IMPACT OF ORGANIC SUGARCANE FARMING ON ECONOMICS AND WATER USE EFFICIENCY IN MAHARASHTRA

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Abstract

This study examines the impact of organic farming on economics and water use efficiency in sugarcane cultivation in Maharashtra. The study is based on primary data collected from both certified organic sugarcane (OS) and inorganic sugarcane (IS) growing sample farmers in the water scarce and groundwater dependent district of Jalgaon in Maharashtra. The study finds that OS cultivation increases human labour employment by 20.2% and its overall cost of cultivation is also lower by 14.67% than IS farming. Although the yield from OS is 6.2% lower than the conventional crop, it is more than compensated by the price premium received and yield stability observed on OS farms. The OS farming gives 15.72% higher profits and profits are also more stable on OS farms than the IS farms thereby enhancing the economic well-being of OS farmers. Crucially, OS farming substantially enhances the water use efficiency (WUE) measured by different indicators. Thus, OS farming offers ample opportunities for enhancing farmers' income and improving water use efficiency in the cultivation of a highly water-consumptive and important sugarcane crop in the state. Finally, the paper discusses the emerging issues and outlines the task ahead for advancing OS farming in Maharashtra.

1. INTRODUCTION

India occupied second position in world in both sugarcane area and production. It shared 21.45% of the total area and 23% of the total sugarcane production in the world during triennium ending (TE) 2002-03 (GoI, 2005)[a]. Sugarcane contributes about 7.5% to agriculture GDP from only 3% of the cultivated area and provides sustenance to about 45 million farmers, their dependents and a large mass of agricultural labours for their livelihood (GoI, 2004). Maharashtra, the study state, is the second largest sugarcane growing state in the country. It contributed 0.58 mha (13.53%) to total area and 45.78 million ton (15.06%) to total production of sugarcane in the country in TE 2002-03 (GoI, 2005)[a]. The potential of Maharashtra has been shown by the steady growth in area and production of sugarcane over the years. However, the unceasing decline in productivity in recent decades is a cause of great concern.[1]

Sugarcane is the second most important cash crop covering less than 3% of the total cropped area of the state but it utilizes more than 60% of the total water available for irrigation in the state. This has already exerted a considerable strain on the limited water resources of the state[2]. The demand of water for sugarcane irrigation has led to an increase in number of tube wells and had resulted into the decrease of water table by more than 4m over the past decade in several areas in the districts of Jalgaon, Ahmednagar and Aurangabad (World Bank, 2003). This has significantly enhanced the number of open wells going dry over the years. The excess use of water combined with higher doses of chemical fertilizers is observed to be resulting in enhanced rate of degradation of water and land resources in certain parts of the state. This is reflected in the secular decline of sugarcane productivity in recent decades in Maharashtra (Samui et al., 2005).

Organic farming is a holistic agricultural production management system that sustains and ameliorates the health of agro-ecosystem encompassing biodiversity, nutrient bio-cycles and soil microbial and bio-chemical activities. It avoids the use of chemo-synthetic fertilizers and pesticides and emphasizes socially and environmentally beneficial practices such as crop rotations, intercropping, green manuring, use of organic

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manures, vermi-compost, bio-fertilizers and bio-pesticides in preference to the use of off-farm inputs considering that regional conditions require locally adapted systems. Thus, organic farming prohibits the use of harmful synthetic chemicals and promotes the use of renewable organic resources for sustainable agriculture.

The organic farming is the fastest growing sector in both land use and market size in the world. It is being cultivated in more than 120 countries covering about 31 mha of area in the world (Willer and Yussefi, 2007). The global market for organic food products was valued at US $ 25 billion in 2003, US $ 50 billion in 2006 and is estimated to reach to more than US $ 100 billion in 2010. Europe is the largest market for organic foods followed by North America. These two markets together share more than 95% of the global market for organic food products. Although the Indian market for organic food products is relatively miniscule, it has great potential to grow in near future and to reap the benefits of the rapidly growing lucrative market for organic products.

Organic farming is as old as agriculture in India. But presently it is being cultivated on relatively very small area. For example, the certified area under organic farming was only 76,326 ha during 2003, which is about 0.05% of the total cultivated area in the country (Willer and Yussefi, 2007). This is negligible when compared with the top 10 countries in organic farming in the world.[3] However, organic farming had received better attention in recent years in India and concerted efforts are being made by the state and central governments, NGOs, farmers and other organizations to promote it in the country. For example, the states of Uttaranchal and Sikkim have been declared as organic states by their respective governments. These initiatives may help in boosting the area under organic farming in near future in the country.

