Research Paper
Impact Factor: 3.996
Peer Reviewed & Indexed Journal

IJMSRR
E- ISSN - 2349-6746
ISSN -2349-6738

AN ANALYSIS OF RESOURCE USE EFFICIENCY AND RETURN TO SCALE IN LEMON CULTIVATION IN TAMILNADU

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Abstract
In case of marginal, small and medium farmers, the co-efficient of determination (R^2) of the function was 0.84 which indicated that 84.00 per cent, 0.832 (83.20%) and 0.624 (62.40%) respectively of the variation in output of Lemon was explained by all the five independent variables. Among the independent variables, human labour, manure and the cost of irrigation were found to be positive and it was statistically significant at five per cent level. The increased use of human labour in marginal, small and medium size farms would augment the income by ₹ 2.23, ₹ 2.62 and ₹ 3.15 times the factor cost respectively.

Key Words: Cobb-Douglas Production Type Function, Return to Scale, Resource-Use-Efficiency.

Introduction

A large variety of fruits are grown in India, and among them mango, banana, citrus, guava, grape, pineapple and apple had been the major ones. Fruits and vegetables are rich sources of vitamins, minerals, proteins and carbohydrates, which are essential for human nutrition. India produced 40 per cent of the tropical fruits, against Asia's production of 90 per cent. The Total production and area of fruits had been estimated at 43.1 Million Tonnes and 4.01 Million Hectares respectively, which had accounted for 10 per cent of the Total world's production of fruits which was Second only to that of Brazil. According to a report of the World Health Organisation (WHO) the low fruit intake had been estimated to cause about 31 per cent of the number of heart diseases and of 11 per cent of stroke in the World. The emphasis on Horticulture was a recognition of the need for attaining nutritional security and for earning a sustainable income. Healthier diets improve the learning capacity of the children and the working capacity of the adults, leading to higher incomes and a reduction in poverty levels. Citrus is the world's leading tree – fruit crop. It is a crop adaptable to wide range of soils, terrain, planting and cultural arrangements, and over 100 nations reported citrus production in the world. The area and production have increased many fold in the past 30 years, particularly in Japan, Brazil, Israel, Turkey and Cuba. Although domestic consumption is the principal market for citrus fruit, the major citrus producing countries, like Spain, USA, Israel, Morocco and South Africa export a sizeable amount of fresh fruits to the world market, in particular to Europen Economic Community, Russia, Canada, Saudi Arabia, Kuwait and Hong kong. Citrus plantations in Israel occupy more than 40,000 hectares and 80 per cent of Israel's agricultural export value lies on citrus. In Cuba the planting is about 1,50,000 hectare, though grapefruit is mainly under cultivation. In Japan, citrus occupies the first place among fruit crops, covering nearly more than 50 per cent of the total areas under fruit crops and 2.8 per cent of the total area under Natsudaidai. Citrus occupies about 9 per cent of the total land under various fruits in India. The most important commercial citrus in India is the mandarin orange followed by the sweet oranges and acid limes

