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AN ECONOMIC ANALYSIS OF ORGANIC FARMING IN TAMIL NADU, INDIA

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Abstract

In view of the economic importance of organic farming, the present study was taken up in Erode district of Tamil Nadu, India. The total cost of cultivation of organic and conventional turmeric per hectare was worked out to US$ 2641.43 and US$ 3529.13 respectively. The net income per hectare was US$ 2727.19 and US$ 1876.13 respectively. The cost of cultivation of organic and conventional cotton per hectare was worked out to US$ 1306.79 and US$ 1725.19 respectively. The net income per hectare was US$ 1332.13 and US$ 1032.68 respectively. The results of logit model for turmeric growers showed that chemical fertilizers cost had highly significant influence on adoption of organic farming whereas in case of cotton growers, chemical fertilizers cost and information received from NGO's highly influenced on adoption of organic farming. The results of Cobb-Douglas production function for organic turmeric revealed that farm yard manure, neem cake, jeevamirtham, vermicompost, panchakaviya and human labour contributed significantly on yield of organic turmeric. The Cobb-Douglas production function for organic cotton revealed that seeds, farm yard manure, neem cake, jeeva amirtham, vermicompost, panchakaviya, human labour and irrigation contributed had significantly influenced the yield of organic cotton. The most important constraints identified by the organic growers in productivity of organic turmeric and cotton were non availability of labour and organic certification whereas conventional growers' constraints were non availability of labour and high wage rate.

INTRODUCTION

Organic agriculture is a unique production management system which promotes and enhances health of agro eco-system, including biodiversity, biological cycles and soil biological activity and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off farm inputs. India is bestowed with lot of potential to produce all varieties of organic products due to its suitable agro-climatic factors in several parts of the country; the inherited tradition of organic farming is an added advantage. (APEDA, 2010).

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This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. Currently, India ranks 33rd in terms of total land under organic cultivation and 88th position for agricultural land under organic crops to total farming area in the World. (APEDA, 2010). The cultivated land under certification is around 2.8 million ha. This includes one million ha under cultivation and the rest is under forest area (wild collection). (APEDA, 2010).

There is a distinct movement in Tamil Nadu among the farmers, agriculture experts and scientists in favour of organic farming. NGOs, Tamil Nadu Agricultural University, State Department of Agriculture and other government and private agencies have started advocating organic farming in major crops. 4006.2 hectares of cultivated land were under certified organic and another 3661.054 hectares were under conversion in the year 2007- 08. This constitutes 0.20 percent of net cultivated area of the state. In Erode district, turmeric and cotton was grown in 9854.44 hectares and 1421. 01 hectares respectively in the year 2009-2010 and hence the study was restricted to these crops.

Organic farming systems have attracted increasing attention over the last one decade because they are perceived to offer some solutions to the problems currently besetting the agricultural sector. Organic farming has the potential to provide benefits in terms of environmental protection, conservation of nonrenewable resources and improved food quality. Countries like Europe have recognized and responded to these potential benefits by encouraging farmers to adopt organic farming practices, either directly through financial incentives or indirectly through support for research, extension and marketing initiatives. As a consequence, the organic sector throughout Europe is expanded rapidly (24% of world's organic land). But, in the developing countries like India, the share is around 2 per cent only (included certified and wildlife). However, there is considerable latent interest among farmers in conversion to organic farming in India. But, some farmers are reluctant to convert because of the perceived high costs and risks involved. Those who have converted are earning equal incomes to their conventional counterparts, if premium markets exist for organic produce. In this scenario, little studies are available to educate the farmers on the benefits of organic farming especially on cost and returns and, efficiency fronts over conventional farming. Hence this study focuses mainly on the issues like economics and efficiency of organic farming vis-à-vis conventional farming in Tamil Nadu.

OBJECTIVES OF THE STUDY

The general objective is to study the economics and efficiency of organic farming vis-à-vis with conventional farming.