Maharashtra is an important organic farming state. It is at the forefront in developing, adopting and spreading organic farming technologies in the semi-arid regions of the country. Different parts of Maharashtra have developed their own local organic farming systems for various crops. Recognising the importance and potential of organic farming, Government of Maharashtra (GoM) has implemented the centrally sponsored scheme for promotion of organic farming in the state since 2003-04. The provision of Rs. 73 million and Rs. 154.50 million were made during the year of 2004-05 and 2005-06 for promotion of organic farming in the state (GoM, 2007). These efforts have helped in increasing the awareness about the organic farming, reducing the use of chemicals, and enhancing the area under organic farming and boosting the organic production in the state. It has been reported by the GoM (2007) that the area registered for organic certification in the state was 51,000 ha in 2006-07. The GoM intends to convert about 650,000 ha of area to organic farming in the state in near future. Organic sugarcane is an important crop grown in the study district. The practice of organic farming is very popular in Jalgaon district and the registered area to be converted to organic farming in the study district increased from 42,696 ha in 2004-05 to 49,000 ha in 2006-07 (GoM, 2007). Thus, the area under organic farming is rapidly expanding in study state as well as in study district.

The findings of several previous studies have shown that excessive use of chemicals in agriculture results in adverse effects on human health, animals, biodiversity and contributes to degradation of water, soil and environmental resources (Ghosh, 2003; Pachauri and Sridharan, 1998; Parrott and Marsden, 2002; Singh et al., 1987). On the other hand, organic farming had beneficial effects on human health, animals, biodiversity, water, soil and environmental resources (Blaise, 2006; Gareau, 2004; Rahudkar and Phate, 1992; Rajendran et al., 2000; Schwank et al., 2001; Singh and Swarup, 2000; Thakur and Sharma, 2005). It is recognized that the results of these studies are valuable to understand the harmful effects of intensive chemical farming and the benefits of various practices followed under the organic farming. However, a keen perusal of these studies indicates that there is dearth of systemic studies probing into the impact of organic farming on economics and water use efficiency (WUE) of sugarcane cultivation in Maharashtra.[4] Therefore, the present study is designed to assess the impact of organic sugarcane (OS) farming on input use, costs, yields, risks, returns and WUE in relation to conventional inorganic sugarcane (IS) farming in the state. The paper also explores the emerging issues and suggests policy measures for advancing organic farming for sustaining the sugarcane cultivation in Maharashtra.

The paper is organized in 7 sections. The next section provides brief information on study area, sampling design, data and its sources. Section 3 delineates the salient characteristics of sampled farmers. The impact of

OS farming on input use, costs, yields, risks and returns is analysed in Section 4. Section 5 examines the impact of OS farming on WUE. Section 6 discusses the emerging issues and outlines the task ahead. Concluding comments are made in the final section.

2. DESIGN OF THE STUDY

The importance of organic farming is steadily growing in Maharashtra. Organic sugarcane is an important crop grown in the state. Jalgaon, the only district in the state that has the largest number of "certified" OS growing farmers was selected for this study. Moreover, the district is also facing the serious problems of water scarcity and sustainability due to sugarcane cultivation. We selected only those certified OS farmers who have obtained certification from nationally accredited and internationally designated and recognized certification agency for their organic sugarcane. These certified OS growing farmers were few in selected villages. Therefore, purposive sampling technique was used for the selection of certified OS sample farmers. The organic and inorganic sugarcane growing sample farmers were selected from the same villages to minimize the edaphic and other agro-economic differences between the two groups of sample farmers. The sample included 72 farmers, 38 certified OS growing farmers and 34 IS growing farmers.

The study is based on primary data collected from OS and IS farmers through personal interviews with the help of a specially designed questionnaire. The questionnaire covered information on household resource base, cropping pattern, input use pattern, cost of sugarcane cultivation, yield, etc. Moreover, farmers perceptions on different parameters of OS and IS cultivation were also elicited. The data pertains to the sugarcane crop, both organic and inorganic, planted and harvested during the 2004-05 agricultural year.

