Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 95 (2016) 41308-41322

ISSN: 2229-712X

Comparative Economic Analysis of Organic and Inorganic Wheat Production in District Matiari Sindh

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ARTICLE INFO

Article history:
Received: 5 May 2015;
Received in revised form:
22 June 2016;
Accepted: 29 June 2016;

Keywords
Wheat, organic,
Inorganic,
Environmental costs,
Gross margin,
Matiari, Sindh.

ABSTRACT

The production of wheat crop for the year 2013-14 is estimated to be 24.2 million tons against last year's production of 23.4 million tons. The major reasons for this enhanced production were increase in support price from Rs.1050 to Rs.1200 per 40 Kg which encouraged improved seed usage and fertilizers. There was also better weather and comparatively more water available from the reservoirs. The target for wheat production for 2013-14 has been fixed at 25.0 million tons. The fertilizer has raised the expenses of the inorganic farmers, which are not, used in organic farming. Cash cost in case of organic and inorganic farming is Rs. 23053.00 and 25846.00 respectively. The non-cash cost of organic and inorganic are Rs.19389.65 and 18815.10 respectively. Total cost is the combination of cash and non-cash costs that is Rs.42442.65 and 44661.00 in organic and inorganic farming. Gross margin (GM) is obtained by subtracting the cash cost from the gross value of product. GM is Rs.33142.65 and 36182.00 in organic and inorganic farming system. Net income is obtained by subtracting the total cost from the gross value of product. It is Rs.13752.35 and Rs.17367.00 in organic and inorganic farming, respectively showing a difference of Rs.2615.35. The analysis shows that low net income in organic farming than the inorganic farming is due to the low yield and high labor cost in organic system. Secondly health and environmental costs are not included in the analysis, because in the study site farmers are unaware of these costs.

Introduction

Agriculture is an important sector of the economy of Pakistan which contributes about 21% of Gross Domestic Product (GDP) and generates productive employment opportunities for 45% of the country's labour force. Besides meeting the food and fiber requirements of the local population, it supports other sectors of economy such as manufacturing and services. During recent years the profitability of agriculture sector has been high as farmers are receiving good returns for their commodities which improved the agrarian based rural economy. Because of occupying significant position in overall economy of the country, an efficient, productive and profitable agriculture sector can play a vital role in ensuring food security, generating overall economic growth, reducing poverty and the country's transformation towards industrialization. Being staple diet, wheat is the most important crop for farmers as well as for the government. The production of wheat crop for the year 2012-13 is estimated to be 24.2 million tons against last year's production of 23.4 million tons. The major reasons for this enhanced production were increase in support price from Rs.1050 to Rs.1200 per 40 Kg which encouraged improved seed usage and fertilizers. There was also better weather and comparatively more water available from the reservoirs. The target for wheat production for 2013-14 has been fixed at 25.0 million tons (GOP, 2014).

This rapid growth of human population requires an expansion in food production, which cannot be come through expanding area under production due to decline in per capita land availability. As food is the basic necessity of life so to feed the additional people and to improve the calorie intake of the present population, a much faster agricultural development is needed. High yielding potential was realized by higher use of fertilizers, pesticides, weedicides, water, etc. The Government was aware of the phenomenon; it encouraged the use of chemical fertilizers initially by providing it free of charge to farmers, then later on at subsidized rates for some years. The Departments of Agricultural Extension and Agricultural Development and Supplies Corporations launched campaigns to motivate farmers to use chemical fertilizers and pesticides by distributing the new seeds, chemical fertilizers and pesticides in the earlier years. Later on private sector also entered into this business. The use of agricultural machinery and tube-wells to supplement canal water was adopted to fulfill the increasing water requirement. The main objective of conventional i.e. inorganic system is to get the highest productivity from a unit of farm land by a-high degree of crop specialization and intensive use of land, labor and capital. Within a period of 4-5 years technology tended to contribute less and less. Yields began to stagnant and simultaneously led to degradation of natural resources, which decreased the ability of future generations to produce and flourish (Yasin, 2007).

The term "Organic agriculture" refers to a process that uses methods respectful of the environment from production stages through handling and processing. Organic production is not merely concerned with a product, but also with the whole system used to produce and deliver the product to the ultimate consumer. Two main sources of general principles and requirements apply to the organic agriculture at the

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international level. One is the Codex Alimentations Guidelines for the production, processing, labeling and marketing of organically produced foods. The other is the International Federation of Organic Agriculture Movements (IFOAM), a private sector international body with some 750 member organizations in over 100 countries. IFOAM defines and regularly reviews, in consultation with its members, the Basic Standard that shape the "organic" term. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. So, organic agriculture is more than a system of production that includes or excludes certain inputs (IFOAM, 2009).