Statement of Problem

India stands first in the production of Lemon. Since the citric acid content in Indian Lemon is high it receives resounding reception in modern cuisine both of indigenous and continental. As the fruit has medicinal and nutritional value it finds a respectable place in many kinds of beverages all over the world. In India, Tamil Nadu occupies sixth place both under area of cultivation and production of Lemon. From the horticultural stand point of view, Dindigul District had numerous special features of which, the first and the foremost one was the prevalence of three distinct climates, namely the temperate, the sub-tropical and the tropical climates. No other districts in the Tamil Nadu State had such unique agro climatic zones. Accordingly, the Dindigul District had been selected as it stood first in the cultivation of lemon with an average area of 1229 Hectares during the year 2009-2010 in Tamil Nadu. Dindigul district has 27.499 hectares of fruit producing area with 380658 tonnes of fruit production. The average productivity in the District is estimated to be 13.84 tonnes per hectares. The district has been famous for Guava, Jack fruit, Pear, Plums and Lemon. Due to the prevalence of red and black soil and moderate climatic conditions the district is known for different varieties of fruits of which lemon is widely grown by number of farmers. The Nilakotai, Ottachandram and Batalgundu fruit markets located in the district drawn hundreds and thousands of wholesale fruit vendors. The farmers are motivated to grow more and more fruits including Lemon. Lemon is a tree fruit which gives substantial revenue to the farmers in addition to providing large scale employment directly and indirectly to the people. Through the fruit is being cultivated in the natural way from time immemorial, the growing awareness among various utilities of lemon fruits and the presence of important fruit markets in the district and the economic factors of production and marketing of lemon create growing enthusiasm among prospective fruit cultivators of the district. As there is no detailed study made so fare on production and marketing of lemon in Dindigul District of Tamil Nadu, the researcher felt

that it is pertinent to have on exploratory study of cultivation pattern and marketing practices certainly help the policy makers to frame suitable policies which ultimately will result in the overall economic development of the region, hence the present study.

Review of Literature

Singh in his study entitled "Production and Marketing of Vegetables around Hyderabad", had employed a multiple regression model for tomato, brinjal and chilli farms around Hyderabad and had pointed out that there was a wide scope for reallocating the resources to optimize the output in the areas selected for the study. He had also observed that the constant returns to scale was found to be in operation in all the vegetable farms.

Objective

The main objective of the study is to analyse the determinants of the gross returns, returns to scale and resource – use efficiency.

Methodology

The Dindigul District comprised of 7 taluks. Lemon is mainly cultivated in Ottanchathiram and Natham taluks while in Kodaikanal, Nilakottai and Dindigul taluks Lemon is cultivated here and there and in negligible proportions. In Vedasandhur and Palani taluks Lemon is not at all grown. Hence the selection of the sample villages had been restricted to the two taluks only. According to the reports of NABARD any sample size between 300 and 500 is suitable for studying the issues related to agricultural farming, particularly about the fruit crops. Hence in consultation with the Officials of the Horticultural Department and the experts in the fields of Food and Fruit crops the researcher had decided to select 400 Lemon cultivators; 200 each from the respective two taluks of Oddanchathiram and Natham. The chosen cultivators were then classified into marginal farmers and small farmers based on their land holdings. Accordingly 107 marginal and 92 small farmers from Oddanchatram taluk and103 marginal and 98 small farmers from Natham taluk making a total of 400 Lemon farmers had formed part of the sample size. Primary data were collected from Lemon growers and merchant middle men. The survey was undertaken during the period of July 2013 to March 2014.

Tools for Analysis

To analyse the determinants of the gross returns, returns to scale and resource – use efficiency, Cobb – Douglas type production function is used. The function in log form is as follow:

$$\text{Log } Y = \log b_0 + b_1 \log X_1 + b_2 \log X_2 + \ldots + b_5 \log X_5$$

Where Y = Annual yield of Lemon (Kgs /acre)
X_1 = Human labour in man-days per acre in a year
X_2 = Manures in Kilograms per acre in a year
X_3 = Cost of pesticides in rupees per acre in a year
X_4 = Cost of irrigation in rupees per acre in a year
X_5 = Number of Lemon plants per acre in a year
b_0, b_1…, b_5 are the parameters to be estimated.
b_0 = Regression constant
b_1, b_2…, b_5 = Partial elasticity of yield with respect to the factors
X_1, X_2…, X_5 respectively.

In order to test the significance of the estimated parameters b_1, b_2…, b_5, the t – test of the following formula was used.

$$t = \frac{b_1}{SEbi}$$

SEbi = Standard Error of bi

The sum of all production elasticities of the factor inputs indicates returns to scale. i.e. $\sum bi$, i = 1, 2…, 5

If $\sum bi > 1$ increasing returns to scale
< 1 decreasing returns to scale
$= 1$ constant returns to scale.

