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Economics and Efficiency of Organic Farming vis-à-vis Conventional Farming in India

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Abstract

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 non-renewable resources and improved food quality. India is bestowed with lot of potential to produce all varieties of organic products due to its diverse agro-climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic market related to the export market. In India, the land under certification is around 2.8 million ha. But, there is considerable latent interest among farmers in conversion to organic farming. However, some farmers are reluctant to convert because of the perceived high costs and risks involved in organic farming. Despite the attention which has been paid to organic farming over the last few years, very little accessible information actually exists on the costs and returns of organic farming in India. The empirical evidences of efficiency analysis of organic and conventional farming systems are scarce or even absent. So, the present paper focuses mainly on the issues like economics and efficiency of organic farming vis-à-vis conventional farming in India. Four states namely Gujarat, Maharashtra, Punjab and U.P were purposively selected for the present study. Similarly, four major crops i.e., cotton, sugarcane, paddy and wheat were chosen for comparison. A model based non-parametric Data Envelopment Analysis (DEA) was used for analyzing the efficiency of the farming systems. The crop economics results showed a mixed response. Overall, it is concluded that the unit cost of production is lower in organic farming in case of cotton and sugarcane crops where as the same is lower in conventional farming for paddy and wheat crops. The DEA efficiency analysis conducted on different crops indicated that the efficiency levels are lower in organic farming when compared to conventional farming, relative to their production frontiers. The results conclude that there is ample scope for increasing the efficiency under organic farms.

Key words: economics, efficiency, organic farming, conventional farming, DEA analysis

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Economics and Efficiency of organic farming vis-à-vis conventional farming in India

Organic agriculture is developing rapidly; its share in agricultural land and farms continues to grow in many countries. According to the (Research Institute of Organic Agriculture, Switzerland) FiBL survey, 2008; almost 30.4 million ha are managed organically by more than 7,00,000 farms (based on 2006 consolidated data). Oceania holds 42 per cent of the world's organic land, followed by Europe (24 per cent) and Latin America (16 per cent). The global organic land area increased by almost 1.8 million ha compared to the previous year, 2005. Global demand for organic products remains robust, with sales increasing by over five billion US dollar per year.

India is bestowed with lot of potential to produce all varieties of organic products due to its agro-climatic regions. In several parts of the country, the inherited tradition of organic farming is an added advantage. 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 agriculture land under organic crops to total farming area in the World. 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). India exported 86 items during 2007-08 with the total volume of 37533 MT. The export realization was around 100.4 million US $ registering a 30 per cent growth over the previous year (APEDA, 2010).

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 non-renewable 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 earning equal incomes to their conventional counterparts, if premium markets are exist for organic produce. Despite the attention which has been paid to organic farming over the last few years, very little accessible information actually exists on the costs and returns of organic farming in India. Similarly, there are only a few attempts of comparing efficiency between organic and conventional production systems in India. This present paper focuses mainly on the issues like economics and efficiency of organic farming vis-à-vis conventional farming in India. Section I of this paper compares economics of organic farming with conventional farming while Section II deals with efficiency of organic farming in India. The final section sums up the findings of paper and suggests measures for strengthening organic farming in India.

I
Economics of organic farming in India

Lampkin (1994) summarized various studies conducted on economics of organic farming in different crops in South and West of England and parts of Scotland and Wales. They concluded that the organic farming systems were more diverse in terms of enterprise mix; have lower yields and higher labor costs which were not compensated for fully by reduced input costs. Higher/premium prices are essential if organic farmers are to achieve similar incomes to their conventional counterparts.

Padel and Uli (1994) reviewed several studies on costs and returns of organic farming in various crops in Germany. Their study revealed that the organic farming under German conditions was equally profitable with conventional farming. Lower yields for arable crops were compensated by reduced costs of inputs and premium prices for most the crops. Many farmers' explained that financial stability was the main reason for converting to organic farming. Introduction of support schemes for conversion and continuing organic farming also made a significant impact on the profitability.

Dubgaard (1994) studied the economic analysis of organic farming in Denmark. His results showed that the yield differences were most noticeable for intensive crops such as wheat and potatoes with organic yields around half the conventional averages. The organic farms used about twice as much labor per hectare as the conventional farms. The study also concluded that the substantial price premiums on output and public support are essential for the economic viability of organic farming in Denmark.

John (1994) reviewed the various field experiments conducted on organic farming in Canada. Many sample farms recorded yields that were the same or slightly below conventional farms. Even though some market regulatory problems exist in case of organic products, the prices for them were higher (about 30%) than the conventional products. Overall, the study concluded that 72 per cent of farmers strongly convinced that 'organic farming is as profitable as conventional'.