Organic agriculture includes crop and livestock systems as well as fish farming systems. Organic livestock production emphasizes a proactive health management programmer that addresses environmental factors to reduce stress and prevent diseases. Organic livestock standards require that animals have access to adequate space, fresh air, outdoors, daylight, shade and shelter for inclement weather, suitable to the species and climatic conditions. Standards require a balanced nutritional programmer using primarily organic feeds. Generally in Argentina, Australia and North America, 100 percent organic feed is required. Under IFOAM, Asian and current European standards, only percent of the feed or less must be organic. Organic agriculture is developing rapidly and is now practiced in more than 120 countries of the world. According to the latest survey on organic farming worldwide, almost 31 million hectares are currently managed organically by at least 633891 farms. In total, Oceania holds 39 percent of the world's organic land, followed by Europe (23 percent) and Latin America (19 percent). The leading countries practicing organic farming are Australia (11.8 million hectares), Argentina (3.1 million hectares), China (2.3 million hectares) and US (1.6 million hectares). In Asia total organic area is around 2.9 million hectares, managed by 130,000 farms (Yussefi *et al.* 2007).

Organic farming methods are regenerative .because they restore nutrients and carbon contents of the soil, thereby improving its quality and capacity and thus resulting in higher nutrient density in crops and increased yields. When properly managed with respect to local conditions, a natural, organic system will increase global yields, improve adaptability to climate change by improving drought and flood resistance, empower the poorest farmers through a sustainable system that does not depend on unaffordable chemical and petroleum-based inputs. By contrast, chemically based degenerative farming systems leave the natural systems in worse shape than they were originally by depleting soils and damaging the environment. Conventional practices using petroleum-based and chemical inputs have been shown to cause continual loss of soil nutrients, soil organic matter and food nutrient content. These practices consume vast quantities of natural resources to prepare, distribute and apply fossil fuel inputs (Salle *et al.* 2008).

With all of these benefits, organic farming when compared with the inorganic or intensive system has certain drawbacks such as release rate of nutrients is too slow to meet the crop requirements in a short time, hence some nutrient deficiency may occur whereas in conventional agriculture nutrients are soluble and immediately available to the plants. In Conventional agriculture, fertilizers are also quite high in nutrient content so small amounts are required for crop growth whereas in case of organic, larger volume of fertilizers is needed to provide enough nutrients for crop growth as they are comparatively low in nutrient contents (Chen, 2008).

However, the immediate impact of organic conversion differs between farmers, depending on the organizational support available and whether the farmer's transition is from traditional low-input methods or from conventional and more intensive methods of production. The switch from a traditional or rustic form of cultivation tends to have positive consequences in terms of yields or output. But, when switching from intensive forms of agriculture, first-year losses in yields were notable. Organic agriculture tends to require somewhat more labor than conventional systems and in areas where there is a labor shortage this may be a limiting factor. Conversely, where workers are abundant and migration occurs, it can help contribute to rural employment and possibly to community stability. Organic farming is primarily knowledge intensive which requires an active system to support farmer learning in order to address both the production and the post-harvest requirements of organics (Giovannucci, 2007).

Objectives

1. The study has following objectives
2. To compare the wheat yield and profitability of organic and inorganic farming systems.
3. To quantify the impact of type of farming (organic and inorganic) and other inputs on wheat yield.
4. To estimate the extent of the use of detrimental environmental variables in organic and inorganic farming systems.
5. To identify constraints in organic farming system and give policy implications.

Materials and Methods

This chapter describes the sampling procedure, sample size and method of data collection and analysis. It consists of four sections. The first section deals with the profile of the selected site. The next section discusses the selection of the study crop. Section three discusses the questionnaire development and pre-testing. Fourth section focuses on the techniques applied, variables used for analysis and brief introduction of the model. At the end limitations of the study are given.

Matiari is a district of Sindh province in Pakistan and has a population of 0.81 million. The main crops of this district are Wheat, Cotton and Sugarcane, but beside these a lot of other crops are cultivated. The fruits and vegetables of this region are also considerable. It is following three taluka Hala, Matiari and Saeedabad. The north borders of District Matiari meet with the District “Nawabshah”, in East they touch District “Sanghar”, in south of Matiari there is Hyderabad District and in west River Indus touches the borders of Matiari, which plays the basic role in agricultural growth of this area. The poverty rate is near about same as that of other districts of rural Sindh.