Results and Discussions

The cost and returns analysis showed that the cultivation of Lemon was profitable in the study area. The question of whether there is any scope to increase the net returns per acre could be answered by analyzing the resource use efficiency. To assess the resource productivity and returns to scale in Lemon cultivation, the Cobb – Douglas type of production function was used.

Determinants of Lemon Yield by Marginal Farmers

In case of Marginal Farmers the function is fitted for the yield of the Lemon plants.

Table 1: Estimated Cobb - Douglas Type Production Function for Marginal Farmers

S. No	Particulars	Notation	Elasticity Co-Efficient	Standard Error
1.	Yield (kgs per acre)	Y	–	–
2.	Constant	b_0	3.541^{**}	0.331
3.	Labour in	X_1	0.671^{**}	0.069
4.	Manure in (kgs / acre)	X_2	0.138^{**}	0.051
5.	Cost of pesticides in (₹ / acre)	X_3	0.099^{NS}	0.152
6.	Cost of irrigation in (₹ /acre)	X_4	0.311^{**}	0.087
7.	Number of Lemon plants (per acre)	X_5	$- 0.147^{**}$	0.041

Source: Computed data

Sum of elasticity co-efficient - 1.078
R^2 - 0.84
F- test - 224.537
** Significant at one per cent level
NS - Not significant

It is observed from Table 1 that the co-efficient of determination (R^2) of the function was 0.84 which indicates that 84.00 per cent of the variation in output of Lemon was explained by all the five independent variables. The F-test shows that the estimated Cobb – Douglas type production function was statistically significant at the one per cent level. The regression constant had a positive value and it was statistically significant at one per cent level, revealing that the error of approximation of the functional form is significant. However the estimated equation was statistically significant and valid to draw inference. So it was used.

Among the independent variables, human labour, manure and the cost of irrigation were found to be positive and it was statistically significant at one per cent level. Among the independent variables, the cost of pesticides was found to be positive but it was statistically not significant.

It could be inferred that the yield of Lemon was significantly influenced by the level of manure utilized. One per cent increase in the level of manure used, keeping all the other factors constant, would increase the yield by 0.138 per cent from its mean level.

The elasticity co–efficient for the variable cost of irrigation was 0.087 which indicates that by increasing the expenditure on irrigation by one per cent, there would be an increase in the yield of Lemon by 0.087 per cent, ceteris paribus.

The variable cost of labour is one of the important inputs contributing to the yield of Lemon. Its co-efficient was 0.331 and it was significant at the five per cent level, indicating that one per cent increase in the cost of labour, would increase the output of Lemon by 0.331 per cent from the mean level.

The Lemon yield was also influenced by the value of pesticides applied. The co-efficient of pesticides was 0.051 which was significant at the one per cent level. This shows that one per cent increase in the value of pesticides would increase the yield by 0.051 per cent from its mean level.

Determinants of Lemon Yield for Small Farmers

The Cobb–Douglas type production function (1) is fitted to test the relationship between the yield of Lemon and the independent variables for small farmers. The results are presented in Table 2 for the yield of the Lemon plants.

Table 2: Estimated Cobb-Douglas Type Production Function for Small Farmers

S. No	Particulars	Notation	Elasticity Co-Efficient	Standard Error
1.	Yield (kgs per acre)	Y	-	-
2.	Constant	b_0	1.074^{*}	0.363
3.	Labour in (man days/acre)	X_1	0.732^{**}	0.087
4.	Manure in (kgs / acre)	X_2	0.317^{**}	0.045
5.	Cost of pesticides in (₹/acre)	X_3	0.178^{NS}	0.152
6.	Cost of irrigation in (₹/acre)	X_4	0.389^{*}	0.029
7.	Number of Lemon trees	X_5	$- 0.097^{*}$	0.350315

Source: Computed data

Sum of elasticity co-efficient - 1.519
R^2 - 0.818
F - test - 137.842 **
*Significant at five per cent level; **Significant at one per cent level
NS - Not significant.

