Economic Viability of Organic Farming: An Empirical Experience of Vegetable Cultivation in Karnataka

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Abstract

The present study was conducted in Belgaum District of Karnataka, India. To know the viability of organic vegetable cultivation, a sample of 30 farmers each practicing organic cultivation of tomato and chilli and 30 farmers each practicing non-organic cultivation of tomato and chilli were selected randomly for the study. The data so collected were analysed using budgeting technique and output decomposition technique. The study revealed that, even though per acre cost of cultivation and yield of both crops on organic farms was less than non-organic farms but the B: C ratio was found higher in organic farms. The outcome of decomposition analysis revealed that in case of both the crops, organic farming technology was the major contributing factor for increase in income of the organic growers over the non-organic growers. Hence it is advisable for the farmers to switch over to organic farming which is environmental friendly and cost effective.

Key Words: Budgeting technique, Organic farming, Non-organic farming and Decomposition technique

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1. Introduction

India is a leading vegetable producing country in the world with an area of 9.21 million hectare with the annual production of 162.19 million tonnes (NHB, 2012-13). Karnataka state is one of the leading vegetable producing state in the country with a production of 75.49 lakh tonnes, vegetables grown over an area of 4.20 lakh ha of which, tomato occupies a major area of 55.39 thousand hectare with a production of 1839.40 thousand tones and chilli occupies about 37.90 thousand hectares (Karnataka State Department of Horticulture, 2011). Belgaum is the major vegetable producing district in the Northern Karnataka, with an area of 5903.00 ha and production of 185080.00 tonnes respectively. The total area and production of tomato and chilli in Belgaum district is 4806.70 hectares and 1,61,170.00 tonnes and 6538.00 hectares and 94394.00 tonnes respectively (Source: DDH Office, Belgaum 2010-11).

Organic farming is practiced in India since thousands of years. The great Indian civilization thrived on organic farming and was one of the most prosperous countries in the world, till the British ruled it. In traditional India, the entire agriculture was practiced using organic techniques, where the fertilizers, pesticides *etc.* were obtained from plant and animal products. Organic farming was the backbone of the Indian economy and cow was worshipped (and till today done so) as a God. The cow, not only providing milk but also bullocks for farming and dung which is used as manure.

According to the International Fund for Agriculture Development (IFAD), organic production in India has been growing steadily. About 2.5 million hectares of land is under organic farming in India. Further there has been a remarkable growth in organic farming and 332 new organic certifications were issued during 2004.The Research Institute of Organic Agriculture reports a total of 15,000 organic farms were operating in the country in 2004. The Agricultural and Processed Food Products Exports Development Authority (APEDA) estimated that around 2,00,000 hectares of certified organic land, mainly cultivated by small holder producers. Recently, an increasing number of companies, NGO’s, farmers’ organizations and Government agencies have been promoting organic agriculture in India. The growth in organic production has been developing mainly by the increasing international demand, but the domestic market is also strengthening due to a large population and increasing wealth (IFAD, 2005-06).

Organic farming is getting popular day by day. The pollution in general and poisoning of food, that we eat with harmful chemicals and their effect on human health and environment is making people to look for organic food. NGO's along with successful organic farmers had a big role to play in bringing organic farming to this level today. There are several states in India, which have declared organic policy with intent to make the entire state organic in the near future.

Many farmers, researchers and policy makers believe that turning to organic farming would mean lower yields and lower profits. Therefore, argument for a premium price for organic produce and consumers on the other hand would, not want to pay higher price for organic produce. Hence, the challenge is to develop systems, which will facilitate acceptance of organic cultivation by the farmers and the consumers. Talking of non-organic, a lot of chemical pesticide is used on the vegetables resulting in the pesticides residue, which definitely affect human health. The study of Green Foundation revealed that, by following a mixed system always get an average price for the vegetables, which ensures regular average profit as opposed to a big loss and occasional big profit in case of monocropped vegetables grown with chemicals. As the price of the organic vegetables were set at the same market price of chemically grown vegetables, consumers from all walks of life; poor, middle and higher class have access to these vegetables. This organic farming system therefore, has potential for attracting more consumers.

As time went by, extensive dependence on chemical farming has shown its darker side. The land is losing its fertility and is demanding larger quantities of fertilizers to be used, pests are becoming immense requiring, the farmers to use stronger and costlier pesticides, due to increased cost of farming, farmers are falling into the trap of money lenders, who are exploiting them, no end and forcing many to commit suicide.