Matiari is the one of oldest territory of Sindh. It has a very bright past from educational point of view. Matiari is the land of Shah Abdul Latif Bhitai, the great saint, soofi Poet and lover of Sindh and the world as well.

Questionnaire

The survey was conducted with a structured questionnaire that was completed during face-to-face interviews. Questionnaire covered:

a) The characteristics of the farmer (age, education, experience),
b) Type of farming (organic or inorganic),
c) Experience of each farming system,
d) Inputs use (fertilizer, FYM, pest control,
e) Costs of input used,
f) Yield of each farming system and

g) Constraints in adopting organic farming. 3.5 Pre-testing

According to Casley and Kumar (1988) a newly constructed questionnaire should be pre-tested on a few pilot respondents to check the weaknesses, ambiguities and omissions before it is finalized for the survey. It provides an opportunity to improve the questionnaire by adding something, which the researcher feels, missing, and by deleting the unnecessary information. In this study a comprehensive questionnaire was developed and pre-tested in the selected site. Then, some minor and necessary changes were made.

Data Analysis

Data thus obtained were tabulated and basic descriptive statistics of both organic and inorganic farmers was discussed. Then the cropping pattern (percent use of area by a crop to the total cropped area) and percentages of each agronomic factors used in organic and inorganic farming were calculated. First of all, Yield was calculated by using the following formula,

Yield= Y/A

Where Y and A are output and area respectively. Then, the data was analyzed statistically and t-test was used to compare the mean yields. 'There were two applications of t-test i.e. testing the difference between independent groups or testing the difference between dependent groups. A t-test for independent groups is useful when to compare the difference between means of two groups on the same variable. In case of t-test for dependent groups, each case is assumed to have two measures of the same variable taken at different types. As the goal was to compare the difference between means of the two groups i.e. organic and inorganic farming on the same variable i.e. yield, so independent samples t-test was used. The assumptions of the independent samples t-test are (1) the dependent variable is normally distributed, (2) the two groups have approximately equal variance on the dependent variable, and (3) the two groups are independent of one another. Further, this test has two specifications, first with equal variances assumed and second with unequal variances assumed. So before conducting t-test, equality of variances is checked by using levene's F-test.

Levine's test is used to assess the homogeneity of variance, which is a precondition for parametric tests such as the t-test and ANOVA. Equal variances across samples are called homogeneity of variance. Some statistical tests, for example the analysis of variance, assume that variances are equal across groups or samples. If there exist no strong evidence about the normal or nearly normal distribution of data then levene's test is used. When the value for F is large and the P-value is less than .05, this indicates that the variances are heterogeneous and t-test for unequal variances is considered and if the /'-value is greater than .05 then t-test assuming equal variances is considered to compare the variances Of the mean yields of organic and inorganic farming system.

The Levine's test is defined as;

$H_0: \sigma_1 = \sigma_2 = \ldots = \sigma_k$

$H_1: \sigma_i \neq \sigma_j$ for at least one pair (i, j)

Test statistics: Given a variable Y with sample of size N divided into k subgroups, where N_i is the sample size of the subgroup, the Levene's test statistic is defined as:

$$W = \frac{(N-ki)\sum_{i-1}^{k} Ni\left(\overline{Z_i} - \overline{Z}\right)^2}{(k-1)\sum_{i-1}^{k} \sum_{j=1}^{Ni} \left(\overline{Z_{ij}} - \overline{Z_i}\right)^2}$$

Where, N is the sample size and 'k' is the no of subgroups

$\overline{Z_i}$ are the group means of the Z_{ij} and $\overline{Z_i}$ is the overall mean of the *Zij*.

Z_{ij} can have one of the following three definitions:

$$Z_{ij} = \left|\overline{Y_{ij}} - \overline{Y}_i\right|$$

Where Y_{ij} is the mean of the *i*th subgroup.

Where $\overline{Y}_i$ the 10% trimmed mean of the *i*th subgroup.

The three choices for defining Z*ij* determine the robustness and power of Levine's test. By robustness, mean the ability of the test to not falsely detect unequal variances when the underlying data are not normally distributed and the variables are in fact equal. By power, mean the ability of the test to detect unequal variances when the variances are in fact unequal (Leven, 1960),

The hypothesis for independent samples t-test is:

Null: The means of the two groups are not significantly different.