It is observed from Table 2 that the co-efficient of determination (R^2) of the function was 0.818 which indicates that 81.8 per cent of variation in output of Lemon was explained by all the five independent variables. The F-test shows that the estimated Cobb-Douglas type production function was statistically significant at the five per cent level. The regression constant had a positive value and it was statistically significant at the five per cent level, revealing that the error of approximation of the functional form is significant. However, the estimated equation was statistically significant and valid to draw inference. So, it was used.

Among the independent variables, human labour, manure and the cost of irrigation were found to be positive and it was statistically significant at five per cent level. Among the independent variables, the cost of pesticides was found to be positive but it was statistically not significant.

It could be inferred that the yield of Lemon was significantly influenced by the level of manure utilized. A one per cent increase in the level of manure used, keeping all other factors constant, would increase the yield by 0.732 per cent from its mean level.

The elasticity co-efficient for the number of Lemon trees was found to be negative but it was statistically not significant.

The elasticity co-efficient for the variable cost of irrigation was 0.218 which indicates that by increasing the expenditure on irrigation by five per cent, there would be an increase in the yield of Lemon by 0.218 per cent **ceteris paribus**.

The variable cost of labour is one of the important inputs contributing to the yield of Lemon. Its co-efficient was 0.115 and it was significant at the one per cent level indicating that one per cent increase in the cost of labour would increase the output of Lemon by 0.115 per cent from the mean level.

The Lemon yield was also influenced by the value of pesticides applied. The co–efficient of pesticides was 0.172 which was significant at the five per cent level. This shows that one per cent increase in the value of pesticides would increase the yield by 0.172 per cent from its mean level.

Determinants of Lemon Yield by Medium Farmers

The Cobb–Douglas type production function (1) is fitted to test the relationship between the yield of Lemon and the independent variables for medium farmers. The results are presented in Table 5.7 for the yield of the Lemon plants.

Table 3: Estimated Cobb - Douglas Type Production Function for Medium Farmers

S. No	Particulars	Notation	Elasticity Co-Efficient	Standard Error
1.	Yield (kgs per acre)	Y	-	-
2.	Constant	b_0	3.945^{**}	0.245
3.	Labour in (man days/acre)	X_1	0.803^{**}	0.069
4.	Manure in (kgs / acre)	X_2	0.294^{**}	0.030
5.	Cost of pesticides in (₹/acre)	X_3	0.035^{NS}	0.019
6.	Cost of irrigation in (₹/acre)	X_4	0.110^{*}	0.044
7.	Number of Lemon trees	X_5	$- 0.121^{NS}$	0.67

Source: Computed data

Sum of elasticity co-efficient - 1.121
R^2 - 0.624
F - test - 163.61 **
*Significant at five per cent level; **Significant at one per cent level
NS - Not significant.

It is observed from Table 3 that the co-efficient of determination (R^2) of the function was 0.624 which indicated that 62.40 per cent of variation in output of Lemon was explained by all the five independent variables. The F-test shows that the estimated Cobb-Douglas type production function was statistically significant at the one per cent level. The regression constant had a positive value and it was statistically significant at the one per cent level, revealing that the error of approximation of the functional form is significant. However, the estimated equation was statistically significant and valid to draw inference. So, it was used.

Among the independent variables, human labour, manure and the cost of irrigation were found to be positive and it was statistically significant at five per cent level.

The elasticity co-efficient for the cost of pesticides was found to be positive but it was statistically not significant.

It could be inferred that the yield of Lemon was significantly influenced by the level of manure utilized. A Five per cent increase in the level of manure used, keeping all other factors constant, would increase the yield by 0.732 per cent from its mean level.

The elasticity co-efficient for the number of Lemon trees was found to be negative but it was statistically not significant.