Both, consumers and farmers are now slowly and gradually shifting back to organic farming in India. It is believed by many that organic farming is healthier. Though the health benefits of organic food are yet to be proved, consumers are willing to pay higher premium for the same. Many farmers in India are shifting to organic farming due to the domestic and international demand for organic food. Further stringent standards for non-organic food in

European and US markets have led to rejection of many Indian food consignments in the past. Organic farming therefore provides a better alternate to chemical farming. At present there is no adequate and proper documentation of organic practices being adopted by vegetable growers and also empherical studies have been hardly conducted on various aspects of organic vegetable production practices in Karnataka. Hence, the present paper aims to compare the costs involved, yields, market, prices and the returns in both organic and non-organic cultivation of vegetables and the causes of yield/income difference between vegetables grown under organic and non-organic farming.

2. Methodology

2.1. Selection of Study Area and Sample Farmers

The study was conducted in Belgaum district of Karnataka as the organic cultivation of vegetable is practiced largely in the district. Two major vegetables largely grown namely tomato and chilli was selected for the study. Organic farming is an emerging trend and practiced throughout the district in the cultivation of vegetables. In order to study costs involved, yields and returns in organic cultivation of vegetables 30 farmers each practicing organic cultivation of tomato and chilli and 30 farmers each practicing non-organic cultivation of tomato and chilli spread over the district of Belgaum were selected randomly for the study.

2.2. Method of Data Collection

For evaluating the specific objectives designed for the study, required primary data were collected from the sample farmers. Majority of the respondents did not maintain records of the cost and returns from the cultivation of both the crops. Hence, data collected was based on the memory of the respondents. At the time of interview, personal bias of the sample farmers was minimized by convincing them about the genuinety of the purpose for which the data were collected. The data collected from the selected respondents were to fulfill the objectives of the study. Data were based on the entire operations practicing in the cultivation of both the crops by organically and also by non-organically. The data on the type and levels of use of manures, fertilizers and plant protection measures and the cost, yields, market prices and returns involved under both the types of farming were collected by personal interview method with the help of well structured and pre-tested schedule.

2.3. Statistical Tools

2.3.1. Budgeting Technique

The budgeting technique was followed to study the costs and returns in the cultivation of both tomato and chilli. The averages and percentages were also worked out.

2.3.2. Output Decomposition Model

2.3.2.1. Structural Break in Production Relation

Before going to the decomposition analysis of the productivity difference between the organic vegetable and non-organic vegetable one must ensure whether there is structural break or not in the production relations between organic and non-organic farming. To identify the structural break, if any, in the production relations with the adoption of organic farming, output elasticities were estimated by ordinary least square method by fitting log linear regression separately for organic and non-organic farmers. The pooled regression was run in combination with organic and non-organic farmers including dummy variable for organic farmers. The dummy variable was quantified as one for organic and zero for non-organic farmers.

The following log linear estimable forms of equations were used for examining the structural break in production relation.

$$\ln y_1 = \ln A_1 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i \quad \ldots\ldots\ldots(1)$$

$$\ln y_2 = \ln A_2 + b'_1 \ln X_1 + b'_2 \ln X_2 + b'_3 \ln X_3 + b'_4 \ln X_4 + b'_5 \ln X_5 + b'_6 \ln X_6 + U_i \quad \ldots\ldots\ldots(2)$$

$$\ln y_3 = \ln A_3 + b''_1 \ln X_1 + b''_2 \ln X_2 + b''_3 \ln X_3 + b''_4 \ln X_4 + b''_5 \ln X_5 + b''_6 \ln X_6 + e_3 d + U_i \quad \ldots\ldots\ldots(3)$$

Where,

Y = Gross return in rupees/acre

a = Intercept

x_1 = Seed cost/acre

x_2 = FYM cost/acre

x_3 = Organic manure cost/acre or Chemical fertilizers cost/acre

x_4 = Human labour cost/acre

x_5 = Bullock labour and machine labour cost/acre

x_6 = Organic plant protection measures cost/acre or Non-organic plant protection measures cost/acre

e_i = Error term

b_i = Elasticities coefficient of respective inputs and summation of these gives returns to scale

Equations 1, 2 and 3 represent non-organic farmers, organic farmers and pooled regression function with organic farming as dummy variables, respectively.