3. IMPORTANT FEATURES OF SAMPLE FARMERS

There are wide differences in the resource endowments across the sample groups. The average family size of OS households was found to be smaller (4.18) than IS households (4.94) in the selected district (Table 1). The heads of OS households are younger and better educated than their counterparts from IS households. Generally, the large land holding is associated with higher and early adoption of agricultural technologies in India. Therefore, it was expected that the size of land holding of OS sample farmers would be larger than IS sample farmers. This notion was found to be valid as the average size of land holding of OS farmers was found to be 6.93 ha compared to 6.43 ha for IS farmers.

Most of the sample farmers used well irrigation for their sugarcane crop. The well irrigation has some advantages over the surface irrigation sources. The well irrigation is relatively less affected by vagaries of monsoon and farmer has better control over water supply. However, the use of wells for sugarcane irrigation in Jalgaon district is now often being associated with certain negative externalities due to over exploitation of groundwater resources. The excessive mining of groundwater for irrigation had jeopardized the sustainability of limited water resources in this district. The issue of equity is also not less important as resource rich farmers are found to be exploiting this resource rampantly.

The livestock position given in Table 1 reveals that OS farmers not only owned more number of livestock but the value of livestock owned by them was also higher than IS farmers. The better livestock position of OS farmers may be attributed to their higher demand for manures and other livestock products for cultivation of organic crops. Sugarcane and cotton, the most important cash crops of the state also prevailed over the cropping pattern on sample farms. From the point of view of present study, it is important to note that the OS crop occupied largest coverage at 17.19% of gross cropped area (GCA) on sample farms in the study district. The percentage area under high value fruit and vegetable crops and low water intensive chickpea crop was substantially higher on OS farms than the IS farms.

Table 1: Important Features of Organic and Inorganic Sample Farmers

Sr. No.	Characteristics	Organic Sugarcane Growing Farmers	Inorganic Sugarcane Growing Farmers
1.	Family Size (No.)	4.18	4.94
2.	Age of Family Head (Years)	42.35	43.50
3.	Education of Family Head (Edu. Years)	10.55	9.88
4.	Average Size of Land Holding (ha)	6.93	6.43
5.	Average Net Irrigated Area (ha)	5.60	5.48
6.	Per cent of Well Irrigated Area	90.74	88.08
7.	Livestock (No./Household)	12.41	10.05
8.	Value of Livestock Owned (Rs. ‘000’ / Household)	70.67	56.21
9.	Major Crops Grown (Percentage of GCA)		
	• Organic Sugarcane	17.19	0.00
	• Inorganic Sugarcane	0.00	15.72
	• Cotton	16.90	28.27
	• Wheat	13.95	16.43
	• Fruit crops	11.59	6.49
	• Sorghum	9.75	11.91
	• Chickpea	7.82	2.37
	• Vegetable crops	3.13	2.15

4. IMPACT OF ORGANIC FARMING ON ECONOMICS OF SUGARCANE CULTIVATION

Even if OS farming is found to be superior in the context of the water use efficiency, it is necessary to examine its performance in terms of its economics which ultimately influences the adoption. Therefore, this section examines the impact of organic farming on the economics of sugarcane cultivation with specific focus on input use pattern, cost of cultivation, yields, gross returns and profits. The results of this analysis are presented in Tables 2 - 4 and are discussed in the following sub-sections.

4.1 Impact on Input Use

The sugarcane sector is one of the important employment generating sector employing over 7.5% of total rural population in India (GoI, 2004). The data presented in Table 2 also indicates that sugarcane cultivation, especially the OS cultivation, needs large number of human labour days. For example, on an average, the per hectare human labour use was found to be 247.80 days on OS farms and 206.15 days on IS farms, showing 20.20% higher use on OS crop than the IS crop. This is mainly attributed to increased labour requirement for carrying out operations such as preparatory tillage, manuring, green manuring and managing the weeds, pests and diseases on OS farms. Furthermore, the intercropping typically found on OS farms, with crops having various planting and harvesting schedules, may distribute the labour demand more evenly which could help stabilize employment. This implies that OS farming may provide an opportunity to rural masses of sustained gainful farm employment throughout the year.