This study is taken up with the following specific objectives:

- To analyze the economic performance of organic farming in terms of productivity, cost and returns, income, employment and asset position and to study the factors influencing the adoption of organic farming.
- To evaluate the resource use efficiency of organic farming and conventional farming.
- To identify the constraints of organic farming and suggest measures for improvement

DESIGN OF THE STUDY

Choice of the study area

In the first stage, Erode district in Tamil Nadu was purposively selected for the present study since it accounted for 65 percent of organic turmeric and cotton growing area of Tamil Nadu. In the second stage, Anthiyur block was purposively selected as it occupied 76 percent of area under organic turmeric and cotton in Erode district. In the next stage, villages cultivating more than 75 percent of total area under organic turmeric and cotton were identified from Anthiur block. The identified villages were Poiyankuttai, Adireddiyur, Perumapalayam, Pudukadu, Esaparai Then two villages namely Poiyankuttai and Pudukadu were selected at random from the identified villages in this block for this study. From each selected village, fifteen turmeric and cotton organic growers and, fifteen turmeric and cotton conventional growers were selected at random and thus the total sample size is 120. The primary data were collected from the sample respondents during the month of January 2012 and the data collected pertain to the agricultural year 2010-2011.

Tools of analysis

Logit model

Mathematically, the logit model is represented as

$$L_i = \ln \left(\frac{P_i}{1 - P_i} \right) = \beta_1 + \beta_2 X_i + u_i$$

Where

X_i represents all the independent variables and β represents the effect of changes in X_i and L_i represent logit in the probability of adoption.

In the study, logit model was estimated. The model estimated was:

$$Y_1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$$

Where,

Y_1 = If the producers have adopted organic farming in their farms (0 if no, 1 if yes),

X_1 = Number of years of farming,

X_2 = Total acres cultivated by the producer,

X_3 = If the producer is a literate (0 if no, 1 if yes),

X_4 = A dummy variable indicating for a producer if he changes from conventional to organic due to chemical fertilizers cost (0 if no, 1 if yes),

X_5 = A dummy variable indicating for a producer who gets information about organic farming from other farmers (0 if no, 1 if yes),

X_6 = A dummy variable indicating for a producer if he gets information about organic farming from NGO's (0 if no, 1 if yes).

Functional analysis

Production function analysis was employed to evaluate the resource use efficiency in turmeric and cotton production both organic and conventional.

The Cobb- Douglas regression model used was

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} X_9^{b9} X_{10}^{b10} U_t$$

Where,

Y = Yield of turmeric and cotton (Kgs /ha)

X_1 = Quantity of planting material (Kgs /ha)

X_2 = Quantity of farm yard manure (tonnes/ha)

X_3 = Quantity of neem cake (Kgs /ha)

X_4 = Quantity of jeeva amirtham (Lit/ha) (Organic preparation from cow dung and urine)

X_5 = Quantity of vermicompost or Quantity of potash (Kgs /ha) (Organic preparation from cow dung and urine)

X_6 = Cost of panchakaviya (Lit/ha) or plant protection (Rs/ha)

X_7 = Cost of harvesting and curing or cost of delinting (Rs/ha)

X_8 = Human labour (man days/ha)

X_9 = Machine hours (hrs. /ha)

X_{10} = Irrigation (numbers/ Crop season)

U_t = Error term

a, b_1, b_2, …….. b_{10} = Parameters to be estimated

Economic Efficiency

Estimate of the parameters $\beta_{1.....}\beta_{10}$ were elasticities of Y with respect of j^{th} input. The marginal products of the resources were derived from these elasticity coefficients. The marginal productivities of significant inputs were worked out at its geometric mean level by using the formula.

$$MVP_j = \beta_j \frac{\bar{Y}}{\bar{X}_j} \times P_y$$

Where

MVP_j - Marginal value product of the j^{th} product

$\bar{Y}$ - Geometric mean value of output

$\bar{X}$ - Geometric mean of input 'j'

β_j - Estimated co-efficient of elasticity

P_y - Price of output

The economic efficiency of resource use and the Marginal Value products of each input were compared with its MIC in order to estimate the efficiency. Equality of MVP_j to the MIC of input 'j' indicates the optimum resource use of a particular input. Ratio of MVP_j to the MIC of input 'j' indicated the degree of resource use efficiency.

Garrett's Ranking Technique

The respondents were asked to rank the problems in turmeric and cotton production, processing and marketing. In the Garrett's ranking technique, these ranks were converted into percent position by using the formula

$$\text{Percent position} = \frac{100 \text{ X } (R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individual

N_j = Number of attributes ranked by the j^{th} individual.

By referring to the Garrett's Table, the percentage positions estimated were converted into scores. Thus for each factor, the scores of the various respondents were added and the mean values were estimated. The mean values thus obtained for each of the attributes were arranged in descending order. The attributes with the highest mean value was considered as the most important one and the others followed in that order.

