Organic Farming For Sustainable Agriculture: A Comparative Analysis Of Organic Versus Conventional Rice And Cotton

R.V.Sujatha[1], K.Suhasini[2] and Y.Eswara Prasad[3]

India is a country with a huge number of small farmers who still follow the traditional methods and do farming with few agricultural inputs. The Green revolution technologies involving greater use of synthetic agrochemicals such as fertilizers and pesticides with adoption of nutrient- responsive, high- yielding varieties of crops have boosted the production output per hectare in most of the cases. However, this increase in production has slowed down and in some cases there are indications of decline in growth of productivity and production. Environmental and health problems associated with agriculture have been increasingly well documented, but it is only recently that the scale of the costs has attracted the attention of planners and scientists.

Organic farming is not new to Indian farming community. Several forms of organic farming are being successfully practiced in diverse climate, particularly in rain-fed, tribal, mountains and hill areas of the country. Among all farming systems, organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons such as it minimizes the dependence on chemical inputs (fertilizers; pesticides; herbicides and other agro-chemicals) thus safeguards/ improves quality of resources, and environment. It is

[1] . Research Associate WTO Cell, Dept. of Agricultural Economics, College of Agriculture, Acharya N.G.Ranga Agricultural University, Rajendranagar, Hyderabad-30
[2] Associate Professor WTO Cell, Dept. of Agricultural Economics, College of Agriculture, Acharya N.G.Ranga Agricultural University, Rajendranagar, Hyderabad-30
[3] *Professor & Univ. Head WTO Cell, Dept. of Agricultural Economics, College of Agriculture, Acharya N.G.Ranga Agricultural University, Rajendranagar, Hyderabad-30*

labour intensive and provides an opportunity to increase rural employment and achieve long term improvements in the quality of resource base.Organic farming has received considerable attention in India in the recent past.

In India, the per cent area under organic farming is only 0.03 per cent of the total area under agriculture when compared to Austria (11.30%), Switzerland (9.70%) and Italy (7.94%) according to SOEL Survey, February 2003. By February 2002, around 1426 farms in India were certified as organic farms with an area of around 2775 hectares which contributes to a very negligible percentage i.e only 0.0015% of the total cultivable land in India. The Indian government has recognized the potential of organic agriculture and started the process of strengthening the sector through legal frame work which includes creation of national organic standards and the possibility of accrediting inspection with in the country and also certification bodies. Some of the major organically produced agricultural crops in India include crops like plantation, spices, pulses, fruits, vegetables and oil seeds etc (Table 1).

Organic agricultural export market is one of the major drivers of greening of agriculture in India. Major export market for Indian producers are Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Singapore, South Africa, Saudi Arabia, UAE, UK, and USA.

Table 1: Major products produced in India by Organic farming

Type of Product	**Products**
Commodity	Tea, Coffee, Rice, Wheat
Spices	Cardamom, Black pepper, white pepper, Ginger, Turmeric, Vanilla, Tamarind, Clove, Cinnamon, Nutmeg, Mace, Chili
Pulses	Red gram, Black gram
Fruits	Mango, Banana, Pineapple, Passion fruit, Sugarcane, Orange, Cashew nut, Walnut
Vegetables	Okra, Brinjal, Garlic, Onion, Tomato, Potato
Oil seeds	Mustard, Sesame, Castor, Sunflower
Others	Cotton, Herbal extracts

(Source: Org-Marg 2002)

Estimated quantity of various products that are exported from India in 2002 is shown in Table 5.This shows that around 3000 tons of tea was exported and in quantity term it was the highest, next major exports are rice (2500 tons), fruits & vegetables (1800 tons), cotton (1200 tons) and wheat (1150 tons).

Export of organic products is allowed only if they are produced, processed or packed under the approved production programme and certified by an accredited certifying agency. The Indian government has recognized the export potential of organic agriculture and is in the process of strengthening the sector by putting a legal frame work in place. This includes creating national organic standards and the possibility of accrediting in-country inspection and certification bodies.

The world demand for organically produced foods is growing rapidly in developed countries like Europe, USA, Japan and Australia. The current estimated share of organic foods in these countries is approximately 1 to 1.5 per cent. Worldwide, food trends are changing with a marked health orientation. Since organic foods are free from chemical contaminants, the demand for these products should steadily increase in the new millennium. According to the ITC, UNCTAD/GAT, more than 130 countries produce certified organic foods. 100 of them are from Asia and Africa.