Anderson (1994) examined different research studies conducted on organic farming in USA. They concluded that the lower yields on organic farms contrasted with conventional farms were balanced by lower production costs. The noted differences between economic performances of organic and other farms may be due to farm size rather than farming system. During the study period, the US organic producers did not receive any benefit from the environmental advantages except to the extent that consumer willing to support by paying a premium.

Wynen (1994) carried out a review study on organic farming in Australia. He concluded that the wheat yields were almost similar between organic and conventional farms. The study also indicated that the variability of wheat yields on organic farms was lower than on conventional farms. The financial results of two groups of farmers per hectare were remarkably similar.

Shirsagar (2008) studied the impact of organic farming on economics of sugarcane cultivation in Maharashtra. The study was based on primary data collected from two districts covering 142 farmers, 72 growing Organic Sugarcane (OS) and 70 growing Inorganic Sugarcane (IS). The results concluded that OS

cultivation enhances human labour employment by 16.9 per cent and its cost of cultivation is also lower by 14.2 per cent than IS farming. Although, the yield from OS was 6.79 per cent lower than the conventional crop, it is more than compensated by the price premium received and yield stability observed on OS farms. Overall, the OS farming gave 15.63 per cent higher profits than IS farms.

Study coverage

The study had purposively chosen four states in India for present study. They are namely; Gujarat, Maharashtra, Punjab and U.P states. From each state; a random sample of fifteen organic and fifteen inorganic farmers were interviewed regarding their cost of cultivation in major crops grown by them. The data for both input and output quantities and their unit prices were collected from sample farmers. The study pertains to the cropping year 2009-10. The details of study coverage and crops identified across different states are presented in table 1.

Table 1 Geographic coverage and crops selected for study

State	Gujarat	Maharashtra	Punjab	U.P
Sample districts	Kutch	Warana	Faridkot and Fatehgarh Saheb	Ahmednagar
Crops Covered	Cotton	Sugarcane	Paddy, wheat and cotton	Wheat, Paddy and Sugarcane

Economics of paddy (basmati) cultivation in Punjab

The per acre economics of paddy cultivation in Punjab state both under organic and conventional farming is presented in table 2. Most of the sample organic farmers in this region are following the concept of 'Natural farming' or 'Zero-budgeting'. The cost of production (variable) per quintal of paddy was Rs.701 under organic farming (OF) where as Rs.427 in conventional farming (CF). It is almost 64 per cent higher in OF than CF. The average cost of cultivation of paddy in OF was Rs.9325 per acre while the same in CF was Rs.7818 per acre. The cost of cultivation was nearly 19 per cent higher in OF when compared to CF. Average yield per acre of paddy was 13.35 and 18.36 quintals respectively in OF and CF. The absolute difference between the yield levels was 5.01 quintal per acre. But, the unit price of paddy was higher (30 percent) in OF relative to CF. There was no significant unit price differences in fodder prices. The average net

returns per acre of paddy cultivation were Rs. 17828 and Rs.20897 respectively in OF and CF. However, the differences between the gross returns per acre of these farming were marginal (Rs.95 only). Among different cost break-ups, the actual costs on weeding and harvesting operations were significantly higher in OF when compared to CF. It clearly indicates the more labor incentive nature of OF than CF. The relative costs on fertilizer application was higher in OF while the same on plant protection was higher in CF. The costs on the remaining cost items were more or less equal in both types. Since, many organic farmers are started practicing organic methods from last two or three years, it takes some more time to stabilize or increase the yields further under organic farming. The premium prices for paddy helping the organic farmers in Punjab to cover their higher costs to some extent.

Table 2 Economics of Paddy cultivation in Punjab (Rs per acre)

	OF	CF	CF=100
Land preparation	1265	1307	97
Seed cost	320	279	115
Sowing cost	1790	1815	99
Fertilizer cost	1955	1760	111
Inter cultivation/Weeding	1245	471	264
Plant protection cost	310	928	33
Irrigation cost	310	72	431
Harvesting cost	1180	771	153
Threshing cost	510	300	170
Marketing cost	440	115	383
Other costs	0	0	-
Total cost of cultivation	9325	7818	119
Yield (Kg)	1335	1836	73
Price (Rs)	19.5	15	130
Fodder (Qtl)	11.2	12.5	90
Price (Rs)	100	94	106
Total revenue	27153	28715	95
Net returns	17828	20897	85
Cost of production (per Qtl)	701	427	164

Economics of wheat cultivation in Punjab

The comparison of crop economics of wheat cultivation between organic and conventional farming systems is presented in table 3. Most of sample organic farmers in the state were cultivating ‘Bansi’ (local) variety of Wheat. The cost of production per quintal was Rs.644 under OF. But, the same in case of CF was Rs.315. The cost of production per quintal of wheat was more than double in OF.