$b_1, b_2, b_3, b_4, b_5, b_6, b_1', b'_2, b'_3, b'_4, b'_5, b'_6, b''_1, b''_2, b''_3, b''_4, b''_5, b''_6,$

represent individual output/income elasticity of respective input variable in equation (1), (2) and (3), 'd' in equation (3) represent dummy variable. If the regression coefficient of dummy variables is significant, then there is structural break in production relations with the adoption of organic farming.

2.3.2.2. Output Decomposition Model

For any production function, the total change in output/income is affected by the change in the factors of production and in the parameters that define the function. This total change in per acre output/income is decomposed to reflect on adoption of organic and the change in input levels. The output decomposition model developed by Bisaliah (1977) is used in the study, which is depicted below.

The output decomposition equation used in this study can be written as

$$\ln Y\ OF - \ln Y\ NOF = [\text{intercept OF} - \text{intercept NOF}] +$$

$$[(b_1' - b_1) \times \ln X_1\ NOF + \ldots\ldots\ldots\ldots\ldots + (b_6' - b_6) \times \ln X_7\ NOF] +$$

$$[\{(b_1' (\ln X_1\ OF - \ln X_1\ NOF + \ldots\ldots\ldots\ldots + (b_6' (\ln X_6\ OF - \ln X_6\ NOF)\}] \ldots. (4)$$

OF= Organic Farming and NOF= Non-Organic Farming

The decomposition equation (4) is approximately a measure of percentage change in output/income with the adoption of organic farming in the production process. The first bracketed expression of the right hand side is the measure of percentage change in output/income due to shift in scale parameter (A) of the production function. The second bracketed expression is the difference between output elasticities each weighted by natural logarithms of the volume of that input used under non adopter category, a measure of change in output/income due to shift in slope parameters (output elasticities) of the production function. The third bracketed expression is the sum of the natural logarithms of the ratio of each input of adopters (OF) to non-adopters, each weighted by the output elasticity of that input. This expression is a measure of change in output due to change in the per acre quantities of seeds, organic manures, human labour, bullock and machine labour, chemical fertilizers, organic plant protection measures, plant protection chemicals.

3. Results and Discussion

3.1. Cost Involved in the Cultivation of Tomato and Chilli on Organic and Non-organic Farms

Per acre cost of cultivation of tomato and chilli crops on organic and non-organic farms are presented in the Table 1 and 2.

Perusal of the Table 1 indicated that the total cost of tomato cultivation on organic farms was less than that of non-organic farms. The average cost of cultivation per acre of tomato on organic farm was Rs 17157.97 as against Rs 17702.53 on non-organic farms. The proportion of variable cost was Rs 13267.53 and Rs 14182.01 with a share of 79.42 per cent and 80.11 per cent of the total cost of cultivation of tomatoes on organic and non-organic farms respectively. In the case of organic farms, the variable costs mainly comprised of cost of human labour, cost of organic manure (FYM, green manuring, vermicompost, biofertlizers and biopesticides) and cost of bullock labour which were Rs 4789.26, Rs 3720.11 and Rs 2751.49 accounted for 27.91 per cent, 21.68 per cent and 16.04 per cent of the total cost of cultivation respectively. The share of other variable cost items such as cost of seeds, cost of machine labour and interest on the working capital was 3.16 per cent (Rs 541.95), 5.44 per cent (Rs 933.20) and 5.20 per cent (Rs 891.52) of the total cost of cultivation of tomatoes on organic farms respectively.

Similarly in the case of non-organic farms also, cost of human labour, cost of bullock labour, cost of FYM, cost of chemical fertilizers and cost of plant protection chemicals were accounted for about 30.38 per cent, 10.94 per cent, 10.89 per cent, 9.08 per cent and 4.78 per cent of the total cost of cultivation respectively. The other minor variable cost items includes were cost of seeds, cost of machine labour and interest on working capital accounted for 3.54 per cent (Rs 626.33), 5.26 per cent (Rs 931.46) and 5.24 per cent (Rs 927.79) of the total cost of cultivation of tomatoes on non-organic farms respectively.

It could be seen from the Table 2 that, in the case of chilli per acre total cost of cultivation on organic farms (Rs 18336.62) was less than that of non-organic farms (Rs 19114.91). In the total cost, variable costs accounted for a major share of about 80.82 per cent and 81.48 per cent of the total cost of cultivation of chilli on organic and non-organic farms respectively.