H_0 $v_1 = v_2$ $v_1 - v_2 = 0$

Alternate: The means of the two groups are significantly different.

H_1 $v_1 \neq v_2$ $v_1 - v_2 \neq 0$

If the t-value is large and is significant at less than 5 percent level of significance, then null hypothesis is rejected, which indicates that there exists a significant difference between the means of the two groups.

Test statistics

$$t = \frac{\left(\overline{Y_1} - \overline{Y_2}\right) - (v_1 - v_2)}{\sqrt{S_p^2\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$ and

$$Sp^2 = \frac{(n_1 - 1)\delta_1^2 + (n_2 - 1)\delta_2^2}{n_1 + n_2 - 2}$$

Where:

$\overline{Y}_1$ is the mean of first category

$\overline{Y}_2$ is the mean of second category

Sp^2 is the estimate of common variance, it is also called pooled variance

n_1 is the number of observations of first category

n_2 is the number of observations of second category

δ_1^2 is the standard deviation of first category

δ_2^2 is the standard deviation of second category

v_1 and v_2 are hypothesized mean values

For estimating cash cost, only the actual cash expenses on purchased items were taken into consideration. For instance, an input such as seed was partly purchased and partly contributed by farm households, and then the opportunity value for the contributed part and actual expenses for the purchased components were combined for computing imputed cost of that input. Profit or net income was calculated by subtracting all these costs from the gross income. Gross margin per. rupee invested is calculated by; per rupee invested = gross margin/ cash cost

The optimum level of fertilizers (urea, DAP and potassium sulphate) was also calculated to determine the difference in applied dozes and optimum level. It was calculated by the following formula;

$$X_i = \beta_i \times Y_i \left(\frac{P_w}{P_{xi}} \right)$$

Where

Xi is the optimum level of respective fertilizer

β_i is the elasticity of the fertilizer level

Y_i is the average wheat yield

P_w is the price of wheat

P_{xi} is the price of respective fertilizer

Finally, to estimate the effect of different factors (organic and inorganic) on yield variability, various regression models were fitted to the data but double log model was found to be the best based on the following criterion:

1. Confirmation and consistency with accepted theory.
2. The size of the coefficient of multiple determinations (R-square).
3. Statistically significant "T" and "F" values.

The Cobb-Douglas production function in double log form is written as;

InYi = β_0 + β_1 ln(X_u)+ p_2 ln(X_{2i})+ f3_3 ln(X_{3i})+ p_4 ln(X_{4i})+ p_5 In(X_{5i})+ p_7 ($D_{(i}$)

Where:

In Yi is the natural log of wheat per acre yield (maunds/acre) obtained by the i'th farmer in the sample β_0 is the intercept (it showed mean wheat yield when no inputs was applied)

1n(Xij) is the natural log of area (in acres) sown under wheat crop by the i'th farmer in the sample

* lmaund= 40 kg

ln(X_{2i}) is the natural log of no. of ploughings given to the wheat cropped area by the i'th farmer

ln(X_{3i}) is the natural log of seed rate (kgs/acre) used by the i'th farmer

ln(X_{4i}) is the natural log of no. of irrigations applied on the acres of wheat crop by the i'th farmer

ln($X_{<,i)}$ is the natural log of nutrients applied to the i'th farms

ln(X_{6i}) is the natural log of farming experience of the i'th farmer

$D_{|i}$ is the dummy for type of fanning system of the i'th farmer i.e. Di = 1 if organic and zero if inorganic

$D_{?}$_i is the dummy for time of sowing of wheat by the i'th farmer i.e. for timely sowing (15-30 Nov) and 0 for late sowing (1-15 Dec)

D_3i is the dummy for green manure practiced by the i'th farmer i.e. D_j = 1 for green manure farm and 0 otherwise

β'_s are the unknown parameters in the production function that represents the change in dependent variable i.e. yield due to the change in respective independent variable and U_g is the disturbance term.

Characteristics of Double-log Model

In this model, both the dependent and independent variables are in logarithms except the qualitative variables. The model has a variety of uses in economics and agriculture. Cobb-Douglas production function is the most commonly used production function in agriculture. The model is linear in the logarithms, even though it was originally nonlinear in terms of both the variables and parameters.

One useful feature of the double-log model is that the elasticity of the dependent variable with respect to an independent variable is given directly by the coefficient and it remains constant over the entire input output range.