It was due the lower (nearly half) yields under organic farming. But, the overall cost of cultivation per acre was slightly higher (17 per cent) in OF when compared to CF. The market price realization of per kg wheat was significantly higher in OF (117 percent). However, the gross returns per acre of wheat cultivation in Punjab were Rs.28747 and Rs.24755 respectively for OF and CF. The data indicates almost 16 per cent higher gross returns per acre of wheat under OF over CF. However, per acre net returns difference between OF and CF was Rs.2889. It clearly shows the high profitability of wheat cultivation under organic farming in Punjab. As the organic farmers gains more experience under OF, higher yields can be expected on par with CF. Among different crop operations, the higher costs under organic farming were observed in weeding, harvesting and threshing. Most of sample organic farmers are following manual harvesting and threshing practices for good quality of wheat grains and straw. Due to that the costs on labor per acre was higher under OF. The costs on fertilizers and plant protection chemicals were significantly higher under conventional farming. Overall, there is huge potential for domestic as well as export market for organic wheat from Northern states.

Table 3 Economics of Wheat cultivation in Punjab (Rs per acre)

	OF	CF	CF=100
Land preparation	1050	1010	104
Seed cost	1240	1285	96
Sowing cost	275	261	105
Fertilizer cost	1163	1520	77
Inter cultivation/Weeding	1350	495	273
Plant protection cost	92	435	21
Irrigation cost	142	130	109
Harvesting cost	1300	840	155
Threshing cost	710	330	215
Marketing cost	217	130	167
Other costs	0	0	-
Total cost of cultivation	7539	6436	117
Yield (Kg)	1170	2042	57
Price (Rs)	22.3	10.3	217
Fodder (Qtl)	11.4	16.4	70
Price (Rs)	233	227	103
Total revenue	28747	24755	116
Net returns	21208	18319	116
Cost of production (per Qtl)	644	315	204

Economics of cotton cultivation in Punjab

The details of economics of organic cotton farming vis-à-vis conventional farming are summarized in table 4. Many of the sample organic farmers are cultivating desi variety of cotton where as conventional farmers are growing Bt cotton varieties. The cost of production per quintal of cotton under OF was Rs.662 while the same in case of CF was Rs.1112. The cost of production in OF was almost 40 per cent lower than CF. The average cost of cultivation per acre of cotton were Rs.5427 and Rs.12455 respectively under organic and conventional farming. There is a huge difference of Rs.7028 (66 %) between these farming types. The mean yield per acre of OF was 73 per cent of conventional farming. The unit price realization of cotton was almost same under both production systems. Total gross returns per acre of organic farming were 72 per cent of conventional farming. But, in case of net returns per acre, the share has increased up to 90 per cent. The mean differences between the OF and CF net returns per acre was Rs.1935. It clearly demonstrates the high efficiency of organic cotton farming when compared to conventional farming in Punjab.

Table 4 Economics of Cotton cultivation in Punjab (Rs per acre)

	OF	CF	CF = 100
Land preparation	967	850	114
Seed cost	125	1250	10
Sowing cost	150	125	120
Fertilizer cost	333	2250	15
Inter cultivation/Weeding	1332	650	205
Plant protection cost	33	4550	1
Irrigation cost	380	150	253
Harvesting cost	1967	2500	79
Threshing cost	0	0	-
Marketing cost	140	130	108
Other costs	0	0	-
Total cost of cultivation	5427	12455	44
Yield (Kg)	825	1125	73
Price (Rs)	28	28.5	98
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	23100	32063	72
Net returns	17673	19608	90
Cost of production (per Qtl)	662	1112	60

Among various cost components, inter cultivation /weeding and irrigation costs were higher in organic farming. But, the costs on seeds, fertilizers and plant

protection chemicals were significantly higher in conventional farming. Actually, the major problem for organic cotton farming was lack of premium prices. Establishment of organic cotton export channels either by government or private organization would really enhance the incomes of the farmers in Punjab. The results clearly reveal that organic farmers can safely earn almost equal amount of net margins per acre as conventional farmers.

Economics of paddy cultivation in Uttar Pradesh

The costs and returns of paddy (basmati) cultivation both under organic and conventional farming types are presented in table 5. Most of the sample organic farmers are practicing the method of 'Natural farming' or Zero-budgeting concept in their farms. The most common basmati varieties growing in this region are Pusa – 1 and Pusa -1121.