Similarly as in the case of tomato cultivation, the major variable costs in the case of organic chilli farms includes were cost of human labour, cost of organic manure (FYM, green manuring, vermicompost, biofertlizers and biopesticides) and cost of bullock labour with an share of 27.89 per cent, 25.15 per cent and 15.54 per cent of the total cost of cultivation respectively. The other variable cost items include were cost of seeds, cost of machine labour and interest on the working capital.

In the case of non-organic chilli farms also, the major variable cost comprised of cost of human labour, cost of FYM, cost of bullock labour, cost of chemical fertilizers and cost of plant protection chemicals which were Rs 5689.86, Rs 2260.87, Rs 2081.16, Rs 1887.00 and Rs 1110.27 respectively. The other variable cost items such as cost of seeds, cost of machine labour and interest on working capital accounted for 2.57 per cent, 5.41 per cent and 5.33 per cent of the total cost of cultivation of chilli on non-organic farms respectively.

It could be seen from both Table 1 and 2 that, the expenditure on organic manure and chemical fertilizers found to be an important item in total cost of cultivation on organic farms and on non-organic farms respectively in case of both crops. The cost of chemical fertilizers and cost of plant protection chemicals on non-organic farms were the differing factors in the cost. The cost incurred on organic compounds was low in organic farms as compared to cost incurred on chemical fertilizers in non-organic farms because most of the organic compounds were available at village level and organic compounds were cheaper as compared to chemical fertilizers. The cost on total human labour was lower on organic farms compared to non-organic farms this was mainly because of more number of times of spraying of plant protection chemicals in non-organic tomato and chilli cultivation and also non-organic cultivation involves more number of times of pickings than organic cultivation of both the crops. The reverse trend was observed in the usage of bullock and machine labour due to practicing of more number of times of intercultivation and harrowing operations in organic farming.

There was more seed cost involved in non-organic farms than organic farms, this was mainly due to the reason that majority of the farmers used the local varieties in the organic farms, whereas in case of non-organic farms the farmers used the hybrids. The cost incurred on plant protection measures was low in organic farms compared to non-organic farms because the organic farmers used biopesticides, most of which were home preparations and some purchased microbial extracts. The cost incurred on land revenue and land rent was similar in both organic and non-organic farms. The depreciation charge was relatively high on non-organic farms and low on organic farms because non-organic farmer's asset position was high. Similar results were observed by Jitendra Singh *et al.* (2006), Sujatha *et al.* (2006) and Waykar *et al.* (2006).

3.2. Yield, Market Price and Returns in Cultivation of Tomato and Chilli on Both Organic and Non-organic Farms

The average yield level, market price, marketing cost and net returns of tomato and chilli on both organic and non-organic farms are presented in the Table 3.

The per acre average yield of tomatoes on organic farm (5.81 tonnes) was comparatively lower than that of non-organic farm (6.95 tonnes).The average per tonne market price of organic tomatoes (Rs 9550.00) was found to be higher than that of non-organic tomatoes (Rs 6850.00). The average transportation cost of organic tomatoes was Rs 440.96 as against Rs 396.63 per tonne of non-organic tomatoes. The commission charges paid during marketing of organically produced tomatoes was Rs 623.17 per tonne, as against Rs 500.56 per tonne for non-organically produced tomatoes. The organically produced tomatoes could fetch premium price in the market. The total marketing cost was Rs 6182.64 and Rs 6235.57 for organic and non-organic tomatoes respectively. The return structure in tomato clearly revealed that the gross returns per acre was higher (Rs 55989.07) on organic farms compared to that of non-organic farms (Rs 47012.62) with a positive net return on both the categories of the farms. The net return on organic farm was Rs 32649.12 and was Rs 23074.52 on non-organic farms. Though the yield levels on organic farms were lower compared to non-organic farms, the net returns were higher because of the premium price received and lower cost of cultivation. The B:C ratio was also higher on organic farms (2.40) compared to non-organic farms (1.96).