The quantity and quality of seed influences the crop stand and productivity. The use of sugarcane seed was found to be 2.97 and 3.35 ton/ha for OS and IS crop respectively in study district. On an average, 11.34% less seed was used by OS farmers mainly due to use of 2-bud setts, and use of strip method of planting. Besides reducing the seed requirement, the strip planting facilitates intercropping with sugarcane. The use of organic manures is quite high on OS farms. The OS farmers used about 5 ton/ha more manure than the manure used by IS farmers. This is obvious considering the dependence of OS farmers on organic manures for augmenting and sustaining the soil resources. In addition, about 180 kg/ha of bio-fertilizer was also used by OS farmers.

Table 2: Input Use Pattern on Organic and Inorganic Sugarcane Sample Farms

Sr. No.	Input	Organic Sugarcane (OS)	Inorganic Sugarcane (IS)	% increase over Inorganic
1.	Human Labour (days)	247.80	206.15	20.20
2.	Bullock Labour (pair days)	9.72	8.51	14.22
3.	Tractor (hours)	6.42	5.96	7.72
4.	Seed (ton)	2.97	3.35	-11.34
5.	Organic Manures (ton)	11.40	6.36	79.25
6.	Bio-fertilizers (kg)	178.70	-	-
7.	Chemical Fertilizers (kg)			
	• Nitrogen (N)	-	341.37	-
	• Phosphate (P)	-	110.25	-
	• Potash (K)	-	77.42	-
8.	Insecticide/ Pesticide (kg)	2.03	2.50	-18.80
9.	Number of Irrigations	21.45	26.51	-19.09

Source: Field Survey

As the sugarcane crop produces huge quantity of biomass, its nutrient requirements are also very high. It could be found from Table 2 that IS farmers used 341.37 kg N, 110.25 kg P, and 77.42 kg K per ha for their sugarcane crop. This is quite high when compared with the levels of 110.10 kg N, 44.70 kg P and 30.10 kg K per hectare for irrigated sugarcane crop in the country (GOI, 2000). The IS farmers also augmented their soil resources by complementing chemical fertilizers with organic manures. In terms of the average use of bio-pesticides for OS crop and chemical pesticides for IS crop, IS farmers used 18.80% more quantity compared to OS farmers. This is mainly because, along with bio-pesticides, OS farmers also used other practices such as crop rotation and intercropping for management of pests and diseases. The average number of irrigations given to OS crop were 19.09% less than the IS crop. We will return to this issue in the next section.

Another notable aspect reported by most of the OS farmers which is important from the point of view of present study is that they did not purchased inputs from the market, rather they used self-produced inputs such as seeds, manures, green-manuring, vermi-compost, bio-fertilizers, Amrutpani, Jivamrut, bio-pesticides, etc. This reduced their dependence on external costly inputs and consequently enhanced their self-reliance in crop production. The OS farmers also expressed their satisfaction on being saved from the risk of getting sub-standard inputs. The water use for sugarcane irrigation is discussed in next section.

4.2 Impact on Cost of Cultivation

This sub-section explores the relative impact of organic farming on operation-wise cost of cultivation of sugarcane in the study districts.[5] This analysis shows that average cost of cultivation of OS crop was Rs. 36,573.74/ ha as against Rs. 42,861.84/ ha for IS crop, reflecting 14.67% lower cost on OS farms than the IS farms (Table 3). The lower cost of cultivation observed on OS farms is not surprising. This is because, first, the highest cost reduction observed on OS farms is on account of non-use of chemical fertilizers. The OS farmers spent Rs. 9,822.65/ha on manures and manuring, mostly produced by themselves, which is 59.65% higher than IS farmers. In addition, Rs. 1,651.15/ha were spent on bio-fertilizers, etc., by the OS farmers. These 2 together cost Rs. 11,473.80/ha which is quite less than the cost of Rs. 15,842.32/ha incurred by IS farmers on chemical fertilizers and manures. Thus, OS farmers saved 27.58% expenditure on account of soil nutrient supplements alone.