RESULTS AND DISCUSSION

Productivity in organic farming

The measure of productivity is defined as a total output per unit of total input. Productivity of organic and conventional farming is furnished in Table 1. It could be seen from the Table that productivity of conventional farms was slightly higher than organic farms. It is also evident that organic farmers were able to achieve 95.49 percent productivity of conventional turmeric and 96.30 percent of conventional cotton.

Table 1. Productivity in organic and conventional farming

(Kg/ha)

Sl.No.	Particulars	Organic	Conventional	Percentage to Conventional
1.	Turmeric	6071	6358	95.49
2.	Cotton	3700	3842	96.30

Annual income of sample farmers

The sample households were post-stratified into three different groups based on the annual income. Households with annual income of below Rs50000 were categorized

Table 2. Annual income of sample farmers

(Rs./ha)

Sl.No.	Annual income (Rs)	Organic	Conventional
1.	Upto 50,000 (Low)	4(6.67)	8(13.33)
2.	50,001 to 1 lakh (Middle)	15(25.00)	24(40.00)
3.	More than 1 lakh (High)	41(68.33)	28(46.67)
4.	Total	60(100.00)	60(100.00)
Average annual income		126,000	103,000

Figures in parentheses indicate percentages of total

as low income group, households with annual income between Rs.50000 and Rs.1 lakh were included under middle income group and those with annual income exceeding Rs. 1 lakh were included under high income group.

It could be observed from the Table 2 that both in organic and conventional farming, more proportion of farmers were in high income group followed by

middle income group and lastly by low income group. On comparison, more proportion of organic farmers were in high income group with a proportion of 68.33 percent to total in that category as compared to low income group with a proportion of 46.67 percent to total in that category. On the other hand, conventional farmers dominated the scene in middle income and low income groups with a proportion of 40.00 percent and 13.33 percent in respective categories. Further, the average annual income of organic farmers was Rs.126,000 and it was higher over conventional farmers by 22.33 percent. From the above results, it is concluded that most of the organic farmers were in high income group and also, organic farmers were also having higher average income as compared to conventional farmers.

Employment position

Employment position of sample farmers is presented in Table 3. It could be seen from the Table that organic farming had higher employment position of 150.13 man days and it was higher over conventional farming by 8.64 percent. Among the farming activities, for both organic and conventional farming, harvesting operation followed by irrigation management occupied the highest employment position. For harvesting, the employment position was 72.50 man days and 61.25 man days respectively for organic and conventional farmers. Likewise, for irrigation management, the employment position was 46.88 man days and 31.25 man days respectively for organic and conventional farmers

Table 3 Employment position of sample farmers (in man days/ha)

Sl.No.	Particulars	Organic	Conventional
Farming			
i)	Main field preparation	3.81	2.56
ii)	Planting	2.25	1.88
iii)	Application of manures	4.06	3.75
iv)	Application of fertilizers	9.38	13.75
v)	Irrigation management	46.88	31.25
vi)	Application of plant protection	3.75	7.50
vii)	Intercultural operation	7.50	16.25
viii)	Harvesting	72.50	61.25
Total		**150.13**	**138.19**

After harvesting and irrigation management, the highest amount of labour was engaged in intercultural operations and irrigation management with 16.25 man days and 13.75 man days respectively in conventional farming. In case of organic farming, application of fertilizers and intercultural operation was the next highest employment position with 9.38 man days and 7.50 man days

respectively after harvesting and irrigation management. Other operations like main field preparation, planting application of manures, application of plant protection contributed the lowest employment in both categories. Hence it could be concluded that organic farming activities accounted for slightly more employment than conventional farming activities.

Asset Position in organic and conventional farming

The asset position of the sample farms are presented in Table 4. Total value of farm assets of organic and conventional per ha was Rs.6150 thousand and Rs.6043 thousand respectively. The farm assets for organic farms were slightly higher over conventional farms. Land was found to be the most important asset and it formed 83.74 percent and 86.59 percent respectively of the total value of both organic and conventional farm assets. Buildings constituted the next with 9.38 percent and 7.86 percent of organic and conventional total farm assets respectively. Irrigation structure was the third important asset with a proportion of 3.66 percent and 2.53 percent for both organic and conventional total farm assets respectively. Organic farmers were having more irrigation channels in field than conventional farmers. For both organic and conventional farms, farm machinery and livestock were of lowest proportion to the total value of farm assets. Hence it could be concluded from the table that land, buildings and irrigation structures were the major assets in the sample farms.