Table 5 Economics of paddy cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	3482	3444	101
Seed cost	501	511	98
Sowing cost	1136	1400	81
Fertilizer cost	1082	930	116
Inter cultivation/Weeding	622	375	166
Plant protection cost	350	521	67
Irrigation cost	2281	3300	69
Harvesting cost	2082	2214	94
Threshing cost	1555	1671	93
Marketing cost	140	80	175
Other costs	0	0	-
Total cost of cultivation	13231	14446	92
Yield (Kg)	1518	1807	84
Price (Rs)	15.8	16.9	93
Fodder (Qtl)	10.5	11.8	89
Price (Rs)	70	93	75
Total revenue	24719	31636	78
Net returns	11488	17190	67
Cost of production (per Qtl)	870	803	108

The average cost of production per quintal of paddy (basmati) under organic farming was Rs.870 while the same in conventional farming was Rs.803. The cost of production per quintal under OF was 8 per cent higher than CF. The mean yield per acre in OF accounted for 84 per cent of the conventional farming yield. The average gross returns per acre of conventional farming were nearly 28 per

cent higher than organic farming. The average net returns per acre of paddy cultivation were Rs.11488 and Rs.17190 respectively for OF and CF. No premium prices were available for organic paddy in Uttar Pradesh. The yield levels under organic farming were lower (16%) than conventional farming. Among different cost items, weeding cost was significantly higher in organic farming. The costs on plant protection chemicals and irrigation were significantly higher in conventional farming. It clearly indicates that organic farming increased water-use-efficiency of the farm. Lack of premium prices as well as absence of export market channels limits the expansion of organic farming in the state.

Economics of sugarcane cultivation in Uttar Pradesh

The detailed break-up of the cost of cultivation of sugarcane in Uttar Pradesh state is presented in table 6. Most of the sample organic farmers were growing CoS 88230 variety of sugarcane while majority of conventional growers were using CoS 88230 or CoS 767 varieties.

Table 6 Economics of sugarcane cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	2892	3533	82
Seed cost	4090	5065	81
Sowing cost	1514	1313	115
Fertilizer cost	1935	1904	102
Inter cultivation/Weeding	3113	3217	97
Plant protection cost	420	687	61
Irrigation cost	2750	2687	102
Harvesting cost	3495	2847	123
Threshing cost	0	0	-
Marketing cost	2190	1846	119
Other costs	0	0	-
Total cost of cultivation	22399	23099	97
Yield (Kg)	27364	24333	112
Price (Rs)	1.95	2.02	97
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	53360	49153	109
Net returns	30961	26054	119
Cost of production (per ton)	820	951	86

The cost of production of sugarcane per ton was Rs.820 under organic farming. But, the cost of production per ton was 16 per cent higher under conventional farming. The mean yield per acre was 12 per cent higher under organic farming.

The average cost of cultivation per acre of organic farming accounted for 97 per cent of the conventional farming cost. The gross returns per acre of OF was 9 per cent higher than CF. However in case of the net returns per acre, this value gone up to 19 per cent. The results conclude that the cultivation of sugarcane was more profitable under organic farming than conventional farming. Premium prices did not exist for organic sugarcane production in U.P. Creation or addition of premium prices would further increase the profitability of organic sugarcane production. Among different cost components, the costs were more or less equal in both farming systems. One of the major benefits under organic sugarcane cultivation was the crop can thrive for more than three years without any yield loss. So, organic farmers can significantly reduce their seeds and sowing costs and reap more benefits. Production of organic jaggary or any other value addition measures would further boost organic sugarcane production in the state.

Economics of wheat cultivation in Uttar Pradesh

The economics of wheat cultivation under organic farming vis-à-vis conventional farming is summarized in table 7. Most of sample organic farmers were cultivating Bansi or 292 varieties of wheat. But, many conventional farmers were growing PBW-343 or WL-711 varieties. The cost of production of wheat per quintal was Rs.620 under organic farming. The same under conventional farming was slightly lower at Rs.609 per quintal. But, the average cost of cultivation per acre was lower in organic farming (8 per cent) when compared to conventional farming. The average yield levels were 1519 and 1682 kg respectively under OF and CF. However, the gross returns per acre was higher (15 per cent) in organic farming than conventional farming. This share has further gone up to 39 per cent in case of net returns per acre. The unit price realization was 28 per cent higher in OF. These results clearly demonstrate that the cultivation of wheat under organic farming is more profitable than conventional farming method. Between different cost components, the costs on weeding and inter culture was higher in organic farming. But, the costs on irrigation were higher under conventional farming. Further expansion in green or organic export market channels will yield higher net incomes per acre to farmers in U.P state.