Table 2. Major organic products exported from India

Product	**Sales (Tons)**
Tea	3000
Coffee	550
Spices	700
Rice	2500
Wheat	1150
Pulses	300
Oil Seeds	100
Fruits & Vegetables	1800
Cashew Nut	375
Cotton	1200
Herbal **Products**	250
Total	**11,925**

Source: Org-Marg, 2002

Certification plays an important role in marketing of organic products especially to the export markets. In India, the accreditation agencies approved by the

Ministry of Commerce, GOI are Agricultural and Processed Food Products export development authority (APEDA), Coffee Board, Spices Board, Tea Board, Coconut Development Board and Cocoa &Cashew Nut Board. In December 2002, the certification bodies fully accredited under the Indian National Programme for organic production are

- ECOCERT International (Based in France and Germany; Branch office in Aurangabad)
- IMO India Pvt. Ltd.-Institute for Market ecology (Based in Switzerland; Branch office in Bangalore)
- INDOCERT (Based in India; Branch office at Aluva, Kerala)
- LACON Gmbh (Based in Germany, Office in Aluva, Kerala)
- SGS India Pvt. Ltd.(Based in Switzerland; Branch office in Delhi and other cities)
- SKAL International(Based in Netherlands and office in Mumbai)

Organic farming is ideal for Andhra Pradesh especially for debt-ridden farmers as most of the farmers in Andhra Pradesh are falling in the trap of debts due to unscrupulous use of pesticides and fertilizers. Hence, agriculture of Andhra Pradesh requires new dimensions to raise the socio-economic status of the peasants. This can be achieved by adopting natural farming and diversifying agriculture. In the present paper, therefore, an attempt has been made to study the comparative analysis of organic and inorganic farming in Andhra Pradesh. The present study also undertakes brief account of the concept of "Organic Farming" and its prospective in Andhra Pradesh vis-à-vis limitations of the organic farming.

Methodology:

A multi-stage random sampling was adopted in selection of sample size. Three mandals were selected from Karimnagar district and from each mandal, two villages were selected. From each village, five organic farmers and five inorganic farmers were selected randomly constituting a sample size of 30 organic farmers and 30 inorganic farmers. Primary data were collected from the selected farmers using a pre-tested schedule.

Various cost concepts and income measures were used to analyse the economic efficiency of the organic versus inorganic cultivation. To analyse the technical efficiency of both organic and inorganic farming situations stochastic frontier production function was used.

Stochastic Frontier Model: In this, the error term is composed of two parts; one symmetric and the other one sided. The symmetric component permits random variation of the frontier across the firms and captures the effects of measurement error, other statistical noise and random shocks outside the firm's control. The one-sided component captures the effects of inefficiency relative to stochastic frontier. By estimating the frontier it will be possible to find out whether the farmer's deviation of yield from the frontier may be because of less efficient management practices used or may be because of external factors.

The model:

The stochastic model recognizes inefficiency as deviations from the production frontier and also assumes all the deviations from the frontier are not due to the inefficiency alone. In this way it decomposes the deviations from the production frontier in terms of technical inefficiency and random effects.

The original specifications involved a production function specified for cross-sectional data which had an error term with two components, one to account for random effects and another to account for technical efficiency. The following functional form of Stochastic Frontier model was applied to determine the output maximizing combination of existing resources with available technology.

$Yi=\beta_1+\beta_1 \log X_{1i}+\beta_2 \log X_{2i}+\beta_3 \log X_{3i}+\beta_4 \log X_{4i}+V_i-U_i$

where, Yi = The production of the i^{th} firm

i= no. of farmers, X_{i1}=extent of land owned, X_{i2}=human labour used

X_{i3}=seed, fertilizers, plant protection chemicals, irrigation

X_{i4}=credit taken from the bank, β = vector of unknown parameters

Vi=random error assumed to be identically and independently distributed N (o, $\sigma^2 v$)

Ui=firm-specific inefficiency effect assumed to follow at '0' ,Normal distribution(ui,$\sigma_2 U$) and m are the factors affecting technical inefficiency .