Table 4. Asset position of sample farmers ('000Rs./**ha)**

Sl. No.	Assets	Organic	Conventional
1	Land	5,150(83.74)	5233(86.59)
2	Buildings	577(9.38)	475(7.86)
3	Irrigation Structure	225(3.66)	153(2.53)
4	Tools and implements & Farm machinery	106(1.72)	91(1.50)
5	Livestock	92(1.50)	91(1.50)
	Total	**6150(100.00)**	**6,043(100.00)**

Figures in parentheses indicate percentages of total

Costs and returns in both organic and conventional farming

The costs and returns for the sample farms in turmeric cultivation were worked out and the results are given in Table 5. It could be seen from Table that the total cost of cultivation of turmeric was higher for conventional farmers and it was 33.07 percent over organic farmers. The share of variable cost was high for both organic and conventional farmers with 93.24 percent and 96.87 percent respectively. Gross income was almost similar for both organic and conventional farmers (Table 5). This state of on par gross income was found in

organic turmeric even though its productivity was less as compared to conventional turmeric, which was due to high premium price received for organic turmeric. But net income was higher for organic farmers than conventional farmers by 45.36 percent due to less cost of production than organic farms.

Table 5 Costs and returns in turmeric cultivation (in Rs./ha)

Sl. No.	Particulars	Organic	Conventional
1.	Fixed cost	10537.34(6.76)	6511.84(3.13)
2.	Variable cost	145307.00(93.24)	201706.69(96.87)
3.	Total cost of cultivation	155844.34(100.00)	208218.53(100.00)
4.	Gross income	316748.80	318910.20
	Net income	**160904.46**	**110691.67**

Figures in parentheses indicate percentages of total

Cost and returns in cotton cultivation

It could be seen from the Table 6 that total cost of cultivation of cotton was higher for conventional farmers and it was 32.02 percent over organic farmers. The share of variable cost was the highest for both organic and conventional farmers with 87.61 percent and 92.84 percent respectively. Gross income was slightly higher with Rs. 162714.60 for conventional farms. Though productivity of organic cotton was found to be lower, due to high premium price received for it, boosted the gross income to the level of conventional farms. But the net income was higher for organic farmers due to its less cost of cultivation. This result of profitability of organic cotton was in line with the findings of Patil (2006), who had demonstrated the profitability of organic cotton in Maharashtra.

Technology adoption of organic farming for turmeric growers

Adoption of technology in turmeric was measured by logistic regression model by employing Gret-1.9.1 software package. It could be observed from the Table 7 that the explanatory variables included for adoption of organic turmeric farming was experience, farm size, education, chemical fertilizers cost, information got from other farmers and information got from NGO's information. Out of these variables, the variables of chemical fertilizers cost, information got from other farmers and information got from NGO's were significantly influencing in the adoption of organic turmeric farming. The chemical fertilizer cost was significant as it resulted in adoption of cheap organic inputs which was not only environment friendly but also attracted premium price. The information from other farmers and NGO's about organic farming resulted in convincing and favorable adoption of organic farming.

Table 6. Cost and returns in cotton cultivation (in Rs./ ha)

Sl. No.	Particulars	Organic	Conventional
1.	Fixed cost	9555.26(12.39)	7289.86(7.16)
2.	Variable cost	67515.31(87.61)	94496.24(92.84)
3.	Total cost of cultivation	77100.57(100.00)	101786.10(100.00)
4.	Gross income	155695.80	162714.60
Net income		**78595.23**	**60928.50**

Figures in parentheses indicate percentages of total

Table. 7 Logit regression model of organic turmeric growers

Sl.No.	Variables	Coefficient (β)	Std. Error	Wald	Significance	Exp (β)
1	Constant	-1.169	3.633	0.103	0.748	0.311
2	Experience	-0.195	0.123	2.522	0.112	0.823
3	Farm size	0.761	0.469	2.634	0.105	2.140
4	Education	-7.405	4.684	2.500	0.114	0.001
5	Chemical fertilizers cost	8.146	3.011	7.322	0.007	34.51
6	Information got from other farmers	3.311	1.674	3.913	0.048	27.408
7	Information got from NGO's	7.669	3.440	4.969	0.026	21.41

With one degrees of freedom

Technology adoption of organic farming for cotton growers

It could be observed from the table 8 that the explanatory variables included for adoption organic cotton farming was experience, farm size, education, chemical fertilizers cost, information received from other farmers and information received from NGO. Out of these variables, chemical fertilizer cost and information received from NGO were significantly influencing the adoption of organic cotton farming. Like organic turmeric, in organic cotton also, high chemical fertilizer cost resulted in cheap organic cotton farming. Information from NGO on organic farming practices favorably influenced the adoption of organic cotton.