Table 7 Economics of wheat cultivation in Uttar Pradesh (Rs per acre)

	OF	CF	CF = 100
Land preparation	2298	2571	89
Seed cost	1281	1034	124
Sowing cost	663	674	98
Fertilizer cost	981	1054	93
Inter cultivation/Weeding	656	432	152
Plant protection cost	85	214	40
Irrigation cost	994	1532	65
Harvesting cost	1510	1674	90
Threshing cost	844	879	96
Marketing cost	106	159	67
Other costs	0	0	-
Total cost of cultivation	9418	10223	92
Yield (Kg)	1519	1682	90
Price (Rs)	13.4	10.5	128
Fodder (Qtl)	14	13.8	101
Price (Rs)	222	193	115
Total revenue	23463	20324	115
Net returns	14045	10101	139
Cost of production (per Qtl)	620	609	102

Economics of sugarcane cultivation in Maharashtra

The cost of cultivation of sugarcane per acre in Maharashtra between organic and convention farming is compared in table 8. Most of sample organic farmers are practicing the method of 'Natural Farming' or Zero-budgeting concept. The most popular varieties under organic and conventional farming systems are Co 86032 and CoC 671/ Co 8014 respectively. The cost of production of sugarcane per ton was Rs.589 in case of organic farming where as the same under conventional farming was Rs.745. The COP under OF accounted for 79 per cent of the same in CF. The mean cost of cultivation per acre was lower (20 per cent) under organic farming compared to conventional farming. The average yields were almost equal under both the farming systems. The gross returns per acre was slightly higher (8 per cent) under OF than CF. But, the difference has increased to 35 per cent in case of net returns per acre. The results clearly lend support to organic farming in Maharashtra than conventional farming. Most of the sample organic farmers are also adding value through organic jaggery production and syrup preparation. Among different break-up costs, the costs on sowing and irrigation were slightly higher under organic farming than conventional farming. But, the costs on fertilizer application and plant protection chemicals were significantly higher under conventional farming. Overall, development of organic

output market channels will create lot of value addition to organic jaggery in Maharashtra.

Table 8 Economics of sugarcane cultivation in Maharashtra (Rs per acre)

	OF	CF	CF = 100
Land preparation	3675	4100	90
Seed cost	4825	5300	91
Sowing cost	1313	1120	117
Fertilizer cost	2344	5450	43
Inter cultivation/Weeding	3313	4300	77
Plant protection cost	275	1550	18
Irrigation cost	3588	3040	118
Harvesting cost	2375	2700	88
Threshing cost	0	0	-
Marketing cost	838	760	110
Other costs	0	0	-
Total cost of cultivation	22546	28320	80
Yield (Kg)	38375	38000	101
Price (Rs)	1.6	1.5	107
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	61400	57000	108
Net returns	38854	28680	135
Cost of production (per ton)	589	745	79

Economics of cotton cultivation in Gujarat

The detailed break-up of cost of cultivation of cotton in Gujarat is presented in table 9. Most of sample organic farmers were growing devraj variety while many of the conventional farmers cultivating Bt cotton or V-797 variety of cotton. Agrocel Industrial Limited at Rapar office is providing the technical service, inputs and buyback arrangements for organic farmers. The cost of production of cotton per quintal was Rs.784 in organic farming. The cost of production was almost 10 per cent higher under conventional farming. The mean average yield per acre of organic farm accounted for 90 per cent of the same in conventional farm. The average costs of cultivation per acre were Rs.9906 and Rs.12088 respectively under OF and CF. The COC per acre was almost 22 per cent higher under conventional farming. The unit price realization under organic farming was 25 per cent higher when compared to conventional farming. The gross returns per acre were 13 per cent higher under organic farming than the conventional farming. But, in case of net returns per acre this gap has become wider (Rs.7187). Overall, the results conclude that the cultivation of cotton under organic farming is

more profitable than conventional farming. Among different cost components, the costs on fertilizer and plant protection chemicals were significantly lower under organic farming than conventional farming. The organic farmers in the study region are enjoying the benefits of Agrocel Industries in form of quality inputs and zero marketing costs.

Table 9 Economics of cotton cultivation in Gujarat (Rs per acre)

	OF	CF	CF = 100
Land preparation	939	1600	59
Seed cost	206	281	73
Sowing cost	443	375	118
Fertilizer cost	1586	2675	59
Inter cultivation/Weeding	1946	1800	108
Plant protection cost	110	478	23
Irrigation cost	1161	1291	90
Harvesting cost	3515	3525	100
Threshing cost	0	0	-
Marketing cost	0	63	0
Other costs	0	0	-
Total cost of cultivation	9906	12088	82
Yield (Kg)	1263	1400	90
Price (Rs)	35	28	125
Fodder (Qtl)	0	0	-
Price (Rs)	0	0	-
Total revenue	44205	39200	113
Net returns	34299	27112	127
Cost of production (per Qtl	784	863	91

Overall, the above findings summarizes that relatively organic farming is a production system which has little lower productivity, needs more labour and low energy inputs, and has a changing net income level relating with unit product selling prices.