Similarly it could also seen from the same table that, the per acre average yield of chilli on organic farm (4.10 tonnes) was comparatively lower than that of non-organic farm (4.86 tonnes).The average per tonne market price of organic chilli (Rs 9830.00) was found to be higher than that of non-organic chilli (Rs 6300.00). The total marketing cost was Rs 3726.30 for organic chilli and Rs 3484.66 for non-organic chilli. The return structure in chilli clearly revealed that the gross returns per acre was higher (Rs 40289.86) on organic farms compared to that of non-organic farms (Rs 30583.33) with a positive net return on both the categories of the farms.

The net return on organic farm was Rs 18226.94 and was Rs 7983.77 on non-organic farms. The B:C ratio was also higher on organic farms (1.83) compared to non-organic farms (1.35).

The average per tonne market price of both organic tomatoes and chilli was found to be higher than that of non-organic tomatoes and chilli since the organically produced tomatoes and chilli could fetch premium price in the market. The transportation cost and commission charges during the marketing of organic tomatoes are more than that of non-organic tomatoes whereas in the case of chilli, organic growers incurred higher commission charges than the non-organic growers. Since the organic farmers send their produce to the distant markets like Pune, Solhapur and Bangalore as they unable to get the premium price in the local market. Though yields were less but because of the premium price it fetched the net return on organic farms was more than non-organic farms. The B:C ratio was also higher on organic farms compared to non-organic farms. The findings are in conformity with the study conducted by Bharadwaj *et al.* (2000) and Jadhav *et al*. (2006).

3.3. Structural Break in the Production Relation of Organic and Non-organic Vegetables

To identify the structural break in the production relation of organic and non-organic vegetables (tomato and chilli) with the introduction of organic farming practice as new technology, direct estimates of Cobb-Douglas type of production function presented in the Table 4 and 5 are used.

3.3.1. Organic and Non-organic Tomato

Perusal of the Table 4 revealed identification of structural break in the tomato production. It could be seen from the table that, in case of new technology (organic farming) farms, the R^2 value (0.942) was statistically significant. The regression co-efficient for seed (0.285) was significant at one per cent level of significance, while the regression co-efficients for organic manures (0.046) and human labour (0.082) were significant at five per cent level of significance where as the regression co-efficients for FYM (0.003), bullock and machine labour (0.011) and organic plant protection measures (0.020) were found to be non-significant.

In case of old technology also (non-organic farming) farms, the R^2 value 0.962 was statistically significant. The regression co-efficients for seed (0.213) and bullock and machine labour (0.183) were found to be significant at one per cent, while for FYM (0.022) and chemical fertilizers (0.035) were significant at ten per cent and five per cent respectively. But for human labour (0.017) and plant protection chemicals (0.009) the regression co-efficients were found to be non-significant.

This revealed that the independent variables included in the model have explained 94.20 and 96.20 per cent of variation in the dependent variable of organic and non-organic farmers, respectively. The elasticities of seed, organic manure and human labour were positive and significant suggesting that, an increase in the use of these factors over and above their present level resulted in substantial increase in gross returns of organic farmers. For identifying the structural break in production with the introduction of organic farming (new technology) in tomato production, the Cob-Douglas type of production function was used. Production function with technology dummy variable was fitted for identifying structural break in production relations between the organic and non-organic farmers. Production function with one for organic farmers and zero for non-organic farmers was estimated.

In case of pooled tomato production function with organic farming as dummy variable was used for identifying structural break if any in production relation with the introduction of organic farming practices as a new technology. The R^2 value 0.955 was statistically significant. The regression co-efficients for seed, organic manures/ chemical fertilizers and for dummy variable were significant at one per cent level of significance, while the regression co-efficients for human labour and bullock and machine labour were significant at five per cent level of significance where as the regression co-efficients for FYM and organic plant protection measures/ PPC were found to be non-significant. The significance of dummy variable (0.226) implied that the parameter governing the input-output relations in case of organic farmers was different from those of non-organic farmers. Thus, the results provided the necessary proof for decomposing the total change in per acre income with the adoption of organic farming.

3.3.2. Organic and Non-Organic Chilli

Similarly to identify the structural break in chilli production same procedures were followed and the results are presented in Table 5.

In case of new technology (organic farming) farms also the R^2 value 0.927 was statistically significant. The regression co-efficient for seed (0.175) was significant at one per cent; while the regression co-efficients for organic manures (0.132) and bullock and machine labour (0.458) were significant at five per cent and ten per cent respectively. Whereas the regression co-efficients for FYM (0.022), human labour (0.043) and organic plant protection measures (0.049) were found to be non-significant.