Table 8 Logit regression model of organic cotton growers

Sl. No.	Variables	Coefficient (β)	Std. Error	Wald	Significance	Explained (β)
1	Constant	-4.647	2.400	3.750	0.053	0.010
2	Experience	0.15	0.49	0.91	0.763	1.015
3	Farm size	-0.158	0.166	0.904	0.342	0.854
4	Education	1.239	1.310	0.894	0.344	3.452
5	Chemical fertilizers cost	3.205	1.056	9.206	0.002	24.665
6	Information got from other farmers	1.755	1.326	1.752	0.186	5.784
7	Information got from NGO's	3.416	1.282	7.099	0.008	30.447

With one degrees of freedom

Resource use efficiency in organic and conventional farms

Cobb-Douglas production functions were fitted to study resource use efficiency and estimated using the Ordinary Least square (OLS) method. Production elasticity with respect to different inputs used in the production of organic and conventional cotton and turmeric were computed.

Organic turmeric

The estimated Cobb-Douglas production function for organic turmeric is furnished in Table 9. It could be seen from the Table that adjusted coefficient of multiple determination was 0.97 revealing that the production function model was a good fit and about 97 percent of the variation in organic turmeric yield is influenced by the explanatory variables included in the model.

Table 9 Resource use efficiency in organic turmeric production

Sl. No.	Variables	Regression coefficient	Standard error	Significance
1.	Regression Constant	7.21	0.27	*
2.	Planting material (Kgs/ha.)	-0.00	0.01	NS
3.	Farmyard manure (tonnes/ha.)	0.34	0.07	*
4.	Neem cake (Kgs/ha.)	0.03	0.01	*
5.	Jeeva amirtham (Lit/ha.)	0.07	0.04	**
6.	Vermicompost (Kgs./ha)	0.13	0.06	**
7.	Panchakaviya (Lit/ha.)	0.18	0.06	*
8.	Harvesting and curing (Rs/ha.)	0.02	0.02	NS
9.	Human Labour (man days/ ha.)	0.03	0.01	**
10.	Machine hours (hrs/ha.)	0.00	0.00	NS
11.	Irrigation (numbers/ crop season)	0.00	0.01	NS

*R^2 = 0.98** $\bar{R}^2$ = 0.97** F- ratio = 112.20 N = 30*

*** Significant at 1 percent level *Significant at 5 percent level NS Non-significant*

The coefficients of farm yard manure, neem cake and panchakaviya were positive and significant at five percent level with the coefficient values of 0.34, 0.03 and 0.18 respectively. The variables jeeva amirtham and vermi compost were also positive and significant at one percent level with the coefficients value of 0.07 and 0.13 respectively. Thus farm yard manure, neem cake , panchakaviya , jeeva amirtham and vermi compost were significant in organic turmeric cultivation as these organic inputs are *sine quo non* in organic turmeric cultivation. Human labour was also positive and significant at one percent level with the coefficient value of 0.02 as organic turmeric cultivation requires more human labour as compared to conventional farming.

The marginal value product (MVP), marginal input cost (MIC) and the ratio between these two were worked out for each input to understand the efficiency of input use and the results are given in Table 10. The input is used efficiently if the ratio between MVP and MIC is one. A ratio of more-than-one and less-than-one would indicate under-utilization and over-utilization respectively. From the Table 10 that the ratio was found to be greater than one for farm yard manure, neem cake, jeeva amirtham, vermicompost, panchakaviya and human labour which indicated that the above resources are at sub optimum level and there exists a possibility for enhancing the yield of organic turmeric by increasing the respective inputs from the existing level. This is evident from the first the first table that the productivity of organic turmeric was 95.49 percent of conventional turmeric and still scope exists for improving the yield by application of these inputs.

Table 10 Economic efficiency of resource use in organic turmeric production

Sl.No.	Variables	Regression coefficient	MVP	MIC	MVP ------ MIC
1	Farm yard manure (tonnes/ha.)	0.336	3255.75	300	10.85
2	Neem cake (Kgs/ha.)	0.027	17.88	8.50	2.10
3	Jeeva amirtham (Lit/ha)	0.074	36.16	30	1.21
4	Vermicompost (Kgs/ha.)	0.132	15.79	4	3.95
5	Panchakaviya (Lit/ha.)	0.183	35.38	20	1.77
6	Human labour (man days/ha)	0.025	170.47	56.25	3.03

Production function analysis for conventional turmeric

The estimated Cobb-Douglas production function for conventional turmeric is presented in Table 11. It could be seen from the Table that the adjusted coefficient of multiple determinations was 0.91 which revealed that the production function model was a good fit. The coefficients of planting material, phosphorus, potash, harvesting and curing, machine hours and irrigation were positive and significant at one percent level with the coefficient values of 0.03, 0.02, 0.03, 0.03, 0.04 and 0.03 respectively because all these inputs are essential in conventional turmeric cultivation. Farm yard manure was not significant because this being the organic input not required much in conventional turmeric cultivation. Human labour was also not significant because it was not required much in conventional turmeric cultivation devoid of organic inputs application.

