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# Resource use efficiency of banana cultivation in Thoothukudi District of Tamilnadu

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## Abstract

Fruit cultivation is a key factor in determining a country's success. Fruit production and consumption per person are commonly used as indicators of a nation's standard of living. It is commonly known that fruits are important for human nutrition. Fruits are the main source of certain minerals and essential vitamins that are needed to maintain optimal health and strengthen resistance to disease. In this country, organic banana farming has become more popular in recent years as worries about the harmful effects of unrestricted chemical use have grown. The false stem of the perennial herb banana plant allows it to reach a maximum height of five metres. Because they are inexpensive and have a high nutritional value, bananas are consumed in large quantities. Analysing the effectiveness of resource use in banana farming in the Thoothukudi District of Tamilnadu's Alwarthirunagari and Karunkulam taluks is the study's main goal. According to the study, in both taluks, plant protection has a factor price ratio and marginal value productivity that are greater than one. It is thought that both of the banana plantations in the taluks sensibly use plant protection.

The cost of tillage practices divided by the marginal value productivity of human labour is less than one in both taluks. It implies that these variables are not being used to their full potential by the planting in these taluks. In contrasting the two taluks, Karunkulam and Alwarthirunagari, it is clear that the Karunkulam plantation uses all three input elements more logically than the Alwarthirunagari plantation. In conclusion, tillage techniques, plant protection, and the marginal value productivity of human labour are positively and statistically significantly correlated. This suggests that the Alwarthirunagari and Karunkulam taluks would produce more bananas if these inputs were applied more frequently.

**Key words :** gross income, resource use efficiency, marginal value product, marginal costs, plant protection.

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India is a country that depends largely on agriculture. Most people living there are dependent on agriculture. It is India's biggest and most important agro-based sector. An active role of agriculture may be seen in the Indian economy[1]. More than 70% of rural households make their living mostly from agriculture. The intensification of demand brought about by the population's rapid growth, along with the rise in income levels and ensuing changes in consumption patterns, have made the development of fruit and vegetable production of utmost importance today[2].

It is difficult to overstate the value of horticulture in increasing land productivity, creating jobs, educating farmers and business owners about their financial circumstances, boosting exports, and, most importantly, ensuring the nutritional security of those living in arid regions[8]. The farming of bananas is very important economically[17]. Mangos are no longer the nation's favourite fruit; bananas have replaced them[18]. India is a major producer of bananas, and the global market has a remarkable need for both processed and fresh bananas[4].

Twenty-five percent of the world's bananas are produced in India alone.[7] India's principal states for banana cultivation include Madhya Pradesh, Kerala, Tamilnadu, Andhra Pradesh, Orissa, and Bihar[14]. Subramanyam claims that throughout India as a whole, the area under cultivation and yield of the banana crop has expanded[5]. Chiquita bananas, which have flawless skin and fetch approximately $1200 per tonne on the global market, are superior to Indian bananas, which have black flaws that form during ripening and render them unfit for export[9]. Global gross banana exports hit a record high of 16.5 million tonnes in 2012, up 1.1 million tonnes (or 7.3%) over the previous year[16].

Malnutrition results from eating cuisine lacking fruits, as has been well-documented. Malnutrition claims the lives of about a million Indian youngsters each year[2]. The human diet requires a certain amount of carbs, sugar, vitamins, minerals, and organic acids, all of which are abundant in bananas[13]. They are vital for physical activity because they restore the body's need for glycogen, carbs, and other fluids used up during exercise[11]. Banana stems are fed to animals, and the leaves are used as a plate[3].

The plant is clipped at the root and used extensively for decoration, either with or without bunches. Its use in the design of India's paper money indicates how popular it is as an ornamental plant[10]. The cost of chemical fertilisers has been rising significantly recently. This research will make it possible to farm bananas using liquid fertiliser, which will reduce cultivation costs in addition to providing numerous other benefits[12]. The cost of fertiliser for the banana crop might be reduced by around Rs. 445 crores if human urine was utilised as liquid organic manure in banana production. In the Thoothukudi District of Tamilnadu's Alwarthirunagari and Karunkulam taluks, banana growing is the subject of a study aimed at analysing the effectiveness of resource use.

*Objectives of the Study :*

The study's particular goals are:

1. To calculate the link between different input parameters and the total amount of money that banana farmers get paid.
2. To ascertain the structural disparities in the production relations between the taluks of Karunkulam and Alwarthirunagari in the district of Thoothukudi.
3. To examine the components involved in the production of bananas' marginal value productivities.
4. To investigate the efficiency of resource utilisation in banana farming.
5. To research the factor price ratio and marginal value productivity of plant protection in banana farming in the Thoothukudi District's Alwarthirunagari and Karunkulam taluks.