The frontier output (Yi) was represented by f (xi,β) exp (vi-ui). Aigner et al (1977) suggested that maximum likelihood estimates of the parameters can be obtained in terms of parameterization.

Then the technical efficiency of the i^{th} farm was the ratio of the observed output to the corresponding frontier output as

$TE_i = Y_i/Y_i^* = \exp(-U_i)$

In this study, the Maximum Likelihood Estimation (MLE) method has been used for estimation .After estimating the estimates; an analysis was made to compute the allocative efficiency of production. Allocative efficiency determines whether a farmer allocating resources in consistent with the prices of input and output. The economic and allocative scores are derived using the duality theory in which the cost frontier is derived algebraically from the estimated stochastic frontier assuming that the production function is self-dual (i.e Cobb-Douglas)The ratio of economic, to the technical efficiency provides a measure of allocative efficiency.

Results: To analyse the economic efficiency of organic farming over inorganic farming, various cost components were used on per hectare basis separately and presented below.

Table 3. Item wise Cost of Cultivation of Rice (Rs./qtl.)

S.No.	Operational Costs	Organic farming	Inorganic farming
1	Human Labour	4258.69 (22.90)	3798.5 (16.54)
2	Tractor power	2456.78 (13.21)	2368.45 (10.32)
3	Seed	1056.42 (5.68)	998.36 (4.35)
4	Manures & Fertilizers	1923.3 (10.34)	4586.46 (19.98)
5	Plant Protection Chemicals	458.52 (2.47)	2095.25 (9.13)
6	Irrigation	469.25 (2.52)	489.16 (2.13)
7	Miscellaneous Expenditure	658.46 (3.54)	769.96 (3.35)
8	Interest on Working Capital	353.09 (1.90)	472.82 (2.06)
	Sub-Total	**11634.51 (62.57)**	**15578.96 (67.85)**
	Fixed Costs		
1	Depreciation on implements & farm buildings	486.55 (2.62)	499.69 (2.18)
2	Land Revenue	186.5 (1.00)	189.74 (0.83)
3	Rent paid for leased-in land	589.25 (3.17)	567.97 (2.47)
4	Rental value of owned land	4985.82 (26.81)	5369.25 (23.39)

5	Interest on owned fixed capital	712.45 (3.83)	754.43 (3.29)
	Sub-Total	**6960.57** **(37.43)**	**7381.08** **(32.15)**
	Total	**18595.08** **(100.00)**	**22960.04** **(100.00)**

Rice:

Both operational and fixed costs were analyzed for both organic and inorganic rice farming and presented in table 3. The results indicate that operational costs were higher than fixed costs in both the cases. Among the operational costs, Human labour occupies major share of 22.90 per cent of total cost followed by tractor power (13.21), manures and fertilizers (10.34). Among fixed costs, rental value of owned land was high (26.81%).

In case of inorganic rice cultivation, operational costs occupied the lion's share of 67.85 per cent among which the manures and fertilizers cost was highest (19.98%) followed by human labour (16.54%), tractor power(10.32%) and plant protection chemicals(9.13%). Among fixed costs, rental value of owned land was found to be high (23.39%) similar to organic farming. From the results, it was found that the cost of cultivation in rice was higher in inorganic cultivation (Rs.22960.04) than organic cultivation (Rs.18595.08) which might be due to higher cost incurred towards manures and fertilizers and plant protection chemicals in inorganic rice cultivation.

Table 4. Item wise Cost of Cultivation of Cotton (Rs./qtl.)

S.No.	Operational Costs	Organic farming	Inorganic farming
1	Human Labour	9042.3 (21.96)	7098.88 (13.29)
2	Tractor power	5469.35 (13.28)	5268.14 (9.86)
3	Seed	1789.56 (4.35)	1853.35 (3.47)
4	Manures & Fertilizers	5102.34 (12.39)	9115.55 (17.06)
5	Plant Protection Chemicals	4954.28 (12.03)	13585.45 (25.43)
6	Irrigation	724.91 (1.76)	592.24 (1.11)
7	Miscellaneous Expenditure	852.49 (2.07)	913.99 (1.71)
8	Interest on Working Capital	874.37 (2.12)	1265.38 (2.37)