Table 11 Resource use efficiency in conventional turmeric production

Sl. No.	Variables	Regression coefficient	Standard error	Significance
1.	Regression Constant	8.02	0.14	*
2.	Planting material (Kgs/ha.)	0.03	0.02	**
3.	Farmyard manure (tonnes/ha.)	0.01	0.01	NS
4.	Nitrogen (Kgs/ha.)	-0.01	0.01	NS
5.	Phosphorous (Kgs/ha.)	0.02	0.01	**
6.	Potash (Kgs./ha)	0.03	0.01	**
7.	Plant protection (Rs/ha.)	-0.01	0.01	NS
8.	Harvesting and curing (Rs/ha.)	0.03	0.01	**
9.	Human Labour (man days/ ha.)	0.00	0.01	NS
10.	Machine hours (hrs/ha.)	0.04	0.02	**
11.	Irrigation (numbers/ crop season)	0.03	0.01	**

*R^2 = 0.94** R^2 = 0.91** F- ratio = 31.19 N = 30*

***Significant at 1 percent level *Significant at 5 percent level NS Non-significant*

The ratio between MVP and MIC were worked out for each input to understand the efficiency of input use and the results are given in Table 12. It could be seen from the Table 12 that the ratio between MVP and MIC of phosphorus, potash, machine hours and irrigation were more than one. It indicated that the above resources are at sub optimum level and there exists a possibility for enhancing the yield of conventional turmeric by increasing the respective inputs from the existing level. The reduction in for planting material and harvesting and curing from the existing mean level was required since MVP is less than MIC.

Table 12. Economic efficiency of resource use in conventional turmeric production

Sl.No.	Variables	Regression coefficient	MVP	MIC	MVP ------ MIC
1	Planting material (Kgs/ha)	0.033	4.92	17.17	0.29
2	Phosphorous (Kgs/ha)	0.021	17.80	5.20	3.42
3	Potash (Kgs./ha)	0.034	22.09	10.8	2.05
4	Harvesting and curing (Rs/ha)	0.026	0.20	12.50	0.02
5	Machine hours (hrs/ha)	0.042	987.47	15.65	63.10
6	Irrigation (numbers/ crop season)	0.026	115.38	105	1.10

Thus, on comparision, in organic turmeric, organic manures like farmyard manure, neem cake, Jeevamirtham, vermicompost and organic pesticides like panchakaviya were significantly influencing the yield. Similarly conventional fertilizers like phosphorus and potash significantly influenced the conventional turmeric. Further, the economic efficiency analyses showed that organic inputs in organic turmeric cultivation and conventional inputs in conventional turmeric cultivation were used at sub optimal level and scope exists for improving their respective yield from present level by increased application of these inputs. Moreover, in organic turmeric, human labour is significant which might be due to the fact that organic manures and pesticides require more human labour for its application.

Production function analysis for organic cotton

The estimated Cobb-Douglas production function for organic cotton is presented in Table 13. It could be seen from the Table that adjusted coefficient of multiple determinations was 0.98 revealing that the production function model was a good fit. The coefficients of seeds, farm yard manure, neem cake, jeeva amirtham, vermicompost and panchakaviya were positive and significant at one percent level with the coefficient values of 0.02, 0.04, 0.07, 0.08, 0.03 and 0.03 respectively. The above five organic inputs barring seed are significant in organic cotton cultivation as these are the main determinants boosting productivity in that crop. Similar results were reported by Satpute *et al*., (2009) who had reported the significant influence of vermicompost on organic cotton in Parbhani district of Maharashtra and by Dodamani *et al*., (2009) who had shown the significant influence of farm yard manure on organic cotton in Dharwad district of Karnataka.

The variables human labour and irrigation were also positive and significant at five percent level with the coefficients value of 0.03 and 0.13 respectively. Human labour and irrigation were the synergic inputs along with organic inputs in organic cotton cultivation and hence it significantly influenced the yield in that crop.