The Thoothukudi District's Karunkulam and Alwarthirunagari blocks have been chosen for this investigation. The farmers in these two blocks discovered that growing bananas is more profitable in these taluks, as is the case with tenancy and owner cultivation. The area used for banana farming is growing. Growing bananas for the market is the primary purpose of this yearly crop. Because the scale of operation may be adjusted based on capital availability, it is regarded as the poor man's commercial crop. Because the poor farmers in the Alwarthirunagari and Karunkulam blocks are illiterate and incapable, intermediaries profit from the marketing of bananas in these areas. There isn't a market that is specifically regulated for bananas. Using the Thoothukudi district as the universe, the block as the stratum, the village as the primary sample unit, and the banana growers as the final unit, a multistage random sampling technique has been employed. Eighty banana farmers are chosen for each block. Primary data will be collected from two villages in each block that have a higher percentage of tenancy cultivation. 160 growers of bananas are chosen from these 4 villages. From four communities, 40 farmers were chosen to be among them.

*Estimation of marginal value productivities:*

The change in gross income that results from changing a factor while maintaining the same values for all other factors is known as the marginal value product of that factor. The appropriate input-output ratio directly affects the variation in marginal value productivity. The following formula, which calculates the marginal value product of the inputs, can be obtained using equation (1).

$$MVPx_1 = B_1 \frac{Y}{X_1}$$

$$MVPx_1 = B_2 \frac{Y}{X_2}$$

$$MVPx_1 = B_3 \frac{Y}{X_3}$$

$$MVPx_1 = B_4 \frac{Y}{X_4} \qquad (2)$$

$$MVPx_1 = B_5 \frac{Y}{X_5}$$

Where, Y and $X_1$..... $X_5$ are the geometric mean level of gross income and input factors, respectively.

*Estimated Results of Regression Equation– Taluk-wise :*

Table-1 displays the findings of the linear regression equation (1) computed for the taluks of Alwarthirunagari and Karunkulam.

Table-1. Estimated results of Regression Coefficients of Alwarthirunagari and Karunkulam Taluks

| Taluks | Size of the Sample | Regression Coefficients and t-values | | | | | | $R^2$ | F | $\Sigma e^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ | | | |
| Alwarthir-unagari | 80 | 1.21 | 0.14* (2.19) | 0.03 (0.11) | 0.012* | 0.11 (0.41) | 0.22* (2.57) | 0.72 | 63.14 | 0.041 |
| Karunkulam | 80 | 0.32 | 0.12 (0.13) | 0.01 (0.11) | 0.018* (3.17) | 0.23 (1.13) | 0.17* (1.88) | 0.73 | 86.27 | 0.031 |

Figures in parentheses are t-values.

* Denotes significance of the coefficients at the five-percentile level.

In Alwarthirunagari, all the size regression coefficients of independent variables are positive, and the value of $R^2$ shows that all the explanatory variables jointly account for roughly 72 per cent of differences in gross income from bananas. The coefficients of human work, plant protection and quantity of bearing trees are statistically significant at a 5 per cent level. It means that with a one per cent rise in these factors, the gross income might be enhanced by 0.14, 0.012 and 0.22 per cent accordingly. The number of bearing trees on the banana plantation has the biggest impact on determining gross income out of these three influencing input parameters. The regression model is determined to be significant at the one percent level based on the F-value presented in Table-1.

All of the variables in the Karunkulam Taluk instance have positive coefficients in relation to gross income. The regression model's variables accounted for approximately 73% of the fluctuations in banana gross income, according to the value of $R^2$. At the five percentiles, it is discovered that the plant protection coefficients and the quantity of bearing trees are important. This indicates that a 1% rise in these factors can result in a 0.018 and 0.17 percent increase in gross revenue, respectively. The regression model's F-value indicates that it is highly significant at the one percent level.

*Tests for structural difference :*

Chow's test has been used to test the null hypothesis that there is no structural difference in the production relation between the two taluks, and the findings are shown in Table-2.

Table-2. Equality test between Alwarthirunagari and Karunkulam production relation

| $\Sigma e^2$ | $\Sigma e_1{}^2$ | $\Sigma e^2{}_2$ | $n_1 + n_2$ -- 2K | F* | F(4,158)at 1% level | Inference |
|---|---|---|---|---|---|---|
| 0.194 | 0.032 | 0.028 | | 13.91 | 1.76 | A structural difference exists between Alwarthirunagari and Karunkulam production relations. |

Table 2 makes it evident that, with (4,158) degrees of freedom, the computed F-value (F*) is determined to be bigger than its table value F. The numbers in table F and calculated are 1.76 and 13.91, respectively. Consequently, a null hypothesis is disproved. Thus, it may be said that the taluks of Karunkulam and Alwarthirunagari have structurally different production relations.

To determine whether there were structural differences in the production relation between two taluks at the slope and intercept levels, the regression equation is further fitted. Table 3 displays the regression model's estimated findings.