	Sub-Total	**28809.6 (69.96)**	**39692.98 (74.29)**
	Fixed Costs		
1	Depreciation on implements & farm buildings	1349.25 (3.28)	1325.48 (2.48)
2	Land Revenue	183.72 (0.45)	184.79 (0.35)
3	Rent paid for leased-in land	1258.11 (3.06)	1059.54 (1.98)
4	Rental value of owned land	8219.49 (19.96)	9897.63 (18.52)
5	Interest on owned fixed capital	1357.75 (3.30)	1298.21 (2.43)
	Sub-Total	**12368.32 (30.04)**	**13765.65 (25.76)**
	Total	**41177.92 (100.00**	**53433 (100.00)**

Cotton:

The item wise cost of organic and inorganic cotton were analyzed and presented in table 4. From table 4, it was clear that the operational costs were mare than fixed costs in organic as well as inorganic farming situations of cotton.

Among the operational costs, human labour occupied major portion (21.96%) followed by tractor power (13.28%). Among fixed costs, rental value of owned land was high for both organic and inorganic farming (19.96% and 18.52% respectively).Thus, it was clear from above tables that the human labour cost was higher in organic cultivation of rice and also cotton as organic farming system is labour intensive, where as in inorganic farming, the cost of manures, fertilizers and pesticides were high compared to other costs.

Cost concepts and income measures:

The cost concepts and income measures of rice and cotton cultivation were worked out to know the economic efficiency of organic vis-à-vis inorganic farming systems and results are presented in table 5 and 6.

From table 5, it can be concluded that all the cost concepts were found to be high in inorganic cultivation compared to organic cultivation. Initially, the difference between both the systems was attributed to expenditure towards fertilizers, plant protection chemicals and the rental value of owned land creating a wide gap of both type of farms accounting for Rs.21536.5 and Rs. 26306.18 respectively

Table 5. Comparison of Cost Concepts and Income Measures in Rice

S.No.	Item	Organic Farming	Inorganic Farming
A			
1	Cost A1	12307.56	16268.39
2	Cost A2	12896.81	16836.36
3	Cost B1	13020.01	17022.82
4	Cost B2	18595.08	22960.04
5	Cost C1	14003.57	17977.49
6	Cost C2	19578.64	23914.71
7	Cost C3	21536.5	26306.18
B	**Income Measures**		
1	Yield (q/ha)	49.87	55.48
2	Gross Income	39347.43	43773.72
3	Net Income	17810.93	17467.54
4	Family Labour Income	20752.35	20813.68
5	Farm Business income	26450.62	26937.36
6	Farm investment income	25467.06	25982.69
7	B-C Ratio	0.83	0.66

When the income measures were considered, higher gross returns of Rs.43773.72 were obtained in inorganic cultivation of rice as the yield of inorganic system was higher than the organic cultivation. But, the levels of yields were commensurate with low cost of cultivation in organic method. Nevertheless, the net returns were slightly higher in organic cultivation than inorganic. A higher B-C ratio was obtained in organic cultivation (0.83) compared to inorganic cultivation (0.66) which may be due to low cost of cultivation.

The cost of cultivation based on cost concepts and income measures in cotton was analyzed and presented in table 6.

Table 6. Comparison of Cost Concepts and Income Measures in cotton

S.No.	Item	Organic Farming	Inorganic Farming
A			
1	Cost A1	30342.57	41203.25
2	Cost A2	31600.68	42262.79

3	Cost B1	31700.32	42501.46
4	Cost B2	40897.63	53158.36
5	Cost C1	32989.45	43757.82
6	Cost C2	42186.76	54414.72
7	Cost C3	46405.43	59856.192
B	**Income Measures**		
1	Yield (q/ha)	26.92	30.89
2	Gross Income	58254.88	66845.96
3	Net Income	11849.45	6989.77
4	Family Labour Income	17357.25	13687.6
5	Farm Business income	26654.20	24583.17
6	Farm investment income	25365.07	23326.81
7	B-C Ratio	0.26	0.11

It can be observed that the total cost was high in inorganic farming due to high use of manures, fertilizers and pesticides. The gross income was also high in case of inorganic farming (Rs. 66845.96) due to high yields compared to organic farming (Rs. 53926.88).In contrast, the net returns were high in organic farming (Rs. 7521.45) compared to inorganic farming (Rs. 6989.77).The benefit cost ratio was also high in organic farming(0.26) compared to inorganic system(0.11)

Finally, it can be concluded that the net returns were higher in organic farming in both the crops compared to inorganic farming though the cost of cultivation was more in inorganic cultivation. The net returns were marginally high in organic farming which may be due to the fact that organic cultivation has started gaining momentum in the recent past and it will take some time to stabilize the yields and to get the marked net returns.