Table 13 Resource use efficiency in organic cotton production

Sl. No.	Variables	Regression coefficient	Standard error	Significance
1.	Regression Constant	6.71	0.18	*
2.	Seeds (Kgs/ha.)	0.02	0.01	**
3.	Farmyard manure (tonnes/ha.)	0.04	0.02	**
4.	Neem cake (Kgs/ha.)	0.07	0.03	**
5.	Jeeva amirtham (Lit/ha.)	0.08	0.04	**
6.	Vermicompost (Kgs./ha)	0.03	0.01	**
7.	Panchakaviya (Lit/ha.)	0.03	0.02	**
8.	Harvesting cost (Rs/ha.)	-0.01	0.00	NS
9.	Human Labour (man days/ ha.)	0.03	0.01	*
10.	Machine hours (hrs/ha.)	-0.02	0.02	NS
11.	Irrigation (numbers/ crop season)	0.13	0.03	*

*$\overline{R^2}$ = 0.99** $\bar{R}^2$ = 0.98** F- ratio = 364.59 N = 30*
*** Significant at 1 percent level *Significant at 5 percent level NS Non-significant*

Table 14 Economic efficiency of resource use in organic cotton production

Sl.No.	Variables	Regression coefficient	MVP	MIC	MVP ------ MIC
1.	Seeds (Kg/ha)	0.020	482.92	160.83	3.00
2.	Farm yard manure (tonnes/ha.)	0.039	272.93	300	0.91
3.	Neem cake (Kgs/ha.)	0.067	53.31	8.5	6.27
4.	Jeeva amirtham (Lit/ha)	0.080	30.44	30	1.01
5.	Vermicompost (Kgs/ha.)	0.026	6.45	4	1.61
6.	Panchakaviya (Lit/ha.)	0.031	21.83	20	1.09
7.	Human labour (man days/ha)	0.032	502.63	450	1.12
8.	Irrigation (number/ crop season)	0.129	565.06	38.75	14.58

The marginal value product (MVP), marginal input cost (MIC) and the ratio between these two were worked out for each input to understand the efficiency of input use and the results are given in Table 14. It could be seen from the Table that the ratio between MVP and MIC of seeds, neem cake, jeeva amirtham, vermicompost, panchakaviya, human labour and irrigation were more

than one. It indicated that the above resources are at sub optimum level and there exist a possibility for enhancing the yield of organic cotton by increasing the respective inputs from the existing level. As already stated in organic turmeric cultivation, for organic cotton also, the productivity was 96.30 percent of conventional cotton and scope exists for furthering the yield improvisation through increased application of organic inputs.

Production function analysis for Conventional cotton production

The estimated Cobb-Douglas production function for conventional cotton in Erode district is furnished in Table 15. It could be seen from the Table that adjusted coefficient of multiple determinations was 0.98 revealing that the production function model was a good fit. The coefficients of seeds, farm yard manure, potash, harvesting cost and human labour were positive and significant at five percent level with the coefficient values of 0.08, 0.10, 0.04, 0.30 and 0.03 respectively' The variables nitrogen was positive and significant at one percent with coefficient value of 0.03. But the variable of machine hours was negatively significant at one percent with coefficient value of 0.03, which might be due to excessive use of it beyond economic optimum point.

Table 15 Resource use efficiency in conventional cotton production

Sl. No.	Variables	Regression coefficient	Standard error	Significance
1.	Regression Constant	4.40	0.60	*
2.	Seeds (Kgs/ha.)	0.08	0.02	*
3.	Farmyard manure (tonnes/ha.)	0.10	0.03	*
4.	Nitrogen (Kgs/ha.)	0.03	0.02	**
5.	Phosphorous (Kgs/ha.)	-0.01	0.02	NS
6.	Potash (Kgs./ha)	0.04	0.01	*
7.	Plant protection (Rs/ha.)	0.00	0.01	NS
8.	Harvesting cost (Rs/ha.)	0.30	0.07	*
9.	Human Labour (man days/ ha.)	0.03	0.01	*
10.	Machine hours (hrs/ha.)	-0.03	0.01	**
11.	Irrigation (numbers/ crop season)	0.02	0.02	NS

$R^2 = 0.98$** $\bar{R}^2 = 0.98$** F- ratio = 119.26 N = 30

** Significant at 1 percent level *Significant at 5 percent level NS Non-significant

The marginal value product (MVP), marginal input cost (MIC) and the ratio between these two were worked out for each input and the results are given in Table 16. It could be seen from the Table that the ratio between MVP and MIC of seeds, farm yard manure, nitrogen and potash were more than one. It indicated that the above resources are at sub optimum level and there exists a possibility for enhancing the yield of conventional cotton by increasing the

respective inputs from the existing level. The reduction in harvesting cost and human labour from the existing mean level was required since MVP is less than MIC.