Table 3: Cost of Cultivation of Organic and Inorganic Sugarcane (Rs./ha)

Sr. No.	Operations	Organic (OS) Sugarcane (OS)	Inorganic Sugarcane (IS)	Per cent over Inorganic
1.	Land Preparation	5834.73 (15.95) [a]	4995.48 (11.65)	16.80
2.	Seed and Planting	5524.27 (15.10)	6834.95 (15.95)	-19.18
3.	Manure and Manuring	9822.65 (26.86)	6152.77 (14.35)	59.65
4.	Bio-fertilizers	1651.15 (4.51)	-	-
5.	Chemical Fertilizers	-	9689.55 (22.61)	-
6.	Weeding and Interculture	5168.24 (14.13)	4951.19 (11.55)	4.38
7.	Irrigation	5899.56 (16.13)	7378.67 (17.22)	-20.05
8.	Plant Protection	862.35 (2.36)	1193.42 (2.78)	-27.74
9.	Others	1810.79 (4.95)	1665.81 (3.89)	8.70
	Total Cost (GCC) [b]	36573.74 (100.00)	42861.84 (100.00)	-14.67

Note: a : Figures in parentheses are percentage of total cost.
b : This does not include the cost of harvesting, transport and marketing.

Secondly, the irrigation cost was found to be 20.05% less on OS farms. Thirdly, OS farmers spent about Rs. 1,310/ha less on seed and planting as compared to IS farmers. Fourthly, the average per ha cost on plant protection was lower on OS farms as most of this material was prepared by OS farmers themselves and they also used other methods. Besides this, the OS cultivation was also found to be more cost efficient than IS cultivation as the per ton cost of production of OS cane was 9.03% lower on OS farms (Table 4).

The increased cost of cultivation due to increased input prices has also increased the requirement of credit for agriculture. However, several studies have concluded that the inability to payback the credit is one of the important reasons for creating distress among farmers (Mishra, 2006; TISS, 2005). The foregoing results indicate that OS farming reduces the cost of cultivation of a crop implying reduced requirement of credit for crop production.

4.3 Impact on Yield

The capacity of organic farming in achieving the yield levels obtained under the conventional inorganic farming is under doubt (Bhattacharyya and Chakraborty, 2005; Das and Biswas, 2002). Some studies have also noted that the change from conventional intensive farming to organic farming reduces the yield, at least during the initial years (IFAD, 2005; Rajendran et al., 2000). This study also found that the average yield of OS crop was 95.16 ton/ha as against 101.45 ton/ha of IS crop showing that OS farmers realised 6.2% lower yield than IS farmers (Table 4). However, the OS farmers were confident and it has also been reported by some scholars that in subsequent years, the OS farming is able to reduce this yield gap (Rajendran et al., 2000) and some times have also given higher yields than conventional methods (Thakur and Sharma, 2005).

Table 4: Yield, Value of Production and Profits from Organic and Inorganic Sugarcane

Sr. No.	Particulars	Organic Sugarcane	Inorganic Sugarcane	% over Inorganic
1.	Sugarcane Yield (ton/ha)	95.16	101.45	-6.20
2.	CV of Sugarcane Yield (%)	29.84	44.38	-14.54
3.	Cost of Production (Rs./ton)	384.34	422.49	-9.03
4.	Gross Value of Production (Rs./ha)	114,017.85	109,784.25	3.86
5.	Gross Profit (Rs./ha)	774,44.11	66,922.41	15.72
6.	CV of Gross Profit (%)	41.63	49.81	-8.18
7.	GVP/GCC	3.12	2.56	21.71

A stable yield is an important feature of sustainability. The yield stability measured by coefficient of variation (CV) indicates that the CV of yields was substantially lower at 29.84% in OS crop as against the 44.38% in IS crop suggesting that yields were more stable under OS farming than the IS farming (Table 4). It is also to be noted here that lower yields on OS farms were more than compensated by the price premium fetched by organic sugarcane and the sugarcane yield stability observed on OS farms.

4.4 Impact on gross value of production and profits

The increase in price of inputs in conventional agriculture had inflated the cost of cultivation and had reduced the profitability (Sen and Bhatia, 2004). Therefore, the issue of profitability is intimately related to economic well-being and livelihood security of the farmers. In this context, the examination of Table 4 shows that the gross value of production (GVP) and profits were higher on OS farms than the IS farms. For example, the GVP from OS farm amounted to Rs. 114,017.85/ha as against Rs. 109,784.25/ha from IS farm. This has resulted in higher profits by 15.72% from OS crop than the IS crop thereby enhancing farmers' income. This is mainly due to lower cost of cultivation on OS farms and relatively higher price fetched by organic sugarcane. Moreover, the CV of gross profits was also lower on OS farms than IS farms denoting greater stability of profits on OS farms. Thus, OS farming not only enhances the farmers' income but also provides greater stability to farm income.