Table-3. Tests of the stability of intercept and slope between Alwarthirunagari and Karunkulam Taluks

| Size of the sample | Regression Coefficients and t-values | | | | | | | | | | | $R^2$ | F | | $\Sigma e^2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\propto_0$ | $\propto_1$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ | $\partial_1$ | $\partial_2$ | $\partial_3$ | $\partial_4$ | $\partial_5$ | | | |
| 160 | 1.18 | 1.04 (1.03) | 0.11 (0.05) | 0.04 (1.01) | 0.12* (2.56) | 0.19 (1.04) | 0.27* (2.23) | -0.05 (-0.43) | 0.02 (1.04) | 0.03 (1.01) | -0.13 (-0.41) | -0.11* (-2.03) | 0.37 | 104.91 | 0.181 |

Figures in parentheses are t-values.

* Denotes significance of the coefficients at the five-percentile level.

Table-3 above shows that the coefficient of the dummy variable at the intercept level is not significant, indicating that there is no difference between the two taluks in terms of the technological change in the production relation.

All of the explanatory factors in Alwarthirunagari have a positive relationship with gross income. At the five-percentile level, there is statistical significance between the plant protection coefficient and the number of bearing trees. It showed that by including a higher percentage of these variables, gross income might rise by 0.12 and 0.27 percent, respectively. The quantity of bearing trees in the plantation is the variable that causes the structural disparities between two taluks at the slope level in production. It demonstrates that boosting this variable can raise gross income by 0.19 percent in the Karunkulam plantation and 0.27 percent in Alwarthirunagari.

*Marginal value productivities of the factors:*

The addition to gross income resulting from an increase of one unit in the input variable in question is indicated by the marginal value productivity of that input. Table-4 displays the marginal value productivities that were calculated for the input variables using formula (2).

Table-4. Marginal value productivities of the factor inputs at the geometric mean level

| Sl. No. | Variables | Alwarthirunagari | Karunkulam |
|---|---|---|---|
| 1. | Human labour | 7.38 | 6.94 |
| 2. | Cost of tillage practices | 3.77 | 4.82 |
| 3. | Plant protection | 7.25 | 9.36 |
| 4. | Age of the plantation | 527.07 | 208.51 |
| 5. | Number of bearing trees | 103.01 | 77.63 |

The findings shown in Table-4 above indicate that in the taluks of Alwarthirunagari and Karunkulam, the marginal value of all factor products input was positive. It suggests that adding another unit to these variables could increase income. When the marginal productivities of inputs from Alwarthirunagari and Karunkulam plantations are compared, it can be seen that the latter has higher marginal value productivities than the former. This is especially true for the variables of human labour, age of the plantation, and number of bearing trees. On the other hand, the marginal value productivities of two other variables—the cost of tillage practices and plant protection—are higher in Karunkulam plantations than in Alwarthirunagari plantations. The analysis of marginal value productivity generally shows the potential for more profitably increasing inputs.

The marginal value products of the input variables are compared with the corresponding factor costs in order to assess the efficiency of resource usage. The equality of marginal value product to factor cost10 is the fundamental requirement that must be met in order to achieve efficient resource usage. The calculation of resource usage efficiency has only considered variables that can be controlled, like labour force, tillage techniques, and plant protection. The age of the plantation and the amount of bearing trees provide conceptual issues. Therefore, factor inputs such as labour from humans, tillage techniques, and plant protection alone have been considered when analysing resource-use efficiency.

The ratios of the factor input costs to the corresponding marginal value products are displayed in Table-5.

Table-5 above shows that in both taluks, the factor price ratio and marginal value productivity of plant protection are more than unity. It suggests that the usage of plant

Table-5. Ratios of marginal value products to factor costs

| Taluks | Rations of MVP to factor cost | | |
|---|---|---|---|
| | Human labour | Tillage Cost of Practices | Plant Production |
| Alwarthirunagari | 0.32 | 0.01 | 5.18 |
| Karunkulam | 0.41 | 0.13 | 7.34 |

protection by the banana plantations in both taluks is determined to be reasonable. The marginal value productivity of human labour and the cost of tillage operations are two other variable inputs for which the ratio of their costs to their marginal values is less than unity in both taluks. It suggests that the plantation in these taluks is not making effective use of these variables. When two taluks, Karunkulam and Alwarthirunagari, are compared, it is discovered that Karunkulam plantation uses all three input components more logically than Alwarthirunagari plantation.

In summary, there exists a positive and statistically significant relationship between the marginal value productivity of human labour, tillage practices, and plant protection. This suggests that increasing the application of these inputs would result in a rise in banana output in two taluks, namely Alwarthirunagari and Karunkulam.

**Conflicts of Interest**

The author does not have any conflict of interest.

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