The elasticity co–efficient for the variable cost of irrigation was 0.218 which indicates that by increasing the expenditure on irrigation by five per cent, there would be an increase in the yield of Lemon by 0.218 per cent ceteris paribus.

The variable cost of labour is one of the important inputs contributing to the yield of Lemon. Its co–efficient was 0.115 and it was significant at the five per cent level indicating that one per cent increase in the cost of labour would increase the output of Lemon by 0.115 per cent from its mean level.

The Lemon yield was also influenced by the value of pesticides applied. The co–efficient of pesticides was 0.172 which was significant at the five per cent level. This shows that one per cent increase in the value of pesticides would increase the yield by 0.172 per cent from its mean level.

The marginal value products of the significant variables were estimated and the details are presented in Table 4.

Table 4 Marginal Value Productivity of the Resource Use in Lemon Cultivation (Marginal Farmers)

S. No	Variable	Geometric Mean	Average Physical Product (Nos)	Elasticity Co-efficient	Marginal Physical Production (Nos)	Marginal Value Products (Rs.)	Marginal Input Cost (Rs.)	MVP/ MIC
1	Yield (fruits/acre) (y)	2849						
2	Labour (man days/ acre) (X_2)	61	46.705	0.671	31.339	581.03	260	2.23
3	Manure (kgs/acre) (X_3)	2226.43	1.280	0.138	0.177	3.27	1	3.27
4	Cost of Irrigation (₹ /acre) (X_4)	840.29	3.390	0.311	1.054	19.55	1	19.55
5	Lemon Plants (Nos/acre) (X_5)	120	0.508	-0.147	-0.075	-0.139	1	-1.39

Source: Computed data.

It could be observed from Table 4 that the ratio of the marginal value products to the factor cost to the marginal farmers were ₹ 2.23, ₹ 3.27 and ₹ 19.55 respectively for human labour, manures and fertilizers and cost of irrigation. It is inferred from the table that there was wide scope for increasing the use of human labour, manures and fertilizers and irrigation to increase the yield of Lemon, as the ratio of the marginal value product to the factor cost was more than unity. It also revealed that every

rupee additionally spent on irrigation and manures and fertilizers would yield ₹19.55 and ₹ 3.27 worth of output respectively. The increased use of human labour would augment the income by ₹ 2.23 times the factor cost.

The marginal value products of the significant variables for yield increasing Lemon plants were estimated and the details are presented in Table 5.

Table 5 Marginal Value Productivity of the Resource Use in Lemon Cultivation (Small Farmers)

S. No	Variable	Geometric Mean	Average Physical Product (Nos)	Elaticity Co-efficient	Marginal Physical Production	Marginal Value Products (Rs.)	Marginal Input Cost (Rs.)	MVP/ MIC
1	Yield (fruits/acre) (y)	2896						
2	Labour (man days/ acre) (X_2)	60	48.267	0.732	35.331	655.04	250	2.62
3	Manure (kgs/acre) (X_3)	19.7176	1.469	0.317	0.466	8.63	1	8.63
4	Cost of Irrigation (₹/acre)	792.99	3.652	0.389	1.421	26.34	1	26.34
5	Lemon Plants (Nos/acre) (X_5)	108	0.556	-0.097	-0.054	-1.00	1	-1.00

Source: Computed data

It could be observed from Table 5 that the ratio of marginal value products to the factor cost of small farmers were ₹ 2.62, ₹ 8.63 and ₹ 26.34 respectively for human labour, manures and fertilizers and cost of irrigation. It is inferred from the table that there was wide scope for increasing the use of human labour, manures and fertilizers and irrigation to increase the yield of Lemon, as the ratio of the marginal value product to factor cost was more than unity. It also revealed that every rupee additionally spent on irrigation and manures and fertilizers would yield ₹ 26.34 and ₹ 8.63 worth of output respectively. The increased use of human labour would augment the income by ₹ 2.62 times the factor cost.