Higher output-input (GVP/GCC) ratio is another feature of OS farming. The ratio was found to be 3.12 on OS farm as compared to 2.56 on IS farm. This indicates that after investing a rupee in the cultivation of OS crop, GVP was 21.71% higher than IS crop. In fact, the higher GVP/GCC ratio on OS farms is the reflection of higher input use efficiency observed on OS farms. In summary, these features of OS farming are critical for ensuring not only the economic well-being and livelihood security of the farmers but also for the sustainable cultivation of sugarcane crop in the state.

5. IMPACT OF OS FARMING ON WATER USE EFFICIENCY (WUE)

In Maharashtra, the coverage of irrigation for sugarcane crop is 100% (GoI, 2005)[a]. Therefore, water is essential not only for cultivation of sugarcane crop but also for increasing its productivity. However, water is the most limiting resource for sugarcane production in Maharashtra. About 80% of the water is utilized for agriculture in Maharashtra (World Bank, 2003) and more than 60% of it is utilized for sugarcane crop alone. Sugarcane crop produces huge quantity of biomass and it also consumes large quantity of water. The water requirement of sugarcane crop varies from 200 cm to 300 cm depending upon the type of soil and agro climatic conditions. It may be recalled that the main source of irrigation water for sugarcane crop was observed to be wells in the study district. Farmers are virtually mining water from deep aquifers for sugarcane crop. This is a cause of great concern and demands its conservation and judicious use as it has endangered the stability and sustainability of agriculture. However, the concern shown by individual farmers is rather circumscribed. This is mainly because the individual farmers are only interested in their own gains and costs and paying no attention at all to the social costs of over exploitation of groundwater resource (Vaidyanathan, 1996).

To study the comparative use of water under OS and IS farming, one may need actual measured data on use of water on both OS and IS farms. However, we concede that we do not have such a irrigation water measured data for sample farms. In absence of actual measured data, other indicators such as irrigation cost, number of irrigations given, productivity per irrigation, and returns per irrigation can be used to assess the WUE in the cultivation of OS and IS crop. The survey data is used to work out the various WUE indicators. The results of this analysis are presented in Table 5.

The results from preceding section revealed that irrigation cost is the second highest cost in the cultivation of sugarcane crop. However, it was considerably lower on OS farms as compared to IS farms. The average per hectare expenditure incurred on irrigation was found to be Rs. 5899.56 on OS farms as compared to Rs. 7378.67 on IS farms. In other words, OS farmers spent Rs. 1479.11/ha less on account of irrigation as compared to IS farmers. Another aspect to be noted from Table 5 is the lower irrigation cost per unit of cane production on OS farm. The average irrigation cost per ton of cane production on OS farm was Rs. 62 while it was Rs. 72.73 on IS farm, meaning 14.75% less irrigation cost per tonne of cane production on OS farm. In other words, it indicates higher sugarcane productivity per unit of irrigation expenditure on OS farms in

Table 5: Water Use Efficiency in Organic and Inorganic Sugarcane Farming

Sr. No.	Indicator of Water Use Efficiency	Organic Sugarcane	Inorganic Sugarcane	% over Inorganic
1.	Irrigation cost (Rs./ha)	5899.56	7378.67	-20.05
2.	Irrigation cost (Rs./ton)	62.00	72.73	-14.75
3.	Number of irrigations applied	21.45	26.51	-19.09
4.	Productivity per irrigation (ton/ha)	4.44	3.83	15.93
5.	GVP per irrigation (Rs./ha)	5315.52	4141.24	28.36
6.	Profits per irrigation (Rs./ha)	3610.45	2524.42	43.02

comparison with IS farms. It follows from this analysis that the irrigation costs incurred on per unit of area as well as per unit of cane production were lower on OS farms implying less use of water, saving of groundwater by OS farmers for cultivation of sugarcane crop.

Another result that comes out very clearly from Table 4 is the number of irrigations given to OS crop were quite less than the IS crop. The OS crop was given 21.45 irrigations while the IS crop was given 26.51 irrigations by the selected sample farmers. This indicates that OS needs 19.09% less number of irrigations than the IS crop. The water use efficiency expressed as the productivity of sugarcane per irrigation was found to be higher at 4.44 ton/ha on OS farm as compared to 3.83 ton/ha on IS farm suggesting 15.93% higher WUE on OS farm. Furthermore, the GVP per irrigation was 28.36% higher on OS farm. Yet another measure, the profits per irrigation was also substantially higher at 43.02% on OS farm than the IS farm.