In case of old technology (non-organic farming) farms, the R^2 value 0.965 was statistically significant. The regression co-efficients for seed (0.202) and human labour (0.240) were significant at one per cent where as in the case of FYM (0.010), chemical fertilizers (0.019), bullock and machine labour (0.0004) and plant protection chemicals (0.019) the regression co-efficients were found to be non-significant. The results revealed that the independent variables included in the model have explained 92.7 and 96.5 per cent of variation in the dependent variable of organic and non-organic farmers, respectively. The elasticities of seed, organic manure and bullock and machine labour were positive and significant suggesting that, an increase in the use of these factors over and above their present level resulted in substantial increase in gross returns of organic farmers.

In case of pooled chilli production function, the R^2 value (0.964) was statistically significant. The regression co-efficients for seed, organic manures/ chemical fertilizers, human labour and for dummy variable were significant at one per cent level of significance, while for organic plant protection measures/ PPC was significant at five per cent level of significance. On the contrary the regression co-efficients for FYM and bullock and machine labour were found to be non significant. As in the case of tomato production here also the regression co-efficient for dummy variable (0.341) was found significant at one per cent level of significance and implied that the parameter governing the input-output relations in case of organic farmers was different from those of non-organic farmers. This result is in conformity with those of Bisaliah (1977) for Punjab wheat economy, Kunnal (2004) for cotton economy in Karnataka.

3.3.3. Estimated Difference in Income Between Organic and Non-organic Farms

The total change in income received from tomato and chilli production due to adoption of organic farming technology was decomposed using decomposition equation (4) developed by Dr. S. Bisaliah provided. The results of output decomposition analysis are presented in Table 6.

A perusal of table revealed that the adopters of organic farming technology produced 14.88 per cent higher income from tomato production than non-organic farming adopters. The increase in the income was further decomposed into different sources of change such as adoption of organic farming technology and all other inputs. The organic farming technology alone could contribute 23.82 per cent increase in income, while the contribution of change in input levels was found to be negative (-8.94 %). Amongst the various inputs, seed (-4.08 %), plant protection measures (-2.07 %), human labour (-1.76 %), organic manures/chemical fertilizers (-0.94 %), FYM (-0.092 %) and bullock and machine labour (-0.01 %) contributed negatively to the income.

In the case of chilli, the adopters of organic farming technology produced 27.07 per cent higher income than non-organic farming adopters. The organic farming technology alone could contribute 33.91 per cent increase in income, while the contribution of change in input levels was found to be negative (-6.84 %). Amongst the various inputs, organic manure/chemical fertilizers (0.83 %) and FYM (0.17 %) were found to contribute positively while rest of the inputs such as seed (-4.29 %), plant protection measures (-1.63 %), bullock and machine labour (-1.52 %) and human labour (-0.39 %) contributed negatively to the income. This implied that the adoption of organic farming has to be encouraged by extension activities to harvest its full benefits. The result highlights the judicious utilization of resources to increase the income from organic cultivation.

4. Conclusion

The results of the study revealed that the yields on organic farms were found to be lower than non-organic farms. Though organic farming gives relatively lower yields in the initial years, its continuous practice will help to build up the soil fertility, thereby to get increased yield in the later years. Hence it is advisable for the farmers to switch over to organic farming which minimizes the environmental degradation. The difference in cost of cultivation between organic farming and non-organic farming is marginal as per the study. The organic inputs are mostly produced on the farms by the farmers themselves. Proper practicing of it will lead to higher net returns to the farmers because of the premium price the organic produce fetch. Hence farmers should be convinced by the extension workers about its economics to achieve its larger scale adoption. Results of the decomposition analysis revealed that, there is a need of encouragement by the extension personnel for the farmers to adopt organic cultivation of vegetables so that they can harvest its full benefits by judicious utilization of seed, organic manure and bullock and machine labour in the cultivation of organic vegetables. Hence it is advisable for the farmers to switch over to organic farming which is environmental friendly and cost effective.