Table 16 Economic efficiency of resource use in conventional cotton production

Sl..No.	Variables	Regression coefficient	MVP	MIC	MVP ------ MIC
1	Seeds (Kgs/ha.)	0.076	2899.62	1900	1.53
2	Farm yard manure (tonnes/ha.)	0.10	698.16	300	2.33
3	Nitrogen (Kgs./ha.)	0.033	62.29	4.6	13.54
4	Potash (Kgs/ha.)	0.043	21.56	10.8	2.00
5	Harvesting cost (Rs/ha.)	0.303	1.51	9.75	0.15
6	Human labour (man days/ha.)	0.029	74.65	450	0.17

On comparison of organic cotton with conventional cotton, it showed the similar result of turmeric with organic fertilizers and pesticides influencing organic cotton and conventional fertilizers like nitrogen and potash influencing conventional cotton. Like turmeric, human labour was also significant for organic cotton. Moreover comparing organic turmeric and organic cotton, the influence of organic manures and pesticides were more significantly influencing the yield in organic cotton as farmyard manure, neem cake and panchakaviya were significant at one percent level. This is attributed to the fact that organic cotton is more successful as compared to organic turmeric.

Problems faced in organic cultivation by sample farmers

The farmers in the study area faced several problems in the production of organic turmeric and cotton. Hence it was decided to study the major constraints in turmeric production in the study area. The three constraints identified by the sample turmeric and cotton growers were ranked using Garrett's ranking technique and the details are furnished in the Table 17. The organic growers expressed that the non-availability of labour was the most important problem (68.54) as most of the labour in the area were more willing to work under Mahatma Gandhi National Rural Employment Guarantee Scheme. The second major constraint in the cultivation was the lack of quick organic certification for organic turmeric and cotton (55.02). Hence there is need of organic certification facilities to farmers. The next crucial problem was high wage rate (47.65) and it was Rs.300 for men and Rs. 120 for women respectively.

Problems faced in conventional cultivation by sample farmers

The four constraints identified by the sample conventional turmeric and cotton growers were ranked using Garrett's ranking technique and the details are furnished in Table 18. The producers expressed that the non-availability of labour and high wage rate as the most important problem for the same reason cited above Third major constraint in the conventional cultivation was the attack of pest and diseases like leaf blotch, rhizome rot, shoot borer and rhizome scale (55.36). Hence the farmers had to spend a lot to control the attack of pests and diseases in the turmeric and cotton crop and cost was Rs. 8577.25 and Rs. 7225.67 per ha respectively. The next important problem opined was high cost of fertilizers.

Table 17 Problems faced in organic cultivation by sample farmers

Sl.No.	Problems	Mean Score	Rank
1.	Non availability of labour	68.54	I
2.	Organic certification	55.02	II
3.	High wage rate	47.65	III

Table. 18 Problems faced in conventional cultivation by sample farmers

Sl.No.	Problems	Mean Score	Rank
1	Non-availability of labour	70.64	I
2	High wage rate	61.22	II
3	Pest and disease attack	55.36	III
4	High cost of fertilizer	47.20	IV

CONCLUSIONS

The findings of the study and the conclusions drawn have got certain specific implications for the policy issues.

1. The results of the study on economics of production showed that the net returns per hectare received from organic farming were relatively higher than conventional farming of sample farmers. So, the agriculture department should take appropriate steps to promote organic cultivation by conducting vigorous campaigns to increase the awareness of conventional farmers. Also, higher premium price and green marketing channel should be promoted by the Government for boosting organic cultivation.
2. The results of production function analysis suggested that an increase in quantity of farm yard manure, neem cake, vermicompost, jeevamirtham, panchakaviya would increase the yield of organic turmeric and cotton.

Hence, the extension infrastructure of agriculture department has to arrange for training programmes to popularise these inputs and also give technical guidance to organic farmers. Also, State Government should provide subsidies for these inputs to attain the productivity level of conventional turmeric and cotton.

3. The main problem faced by organic growers in production was the difficulty in getting organic certification. Hence cheap and quick certification process should be promoted by certification agencies and government should also come to the farmers rescue in this regard.

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