The foregoing results revealed that various water use indicators performed better under OS farming as compared to IS farming. This suggests that OS farming is very effective and superior in saving water as compared to conventional IS farming. This may be mainly attributed to the fact that incorporation of organic matter to soil improves its structure and enhances its micro-porosity leading to improved infiltration of rain water and increased soil moisture retention capacity (Kumar and Tripathi, 1990; Sarkar et al, 2003). Rahudkar and Phate (1992) also observed that irrigation requirement of OS crop reduced by 45% than the conventional production method. Thus, OS farming has substantial potential in enhancing the sugarcane productivity and profit per unit of water use and saving the scarce groundwater thereby providing an opportunity for its conservation and sustainable use. No doubt, this is crucial for a relatively water scarce state like Maharashtra.

6. EMERGING ISSUES AND FUTURE POLICIES

The preceding results from this study indicate that organic farming is quite successful in the study area. Some of the key factors that are important for the success of OS farming, and not discussed so far, are related to conversion to organic farming, certified organic inputs, low yields and certification. These and few other issues are discussed in this section.

6.1 Conversion to organic farming

The sample farmers reported that the period involved in conversion from conventional farming to organic farming is the most difficult one. This is mainly because (a) lack of knowledge about the principles of organic farming, (b) shift to organic farming brings in several significant changes in agricultural practices, (c) at least it takes three years to complete the conversion successfully, (d) decrease in sugarcane yield with the beginning of the conversion period, (e) no premium prices, (f) due to (d) and (e) there is reduction in farmers income during the conversion period, and (g) non-cooperation from neighbouring farmers who practice conventional agriculture. These factors form the major hurdle in the adoption and spread of organic farming. Therefore, it is recommended that the beginners should receive not only the training but also the support in organic production methods, certification and marketing during this period. If feasible, the beginners should shift to organic in stages rather than trying to convert all their landholding at once. It is also suggested that the beginners themselves should prepare for the transition period in terms of time required, crops to be taken, inputs management, financial provision, etc., to pass the period of transition rather smoothly. Moreover, all the farmers having contiguous fields should be encouraged to shift to organic methods to avoid problems related to leaching and or contamination of chemical fertilizers and pesticides.

6.2 Certified Organic Inputs

The use of organic inputs such as organic manures, bio-fertilizers, vermi-compost, bio-pesticides, etc., was found to be higher on OS farms compared to IS farms as organic farmers substituted chemical fertilizers and pesticides with these organic inputs. The demand for these inputs is likely to increase with the expansion of area under organic farming. Therefore, it is most essential to ensure the smooth flow of these inputs so that they do not form the hurdle in the progress of organic farming in the state. In this context, the involvement of self-help groups (SHGs) of landless households for production of certified inputs would be most useful. Therefore, it is recommended that specific schemes may be developed for involvement of SHGs in production of certified inputs required for OS farming. The transfer of technology for production of certified organic inputs along with training, financial assistance, facilities for distribution and marketing should form the major components of such schemes for the SHGs. This may help in smooth supply of quality organic inputs at a reasonable price to organic farmers. At the same time it may also help in providing gainful employment opportunities to the landless rural people in their own area.

6.3 Low Yields

The sugarcane yield on OS farms was observed to be 6.20% lower than the IS farms. It is thus necessary to resolve the yield limiting issues in OS farming on priority basis. A fairly well developed infrastructure for agricultural research, training, and education exists in Maharashtra. The use of this infrastructure can be made effectively to resurrect the productivity by developing and spreading package of practices for water and soil nutrient management, as well as biotic and abiotic stress management in OS farming. Involvement of farmers by the researchers, where possible, should prove beneficial for developing and transferring the new technologies within the shortest possible time.

6.4 Certification

The certification of organic products is essential to distinguish it from those produced by conventional methods and to get an appropriate price in the market. The OS sample farmers operated certified farms. Even the study district has the largest number of certified OS farmers in the state. The credit for this goes to farmers associations. The association facilitated the certification of organic produce through an internationally recognised certification agency under the group certification programme. Thus, the association made organic certification easy, less costly and beneficial for its member farmers. This emphasizes the need of such associations which play an important role in not only helping the farmers in organic certification but also during the difficult period of conversion and post harvest operations. Such associations can also play an important role in stimulating the rapid adoption and spread of organic farming. Therefore, public and private agencies and NGOs may encourage farmers to form their own associations.