II

Efficiency of organic farming in India

It is clear from various studies, that every effort to promote organic farming could be invalidated if individual farms do not reach adequate productive and efficiency levels (Lampkin and Padel, 1994; Offermann and Nieberg, 2000). This means that any policy effort in supporting conversion to organic farming needs an adequate level of efficiency of individual farms to achieve success (Tzouvelekas et al., 2002a). This would imply that organic farming must strive to be efficient both productivity and economically. Therefore, development of organic methods raises significant research questions related to productivity and efficiency. Studies on productivity are certainly relevant, but also efficiency analysis provides useful information on the convenience or otherwise of adopting organic techniques (Cembalo and Cicia, 2002). The comparative studies between organic and conventional farms, efficiency analysis is particularly suitable for assessing the farmers' relative ability in optimizing internal resources. Further more, the utilization of an efficiency estimation approach is advisable in studies aimed at providing policy indications (Coelli et al., 2002; Lovell 1995).

But, there are only a few attempts of comparing efficiency between organic and conventional production systems. Several studies were conducted by Tzouvelekas *et al.* (2001a, b; 2002a, b) on Greek agriculture. The authors used a parametric approach to evaluate olive, cotton and durum wheat farms and obtained controversial results. In the analysis on cotton farms, Tzouvelekas *et al.* (2001b) found that technical efficiency (TE), with respect to their specific technology (organic and conventional) was higher in conventional farming's favour. On the other hand, the studies on olive-growing and durum wheat-growing demonstrated the improved ability of organic farmers in minimizing inefficiency (regarding their specific technology). Oude Lansink *et al.* (2002) compared efficiency measures of organic and conventional farms in Finland. They suggested that organic producers have higher technical and sub-vector efficiencies than conventional farms in their own reference groups, but overall efficiency measures suggest that organic farms are using less productive technology. In Italy, Madau (2005) applied a stochastic frontier

production model and found that conventional cereal farms were significantly more efficient than organic cereal farms, with respect to their specific technology, which counter the findings from Tzouvelekas *et al.* (2001a, 2002a). In another study by Larsen and Foster (2005) compared efficiency measures of organic and conventional farms in Sweden by a non-parametric technique. Their results indicate that the average efficiency scores of the organic producers are lower than the average efficiency of the conventional producers.

The objective of this section made an empirical evaluation of the technical efficiency achieved by organic farms in comparison with conventional farms, by utilizing the recently developed DEA model (Lovell, 1993; Coelli, 1996; kumaracharyulu and Subho, 2010). Interpreting technical efficiency scores of two different methods of farming always come with an important caveat, i.e. the higher scores exhibited by one farming system with respect to the other does not indicate that the former are more efficient by some degree than the latter (Tzuovelekas, Pantzios, and Fotopoulos 2001, 2002; Oude Lansink et al., 2002). The sample farms considered in this study are facing different production technologies. As per review of various studies (Mayen *et al.,*2010 and Funtanilla *et al*., 2009), higher technical efficiency score of one sample farm relative to their counterpart means that, on average, the former lay closer to their specific production frontier than the sample counterpart does with their respective production frontier. Each observation consists of the gross value of production per acre as output (Y) and costs on four inputs. They are per acre cost on seeds (X1), fertilizers (X2), pesticides (X3) and inter culture/weeding (X4). Since the costs on land preparation, sowing, irrigation, harvesting, threshing and marketing did not vary significantly among organic and conventional farms, they are not included in efficiency analysis. In-put oriented DEA model is used and the analysis is carried out by using DEAP 2.0 (Coelli, 1996).

Efficiency of Paddy cultivation in Punjab

The comparison of technical and scale efficiencies of conventional and organic farms in Punjab are presented in table 10. Mean technical efficiency both under CRS and VRS models were higher in conventional farming than organic farming, relative to their specific frontiers. However, it does not indicate that conventional

farms are more efficient than organic farms to the same degree, because the two practices are situated on different technology frontiers. It only implies that conventional farms operate close to their specific frontier than organic farms. Organic (conventional) farms under CRS assumption would be able to increase the efficiency by 45 per cent (12.9%) with the present state of technology, using their disposable resources more efficiently. The scale efficiency is also higher in conventional farming. These results are in conformity with the study done by Madau (2005) in Italian cereals.

Table 10 Frequency distribution of technical and scale efficiencies of paddy farms in Punjab

Efficiency %	Conventional farming (n=7)			Organic farming (n=10)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	10	0	10
26-50	14.3	0	0	40	30	10
51-75	0	14.3	14.3	30	10	30
75-100	85.7	85.7	85.7	20	60	50
Max (%)	100	100	100	100	100	100
Min (%)	38.1	66.5	57.4	9.3	31.3	24.7
Mean (%)	87.1	93.8	91.3	55.0	77.9	70.8

Efficiency of wheat cultivation in Punjab

The frequency distribution of technical and scale efficiencies of organic and conventional wheat farms in Punjab are presented in table 11. The average technical (both CRS and VRS) and scale efficiencies were higher under conventional farming than organic farming, relative to their production frontiers. The frequency distribution of technical and scale efficiencies clearly indicates that most of the conventional farms were in the range between 75 and 100. But, significant sample of organic farms were distributed under less than 50 per cent category. The minimum technical and scale efficiency values were very low in organic farming when compared to conventional farming.