Technical Efficiency: The technical efficiency of rice and cotton production in the study area was analyzed using Stochastic frontier production function. Production frontiers were estimated separately for both organic and inorganic farming in rice as well as which are discussed here under.

Technical Efficiency in Rice:

Table 7 reveals the maximum likelihood estimates of the stochastic frontiers for both organic and inorganic farming. In case of organic rice cultivation, all the independent variables included in the model had positive coefficients. The variables

operational area, seed, plant protection chemicals and labour were found to be significant at five per cent level of probability where as irrigation, manures and fertilizers were not significant even at 10 per cent level of probability.

Table 7. Maximum likelihood estimates of Stochastic Frontier model for Rice

S.No.	Variable	Coefficients	
		Organic	**Inorganic**
1	Constant	4.3985**	3.8956**
2	Operational area	0.3216**	0.2989*
3	Seed	0.3519**	0.3328**
4	Manure and fertilizers	0.1151	0.0923
5	Plant protection chemicals	0.07196**	0.05824**
6	Irrigation	0.03649	0.03244
7	Labour	0.7865**	0.7421**
8	D2	0.5989	0.5464
9	γ	0.9263**	0.8954**

Note :

** - Significant at five percent level of probability

Table 91. - Significant at 10 percent level of probability

The variance ratio (γ) was 0.9263 was significant at five per cent level of probability indicating that the total variation in output from the frontier is attributable to technical inefficiency. This means that about 93 per cent of the differences between the observed and the maximum production frontier outputs were due to difference in levels of technical efficiencies of the farmers and not related to random error.

In case of inorganic, the coefficients of all the independent variables included in the model were positive. The variables seed, plant protection chemicals and labour were found out to be significant at five per cent level of probability, where as operational area was significant at 10 per cent level of probability. The variance ratio (γ) was 0.8954 indicating that the inefficiency effect over the random error. The results thus indicate that there is lot of scope for escalating the production through increasing the level of these inputs..

Technical Efficiency in Cotton:

The maximum likelihood estimates of the parameters of stochastic frontiers for both organic and inorganic cotton cultivation are presented in table 8.

Table 8. Maximum likelihood estimates of Stochastic Frontier model for Cotton

S.No.	Variable	Coefficients	
		Organic	**Inorganic**
1	Constant	2.9969**	3.0195**
2	Operational area	0.2423**	0.0975*
3	Seed	0.2351**	0.1133**
4	Manure and fertilizers	0.2961*	0.2665*
5	Plant protection chemicals	0.0966**	0.0118**
6	Irrigation	0.1336	0.0932
7	Labour cost	0.7865**	0.7421**
8	D^2	0.2599	0.1554
9	γ	0.8993**	0.7895**

Note : ** - Significant at five percent level of probability

Table 91. - Significant at 10 percent level of probability

In organic cotton cultivation, all the independent variables exhibited positive coefficients in both systems of farming. Among them, operational area, seed, plant protection chemicals and labour were found to be significant at five per cent level of significance where as, manures and fertilizers were significant at one per cent level of significance. The variance ratio (γ) was 0.8993 indicating that the farm specific variability contributed more to the variation in yield among the rice farmers i.e. the total variation in output from the frontier is attributed to technical inefficiency. This shows that about 89 per cent of the differences between the observed and frontier outputs were due to differences in farmers' level of technical efficiency and not related to random variability. These factors were under the control of the farm and the influence of which can be reduced to enhance technical efficiency of farmers.

In inorganic cotton cultivation, the independent variables viz., seed, plant protection chemicals and labor were found to be significant at five per cent level of probability where as the operational area was found to be significant at one per cent level of significance. The non-significant variable in both types of farming is irrigation. . The variance ratio (γ) which was 0.7895 indicates that about 79 per cent of the differences between observed output and frontier outputs were due to differences

in farmers' levels of technical efficiency and not due to random variability. The positive coefficients of all the independent variables in both the situations indicate that there is further scope for increasing production of cotton by increasing the levels of these inputs.