The marginal value products of the significant variables for medium farmers were estimated and the details are presented in Table 6.

Table 6: Marginal Value Productivity of the Resource Use in Lemon Cultivation (Medium Farmers)

S. No	Variable	Geometric Mean	Average Physical Product (Nos)	Elaticity Co-efficient	Marginal Physical Production	Marginal Value Products (Rs.)	Marginal Input Cost (Rs.)	MVP/ MIC
1.	Yield (fruits/acre) (y)	3010.85						
2.	Labour (man days/ acre) (X_2)	57	52.822	0.803	42.416	786.39	250	3.15
3.	Manure (kgs / acre) (X_3)	1664.77	1.809	0.294	0.532	9.86	1	9.86
4.	Cost of Irrigation (₹ /acre)	773.65	3.892	0.110	0.428	7.94	1	7.94

Source: Computed data

It could be observed from Table 6 that the ratio of marginal value products to the factor cost of medium farmers were ₹ 3.15, ₹ 9.86 and ₹ 7.94 respectively for human labour, manures and fertilizers and cost of irrigation. It is inferred from the table that there was wide scope for increasing the use of human labour, manures and fertilizers and irrigation to increase the yield of Lemon, as the ratio of the marginal value product to factor cost was more than unity. It also revealed that every rupee additionally spent on irrigation and manures and fertilizers would yield ₹ 7.94 and ₹ 9.86 worth of output respectively. The increased use of human labour would augment the income by ₹ 3.15 times the factor cost.

Conclusion

In case of marginal, small and medium farmers, the co-efficient of determination (R^2) of the function was 0.84 which indicated that 84.00 per cent, 0.832 (83.20%) and 0.624 (62.40%) respectively of the variation in output of Lemon was

explained by all the five independent variables. Among the independent variables, human labour, manure and the cost of irrigation were found to be positive and it was statistically significant at five per cent level. The increased use of human labour in marginal, small and medium size farms would augment the income by ₹ 2.23, ₹ 2.62 and ₹ 3.15 times the factor cost respectively.

References

1. B.M.K. Singh, "Production and Marketing of Vegetables around Hyderabad" M.Sc (Agri.) Project Report Andhra Pradesh Agricultural University, Hyderabad, 1982.
2. Shanmugiah, S., "An Economic Analysis of Production and Marketing of Lime in Tirunelveli District", M.Sc. (Agri.) Dissertation submitted to Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, 2000.
3. C.K. Mohan, "Production, Marketing and Price Behavior of Pepper in Vazhoor Block of Kerala State", M.Sc (Agri) Project Report, Tamil Nadu Agricultural University, Coimbatore, 1973, p.28.
4. V.K Madalia and M.V. Kukadia, "Costs and Returns in Vegetable Cultivation", **Financing Agriculture**, Vol. X, No.1, 1978, pp.15-18.
5. Ravindran, "Export and Domestic Trade of Turmeric in Tamil Nadu', Unpublished Ph.D. Thesis, Madurai Kamaraj University, Madurai.
6. S. Geetha, "Production and Marketing of Fruits in Kodaikanal with Special Reference to Pear", Unpublished Ph.D. Thesis, Madurai Kamaraj University, Madurai, 2010.
7. S. Jeyabalan, "Production and Marketing of Vegetables inn Kodaikanal Taluk, Dindigual District, Unpublished Ph.D. Thesis, Madurai Kamaraj University, 1998
8. S.G. Shivanand, "Performance of Banana Plantation in North Karnataka –An Economic Analysis", M.Sc (Agri) Project Report, University of Agricultural Sciences, Dharwad, 2002.
9. S.N. Kulkarni, "Production and Marketing of Grapes in Bijapur District, Karnataka". M.Sc. (Agri.) Project Report, University of Agricultural Sciences, Dharwad, India, 1989.