	0.0807		
γ	0.7826		
Log Likelihood	75.1347		
N	150		

Source: Survey Data

The maximum likelihood estimates of the stochastic frontier production based on sample farm level data from Nambiyur Taluk show that four input variables, namely, area under tapioca crop, seed, labour, and machine hours used, were registered with a priori signs and statistically significant at 1%, 5%, and 10% levels. In other words, the production elasticities of tapioca were calculated as 0.1799, 0.1451, 0.1033 and 0.0508, respectively, for area under crop, seed, labour, and machine hours. Despite the fact that the usage of inorganic fertiliser and the expense of organic fertiliser have favourable effects on tapioca productivity, the results were not statistically significant. u2 and v2 were estimated to be 0.0807 and 0.0208, respectively. The prevalence of severe inefficiencies in the tapioca production of the farmers of the Nambiyur Taluk was indicated by a high score for (0.7826). In other words, the inefficient use of resources within the control of the sample farmers in the area accounted for 78 percent of the gap between observed and frontier productivity among farms.

4.3.2. Efficiency Scores

Technical efficiency ratings were calculated using maximum likelihood estimations of the frontier production function to determine the extent of farm level inefficiencies observed for tapioca growing farmers in Nambiyur Taluk. Table 5 shows the frequency distribution of projected technical efficiencies for tapioca farming sample farmers in the Erode District.

Table–5: Technical Efficiency by Farm Size Groups for Tapioca Cultivation

Levels of Technical Efficiency (Per cent)	N	%
<75	34	22.67
75-85	62	41.33
>85	54	36.00
N	150	100
Mean TE	.7812	

Source: Primary data

The average degree of technical efficiency was judged to be 78 percent, according to table-5. It was also discovered that 22.67 percent of the farmers in the area had efficiency levels of less than 75 percent, 41.33 percent had efficiency levels of 75-85 percent, and 36.00 percent had efficiency levels of more than 85 percent. The average technological efficiency of farms was calculated to be 0.7812.

5.3.4. Determinants of Technical Efficiency

The efficiency scores generated by the frontier model were regressed on the variables viz., Farm Size, Family Size, Age and Education as furnished in table-6.

Table–6: Determinants of Technical Efficiency

Variables	B	t	Sig.
Intercept	0.735	12.876	0.000
Farm size	0.132**	3.4431	0.028
Family Size	0.156*	2.636	0.003
Age	0.198**	3.265	0.008
Educational status	0.103**	2.610	0.038
R^2	0.812		
Adj R^2	0.799		
N	150		

Source: Survey Data

The model explained the diversity in technical efficiency on the sample farms, in terms of R^2, which ranged from 81 percent for tapioca growing farmers. All of the variables show positive signals, as expected. The technical efficiency of tapioca farming in the taluk was positively associated to farm size, family size, age, and education, and all of the coefficients were statistically significant at the 1% and 5% levels. It's reasonable to assume that age affects technical efficiency because having a large family increases tapioca output efficiency.

6. Conclusion

Tapioca output has increased dramatically as a result of increased yields and yields. Planting more tapioca did not enhance yields, however this was attributable to other variables such as rainfall and crop price. Education, unexpectedly, improves technical inefficiency. This might be due to a lack of Tapioca-related education among farmers, which could affect their technical efficiency regardless of educational level. Farmers must also form groups to take advantage of economies of scale and access resources at a reduced cost. New seed production and distribution strategies are necessary to completely eliminate Tapioca farmers' overdependence on the age-old practise of utilising varieties developed in previous years as cuttings in subsequent years. Farmers' continued use of this approach has been proved to add to their inefficiency in terms of technology. Farmers' organisations and seed firms should collaborate directly. Tapioca's value chain has to be strengthened.

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