Table 11 Frequency distribution of technical and scale efficiencies of wheat farms in Punjab

Efficiency %	Conventional farming (n=12)			Organic farming (n=13)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	38.47	7.69	15.38
26-50	0	0	0	7.69	15.38	7.69
51-75	33.33	16.66	16.66	15.38	0	30.77
75-100	66.67	83.34	83.34	38.46	76.93	46.16
Max (%)	100	100	100	100	100	100
Min (%)	60.5	72.2	63.6	14.8	24.4	14.8
Mean (%)	86.2	93.0	92.5	55.1	84.2	66.1

Efficiency of cotton cultivation in Punjab

The summary of technical and scale efficiencies of cotton farms in Punjab are tabulated in table 12. Contrary to the earlier findings, the mean technical and scale efficiencies were higher in organic farms (relative to their production frontiers) than conventional farms. Most of the sample organic farms were categorized in the range between 75 and 100 where as many sample conventional farms were between 51 and 75. The minimum technical and scale efficiency values were also more in organic farming. The results were inconformity with Oude Lansink *et al.,* (2002).

Table 12 Frequency distribution of technical and scale efficiencies of cotton farms in Punjab

Efficiency %	Conventional farming (n= 4)			Organic farming (n= 4)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	0	0	0
51-75	75	0	75	25	0	25
75-100	25	100	25	75	100	75
Max (%)	100	100	100	100	100	100
Min (%)	58.3	-	58.3	60.3	-	60.3
Mean (%)	69.5	100	69.5	90.1	100	90.1

Efficiency of paddy cultivation in Uttar Pradesh

The mean, maximum and minimum technical and scale efficiencies of paddy farms under organic and conventional farming are summarized in table 13. The

average technical efficiencies (both under CRS and VRS) were 80.8, 89.0 and 73.4, 87.9 per cent respectively for conventional and organic farming systems. The mean scale efficiencies were 90.4 and 81.6 per cent respectively for CF and OF. The results indicate that the three efficiencies calculated in the study are higher for conventional farming than organic farming (relative to their production frontiers). It also suggests that the technical efficiency (CRS model) can be further improved by 19.2% and 26.6% respectively under conventional farming and organic farming systems. The organic farms are not able to compensate for their technical disadvantage (less productivity) with higher efficiency of input use.

Table 13 Frequency distribution of technical and scale efficiencies of paddy farms in U.P

Efficiency %	Conventional farming (n= 7)			Organic farming (n= 11)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	14.3	0	0	27.27	9.09	0
51-75	28.6	28.57	28.57	9.09	18.18	27.27
75-100	57.1	71.43	71.43	63.64	72.73	72.73
Max (%)	100	100	100	100	100	100
Min (%)	46.0	61.0	59.0	31.7	48.2	50.9
Mean (%)	80.8	89.0	90.4	73.4	87.9	81.6

Efficiency of sugarcane cultivation in Uttar Pradesh

The frequency distribution of technical and scale efficiencies of sugarcane farms under conventional and organic farming are presented in table 14. In relative terms, the mean technical and scale efficiencies of organic farms were lower than the conventional farms. There is a huge difference of technical efficiency (TE) between CF and OF. Most of conventional farms were distributed in the range between 75 and 100 per cent. In contrary, many of organic farms fell under less than 50 per cent category. The estimated TE scores suggest that production is not adequately efficient under organic farming. The results clearly indicate that there is a need for improvement of efficiency under organic farms through more technical trainings and field demonstrations.

Table 14 Frequency distribution of technical and scale efficiencies of sugarcane farms in U.P

Efficiency %	Conventional farming (n= 15)			Organic farming (n= 11)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	36.37	27.27	0
26-50	6.6	0	0	27.27	27.27	9.10
51-75	13.4	13.4	6.67	9.09	0	45.45
75-100	80	86.6	93.33	27.27	45.46	45.45
Max (%)	100	100	100	100	100	100
Min (%)	42.2	68.0	62.0	8.7	12.5	43.9
Mean (%)	87.6	93.4	93.0	45.3	60.3	74.3

Efficiency of wheat cultivation in Uttar Pradesh

The efficiency of wheat cultivation both under conventional and organic farming systems in Uttar Pradesh is summarized in table 15. The mean technical and scale efficiency values were higher (relatively) in conventional system when compared to organic system. There is ample scope for further increase in the efficiency of organic wheat farms in U.P. The conventional farms were relatively closer to their production frontiers than the distance between organic farms and their frontiers. Nearly 60 per cent of conventional farms were having the CRS-technical efficiency in the range of 75 to 100 per cent. But, only 30 per cent of organic farms showed this range of technical efficiency.