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Table 1: Cost involved in tomato cultivation on organic and non-organic farms

(Rs/acre)

Sl. No.	Particulars	Organic farms		Non-organic farms		Difference	
A	**Variable costs**	**Cost**	**Per cent to total cost**	**Cost**	**Per cent to total cost**	**Cost**	**Per cent**
1	Seeds	541.95	3.16	626.33	3.54	-84.38	15.50
2	Farm yard manure	1829.03	10.66	1928.47	10.89	-99.44	18.26
3	Green manuring seeds	396.62	2.31	-	-	396.62	-72.83
4	Vermicompost	898.61	5.24	-	-	898.61	-165.02
5	Biofertilizers	302.19	1.76	-	-	302.19	-55.49
6	Biopesticides	293.66	1.71	-	-	293.66	-53.93
7	Chemical fertilizers	-	-	1607.12	9.08	-1607.12	295.12
8	Plant protection chemicals	-	-	845.69	4.78	-845.69	155.30
9	Human labour	4789.26	27.91	5377.98	30.38	-588.72	108.11
10	Bullock labour	2751.49	16.04	1937.17	10.94	814.32	-149.54
11	Machine labour	933.20	5.44	931.46	5.26	1.74	-0.32
12	Interest on working capital	891.52	5.20	927.79	5.24	-36.27	6.66
	Sub total (A)	**13267.53**	**79.42**	**14182.01**	**80.11**	**-914.48**	**167.93**
B	**Fixed costs**						**0.00**
1	Land revenue	25.00	0.15	25.00	0.14	0	0.00
2	Rental value of the land	2500.00	14.57	2500.00	14.12	0	0.00
3	Depreciation	452.62	2.64	472.28	2.67	-19.66	3.61
4	Interest on fixed capital	552.82	3.22	523.24	2.96	29.58	-5.43
	Sub total (B)	**3530.44**	**20.58**	**3520.52**	**19.89**	**9.92**	**-1.82**
	Total cost of cultivation (A+B)	**17157.97**	**100.00**	**17702.53**	**100.00**	**-544.56**	**100.00**

Table 2: Cost involved in chilli cultivation on organic and non-organic farms

(Rs/acre)

Sl. No.	Particulars	Organic farms		Non-organic farms		Difference	
A	**Variable costs**	**Cost**	**Per cent to total cost**	**Cost**	**Per cent to total cost**	**Cost**	**Per cent**
1	Seeds	372.34	2.03	491.45	2.57	-119.11	15.30
2	Farm yard manure	1821.95	9.94	2260.87	11.83	-438.92	56.40
3	Green manuring seeds	444.10	2.42	-	-	444.1	-57.06
4	Vermicompost	1436.85	7.84	-	-	1436.85	-184.62
5	Biofertilizers	162.32	0.89	-	-	162.32	-20.86
6	Biopesticide	744.93	4.06	-	-	744.93	-95.71
7	Chemical fertilizers	-	-	1887.00	9.87	-1887	242.45
8	Plant protection chemicals	-	-	1110.27	5.81	-1110.27	142.66
9	Human labour	5113.87	27.89	5689.86	29.77	-575.99	74.01
10	Bullock labour	2848.86	15.54	2081.16	10.89	767.7	-98.64
11	Machine labour	904.55	4.93	1034.78	5.41	-130.23	16.73
12	Interest on working capital	969.48	5.29	1018.88	5.33	-49.4	6.35
	Sub total (A)	**14819.26**	**80.82**	**15574.27**	**81.48**	**-755.01**	**97.01**
B	**Fixed costs**						**0.00**
1	Land revenue	25.00	0.14	25.00	0.13	0	0.00
2	Rental value of the land	2500.00	13.63	2500.00	13.08	0	0.00
3	Depreciation	465.84	2.54	469.28	2.46	-3.44	0.44
4	Interest on fixed capital	526.52	2.87	546.36	2.86	-19.84	2.55
	Sub total (B)	**3517.36**	**19.18**	**3540.64**	**18.52**	**-23.28**	**2.99**
	Total cost of cultivation (A+B)	**18336.62**	**100.00**	**19114.91**	**100.00**	**-778.29**	**100.00**

Table 3: Yield, market price and returns in tomato and chilli cultivation on organic and non-organic farms