6.5 Other issues

Water is one of the most important resources essential in the cultivation of sugarcane crop in Maharashtra. Therefore, further research is necessary to critically assess the actual water requirements of organic vis-à-vis inorganic sugarcane crop in the state. In this context, the researchers may accurately measure the quantities of water applied to OS and IS crop with different water saving technologies and soil types. It is also necessary to study the impact of OS farming on the quality of groundwater resources in the state of Maharashtra. This kind of studies may help in making the specific recommendations for the use of irrigation water in the cultivation of OS crop in Maharashtra.

Some OS sample farmers complained of being deceived by traders by selling them spurious organic inputs. This resulted in heavy losses to victimized farmers. Therefore, efforts may be made to enhance the awareness among the organic farmers and strict vigilance by the quality control and regulatory authorities to prevent such malpractices involving pseudo-organic inputs.

The foregoing results of this study clearly indicated that the benefit of OS farming is not in enhancing the yield but in other crucial benefits. Therefore, it is essential for extension agencies to project these crucial benefits such as superiority of OS farming in saving water, low cost farming, higher farm employment, higher profit, farmers' increased self-reliance and reduced risk in right perspective for its rapid adoption in the state. The growing of crops by following organic practices in conformity with certain standards is a process beginning from land preparation to finally reaching the produce in the hands of consumers. Therefore, it is essential to impart scientific training not only to farmers but also to other stakeholders to make them knowledgeable, skilled and efficient in production, processing and marketing of organic products

The organic farming does have social benefits in terms of saving water, conservation of soil resources and benefits to human health and environment. Therefore, it is suggested that the social benefits as well as the social costs of OS farming may be properly measured and quantified to get an idea about the extent of incentives that could be justified for promotion of OS farming in the state.

In summary, it is essential to resolve these emerging issues in order to realize its full potential for ensuring sustainability of sugarcane cultivation and for enhancing the economic well-being and livelihood security of the farmers in the State.

7. CONCLUSIONS

The study finds that farmers practicing OS farming are relatively younger and more educated having larger landholding and better resources. The OS farming was found to be superior than IS farming on account of increased human labour employment, lower cost of cultivation, higher profits, better input use efficiency and reduced risk leading to increased income, enhanced self-reliance and livelihood security of the farmers. Moreover, OS farming had positive impact on water use efficiency demonstrating substantial potential for conservation and sustenance of water resources in a water scarce state like Maharashtra. Thus, OS farming has greater potential in achieving the goal of sustainable cultivation of sugarcane crop and ensuring economic well-being of the farmers. Besides addressing the emerging issues from this study, it is crucial to formulate policies and strategies to promote OS farming in order to realize its full potential in selected regions of Maharashtra.

Notes

1 The sugarcane productivity in Maharashtra attained a high level of 95.15 ton/ha in TE 1982-83 from just 70.95 ton/ha a decade earlier (TE 1972-73). After that the productivity declined to 80.98 ton/ha in TE 1992-93 and further dwindled to 78.33 ton/ha in TE 2002-03.

2 The area under irrigation was only 18.10% of gross cropped area of the state as compared to 40.20% at the national level in 2002-03. Thus, Maharashtra is on one of the water deficient states of the country. Despite this, the coverage of irrigation for sugarcane crop is 100% in the state. Sugarcane being a relatively long durational water intensive crop producing huge quantity of biomass, it requires enormous quantity of water for its cultivation.

3 The top ten organic countries in the world are Australia, Argentina, China, USA, Italy, Brazil, Spain, Germany, Uruguay, and UK. The area under organic farming in these countries varies between 620,000 ha in U K to 11,800,000 ha in Australia. These ten countries cover more than 77% of total area under organic farming in the world (Willer and Yussefi 2007).

4 In fact, we have not came across a single comprehensive study that is based on farm level data looking at the impact of organic farming on input use, costs, yields, returns and WUE in the cultivation of sugarcane crop in Maharashtra.

5 The cost of cultivation is referred to cost A_2 plus family labour which includes all actual expenses in cash and kind incurred in production by owner plus rent paid for leased-in land plus imputed value of family labour as defined by the Commission for Agricultural Costs and Prices (CACP), Government of India (2005)[b]. The gross profit is calculated as gross value of production minus the cost of cultivation.

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