Table 15 Frequency distribution of technical and scale efficiencies of wheat farms in U.P

Efficiency %	Conventional farming (n= 14)			Organic farming (n= 16)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	18.8	0	0
26-50	7.10	0	0	12.5	6.25	31.25
51-75	28.6	14.3	7.1	37.5	12.5	31.25
75-100	64.3	85.7	92.9	31.2	81.25	37.5
Max (%)	100	100	100	100	100	100
Min (%)	45.5	58.8	54.4	12.6	32.2	27.9
Mean (%)	85.1	90.9	93.3	60.8	89.6	65.2

Efficiency of sugarcane cultivation in Maharashtra

The findings from the efficiency of sugarcane cultivation in Maharashtra are presented in table 16. The empirical findings show that the conventional farms were having higher (97.6 per cent) efficiency than the organic farms (77.6 per cent), relative to their production frontiers. The result would suggest that there exist ample margin for the increasing of managerial and technical skills as to improve performance in organic sugarcane-growing in order to compensate adequately the gap (with respect to conventional farms) in terms of efficiency. The technical efficiency of conventional farms ranged from 89.2 to 100 per cent where as the same in case of organic farms 45.1 to 100 per cent. Moreover, these findings were against to results obtained by Tzouvelekas *et al* (2001a) in Olive-farms in Greek.

Table 16 Frequency distribution of technical and scale efficiencies of sugarcane farms in Maharashtra

Efficiency %	Conventional farming (n= 5)			Organic farming (n= 8)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	12.5	12.5	0
51-75	0	0	0	37.5	37.5	0
75-100	100	100	100	50.0	50.0	100
Max (%)	100	100	100	100	100	100
Min (%)	89.2	-	89.2	45.1	47.5	89.0
Mean (%)	97.6	100.0	97.6	77.6	79.4	96.9

Efficiency of cotton cultivation in Gujarat

The estimated farm-specific, input-oriented technical efficiency measures for both farming methods are presented in table 17. The average input-oriented technical efficiency score is 88.2% for organic farms and 76.9% for conventional farms under CRS model. Hence, conventional farms may be viewed, in general, as more technically efficient than conventional farms. However, it should be stressed that since organic and conventional cotton farming represents different production technologies, organic cotton farms face a different production frontier from the conventional ones. Therefore the differences between the average technical efficiency score of organic farms and that of conventional farms does

not imply that conventional are more efficient than organic farms, by the same degree.

Table 17 Frequency distribution of technical and scale efficiencies of cotton farms in Gujarat

Efficiency %	Conventional farming (n = 4)			Organic farming (n=14)		
	CRS-TE	VRS-TE	SE	CRS-TE	VRS-TE	SE
> 25 %	0	0	0	0	0	0
26-50	0	0	0	7.2	0	7.2
51-75	25	0	25	42.8	0	42.8
75-100	75	100	75	50.0	100	50.0
Max (%)	100	100	100	100	100	100
Min (%)	67.7	-	67.7	50.0	-	50.0
Mean (%)	88.2	100	88.2	76.9	100	76.9

III

Summary and Conclusions

Due to very little accessible information on economics and efficiency of organic farming in India, an attempt is made to assess it in different crops and states. The crop economics results showed a mixed response. In general, organic farming is a production system which has low productivity levels, needs more labor, require low energy inputs and has a changing net income levels along with selling prices. Overall, crop economics results concluded that the unit cost of production is lower in organic farming in case of Cotton (both Gujarat and Punjab) and Sugarcane (both in U.P and Maharashtra) crops where as the same is lower in conventional farming for Paddy and Wheat (both in Punjab and U.P) crops. These mixed results are in conformity with the findings of Lampkin and Padel, 1994. The DEA efficiency analysis conducted on different crops indicated that the efficiency levels are lower in organic farming when compared to conventional farming, relative to their production frontiers. There was only one exception in case of cotton in Punjab where the reverse trend was observed. The results conclude that there is ample scope for increasing the efficiency under organic farms. Exposure to more trainings as well as increase in technical guidance would enhance the productivity and efficiency of organic farms in India.

The role of the Government is critical in motivating the farmers towards organic farming in the country. Some of the major suggestions for expansion of organic farming are: creation of separate ‘green channels’ for marketing of organic foods; announcement of premium prices for organic staple food crops; creation of demand by more awareness programs; input/conversion subsidies for encouraging organic growers; more R & D investments on organic farming and finally cheap and quick certification process etc.

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