Sl. No.	Particulars	Organic tomato	Non-organic tomato	Organic chilli	Non-organic chilli
1	Yield (tonne per acre)	5.81	6.95	4.10	4.86
2	Market price (Rs per tonne)	9550.00	6850.00	9830.00	6300.00
3	Transportation cost including loading and unloading charges (Rs per tonne)	440.96	396.63	265.19	284.89
4	Commission charges (Rs per tonnne)	623.17	500.56	643.65	432.11
5	Total marketing cost (Rs per acre)	6182.64	6235.57	3726.30	3484.66
6	Gross returns (Rs per acre)	55989.07	47012.62	40289.86	30583.33
7	Cost of cultivation (Rs per acre)	17157.97	17702.53	18336.62	19114.91
8	Net returns (Rs per acre)	32649.12	23074.52	18226.94	7983.77
9	B:C ratio	2.40	1.96	1.83	1.35

Table 4: Production function estimates in tomato production on organic and non-organic farms

Sl. No.	Particulars	Parameter	Organic	Non-organic	Pooled
1	No. of observations	N	30	30	60
2	Intercept	a	7.867 (0.657)	7.277 (0.348)	7.226 (0.336)
3	Seed (Rs)	X_1	0.285*** (0.071)	0.213*** (0.032)	0.231*** (0.033)
4	FYM (Rs)	X_2	0.003 (0.005)	0.022* (0.011)	0.004 (0.004)
5	Organic manure/Chemical fertilizers (Rs)	X_3	0.046** (0.020)	0.035** (0.016)	0.048*** (0.012)
6	Human labour (Rs)	X_4	0.082** (0.032)	0.017 (0.016)	0.030** (0.015)
7	Bullock and machine labour (Rs)	X_5	0.011 (0.122)	0.183*** (0.062)	0.153** (0.061)
8	Organic plant protection measures/PPC (Rs)	X_6	0.020 (0.031)	0.009 (0.019)	0.024 (0.016)
9	Dummy for organic farming	-	-	-	0.226*** (0.021)
10	Coefficient of multiple determination	R^2	0.942	0.962	0.955
11	Adjusted R	$\bar{R}^2$	0.927	0.952	0.948
12	F Value	F	62.322	96.094	156.189

Note: *** Significant at 1% level
** Significant at 5% level
* Significant at 10% level
Figures in parentheses indicate standard errors of coefficients

Table 5: Production function estimates in chilli production on organic and non-organic farms

Sl. No.	Particulars	Parameter	Organic	Non-organic	Pooled
1	No. of observations	N	30	30	60
2	Intercept	A	3.983 (1.737)	6.618 (0.684)	6.688 (0.547)
3	Seed (Rs)	X_1	0.175*** (0.050)	0.202*** (0.035)	0.204*** (0.029)
4	FYM (Rs)	X_2	0.022 (0.044)	0.010 (0.007)	0.010 (0.007)
5	Organic manure/ Chemical fertilizers (Rs)	X_3	0.132** (0.057)	0.019 (0.054)	0.114*** (0.037)
6	Human labour (Rs)	X_4	0.043 (0.054)	0.240*** (0.057)	0.135*** (0.034)
7	Bullock and machine labour (Rs)	X_5	0.458* (0.243)	0.0004 (0.096)	-0.009 (0.087)
8	Organic plant protection measures/ PPC (Rs)	X_6	0.049 (0.036)	0.019 (0.032)	0.047** (0.023)
9	Dummy for organic farming		-	-	0.341*** (0.015)
10	Coefficient of Multiple determination	R^2	0.927	0.965	0.964
11	Adjusted R	$\overline{R}^2$	0.908	0.956	0.959
12	F Value	F	48.541	104.875	198.327

Note: *** Significant at 1% level
** Significant at 5% level
* Significant at 10% level
Figures in parentheses indicate standard errors of coefficients

Table 6: Estimated difference in income between organic and non-organic farms in cultivation of tomato and chilli

(In per cent)

Sl. No.	Particulars	Tomato	Chilli
I	**Total difference in the gross income**	**14.88**	**27.07**
II	**Sources of income growth**		
1	**Technology component**	**23.82**	**33.91**
a	Neutral component	59.06	-263.44
b	Non-neutral component	-35.24	297.35
2	**Input use difference**	**-8.94**	**-6.84**
a	Seeds (Rs per acre)	-4.08	-4.29
b	FYM (Rs per acre)	-0.092	0.17
c	Organic manure/chemical fertilizers (Rs per acre)	-0.94	0.83
d	Human labour (Rs per acre)	-1.76	-0.39
e	Bullock and machine labour (Rs per acre)	-0.01	-1.52
f	Organic plant protection measures/PPC (Rs per acre)	-2.07	-1.63