The farm specific technical efficiencies were estimated for rice and cotton in both organic and inorganic situations and presented below.

From table 9, it can be concluded that in case of organic rice cultivation, more than half of the farmers i.e. 53.33 per cent of the farmers are operating with the technical efficiency of 81-90 per cent followed by 71-80 per cent (20.00). In case of inorganic farming of rice, most of the farmers are operating with the technical efficiency of 71-80 per cent (46.67%). In both the cases, none of the farmers are operating with the technical efficiency of less than 50 per cent. In organic and inorganic farming, only 16.67 and 10.00 per cent of farmers respectively are operating with at a technical efficiency of 91-100 per cent.

Table 9. Distribution of farmers based on the technical efficiency of Rice Production

	N=30	N=30
Technical Efficiency	**Organic farmers**	**Inorganic farmers**
< 50	0(0.00)	0(0.00)
51-60	1(3.33)	2(6.67)
61-70	2(6.67)	6(20.00)
71-80	6(20.0)	14(46.67)
81-90	16(53.33)	5(16.67)
91-100	5(16.67)	3(10.00)

Table 10.Distribution of farmers based on the technical efficiency of Cotton Production

N=30

N=30

Technical Efficiency	**Organic farmers**	**Inorganic farmers**
< 50	0(0.00)	3(10.00)
51-60	4(13.33)	11(36.67)
61-70	6(20.00)	9(30.00)
71-80	7(23.33)	4(13.33)

81-90	10(33.33)	3(10.00)
91-100	3(10.00)	0(0.00)

The table 10 reveals that one-third of the farmers(33.33%) are operating at the technical efficiency of 81-90 per cent in case of organic cotton production followed by the farmers with technical efficiency of 71-80 per cent (23.33%) and 61-70 per cent(20.00). On contrast, none of the farmers fall under the technical efficiency of less than 50 per cent. In case of inorganic cotton cultivation, most of the farmers fall under the efficiency range of 51-60 per cent (36.67%) followed by 61-70 per cent (30.00%0 and 71-80 per cent (13.33%). It is interesting to note that none of the farmers fall under the technical efficiency of 91-100 per cent.

The results clearly indicate that more number of organic farmers in both rice and cotton were operating at high level of technical efficiency compared to inorganic farmers. This also indicates that there is ample scope for increasing the efficiency of production through better utilization of the available resources from the existing level of technology.

Constraints: Some of the constraints identified for promoting organic agriculture in India are

- Lack of proper knowledge about the organic farming among the farming communities.
- Lack of market information about the domestic as well international market opportunities of organically produced commodities
- Small farmers can not afford the expensive procedure for certification of their farms as organic (nearly Rs.30,000 per certification)
- Poor marketing infrastructure for organic products.
- Conversion of farms from conventional to organic is time consuming and cost-effective which hinders the interest of farmers
- Lack of subsidies on bio-fertilizers and bio-pesticides

Policy Suggestions:

- Introduction of contract farming inorganic agriculture
- Provision of insurance to the organic farms to reduce the risk in case of crop failure
- Developing awareness and health consciousness of organic products among consumers

- Provision of infrastructural facilities for post-harvest management as well as marketing
- Providing financial assistance to the farmers for converting their traditional farms in to organic farms and intending support to meet certification fees especially for the small and marginal farmers etc.

References:

James J. Ferguson. 2004. World Markets for Organic Fruits and Vegetables. Publication of Horticultural Sciences Department, University of Florida. Publication

Organic and Biodynamic farming.2001.Government of India. Planning Commission report. September 2001

Balachandran V. 2004.Future in the Past: A study on the status of organic farming in Kerala.

Discussion Paper No. 82 Kerala Research Programme on Local Level DevelopmentCentre for Development Studies. Thiruvananthapuram

Down To Earth (2001) Organic Farming – Untapped Potential, 10(8): 34-41.

S Rajendran.2003. Environment and Economic Dimensions of Organic Rice Cultivation in South India. Publication of DOS in Economics and Cooperation, University of Mysore