Results

This chapter is concerned with the results. First section deals with the explanation of the descriptive statistics of organic and inorganic farmers. The cropping patterns of organic and inorganic fanning systems are also presented in this section. Second section comprised of the comparative statistics of yield and profitability analysis for organic and inorganic farming. In the third section; parameters used in the model are discussed.

Basic Characteristics of Organic Farmers

Table-l shows the average farm size operated by the organic farmer is 8.72 acres with standard deviation of 5.78. Its minimum and maximum values are 2 and 30 acres, respectively. The average cropped area of organic farmers is 16.53 acres with standard deviation of 10.93. Its minimum and maximum values are 4 and 60 acres, respectively. The average area under organic wheat is 6.17 acres with standard deviation of 4.24. Its minimum and maximum values are 1.25 and 24 acres, respectively. The average • number of adult animal units per acre is 1.8 with standard deviation of 1.36. Its minimum and maximum values are 0.1 and 6.6 .

The mean age of the organic farmers is 45.70 years with standard deviation of 10.71. Its minimum and maximum values are 25 and 70 years, respectively. On an average they are middle passed represented by its mean value i.e.8.00 with standard deviation of 3.37. Its minimum and maximum values are 0 (uneducated) and 12 (F.A), respectively. Overall farmers have 23.30 years of farming experience with its minimum and maximum values of 5 and 54 years, respectively. Its standard deviation is 11.50. The average organic farming experience is 4.35 years with standard deviation of 4.39. Its minimum and maximum values are 1 and 32 years.

The average number of ploughings given to an acre of wheat is 2.98 with standard deviation of 0.75. Its minimum and maximum values are 2 and 4 respectively whereas the average number of planking is 1.98 with standard deviation of 0.72. Its minimum and maximum values are 1 and 5 respectively. The average quantity of seed used is 41.58 kg/acre with standard deviation of 2.42. Its minimum and maximum values are 40 and 50 kgs/acre, respectively. The average number of irrigations applied to an acre of wheat crop is 2.85 with standard deviation of 0.66. Its minimum and maximum values are 2 and 4 respectively. The average number of trolleys of FYM applied to the farms is 2.48 trolley/acre with standard deviation of 0.89. Its minimum and maximum values are land 4 trolleys/acre, respectively. Mean organic wheat yield produced is 34.95 maund/acre with standard deviation of 4.97. Its minimum and maximum values are 21 and 45.0 maunds/acre.

Basic Characteristics of Inorganic Farmers

Table-2 shows the average farm size operated by the inorganic farmer is 10.60 acres with standard deviation of 9.65. Its minimum and maximum values are 1 and 50 acres, respectively. The average cropped area of inorganic farmers is 20.29 acres with standard deviation of 18.97. Its minimum and maximum values are 2 and 100 acres, respectively. The average area under organic wheat is 8.59 acres with standard deviation of 8.23. Its minimum and maximum values are 0.5 and 45 acres, respectively. The average number of adult animal units per acre is 0.99 with standard deviation of .82. Its minimum and maximum values are 0 and 4.4.

The mean age of the inorganic farmers is 48.5 years with standard deviation of 11.5. Its minimum and maximum values are 25 and 75 years, respectively. On an average they are primary passed represented by its mean value i.e. 5.03 with standard deviation of 4.73. Its minimum and maximum values are 0 (uneducated) and 12 (educated), respectively. Overall farmers have 23.13 years of farming experience with its minimum and maximum values of 10 and 50 years, respectively. Its standard deviation is 9.78. The average inorganic farming experience is 23.13 years with standard deviation of 9.78. Its minimum and maximum values are 10 and 50 years.

The average number of ploughings given to an-acre of wheat is 3.68 with standard deviation of 0.98. Its minimum and maximum values are 2 and 6 respectively whereas the average number of plankings is 2.07 with standard deviation is 0.68. Its minimum and maximum values are 1 and 5, respectively. The average quantity of seed used is 44.17 kgs/acre with standard deviation of 4.33. Its minimum and maximum values are 40 and 55 kgs/acre, respectively. The average number of irrigations applied to an acre of wheat crop is 3.52 with standard deviation of 0.96. Its minimum and maximum values are 2 and 6 .

The average number of trolleys of FYM applied to the farms is 0.66 trolleys/acre with standard deviation of 0.35. Its minimum and maximum values are 0 and 1 trolleys/acre, respectively. The average number of bags of urea applied to the farms is 2.092 bags/acre with standard deviation of 0.34. Its minimum and maximum values are 1 and 2.5 bags/acre, respectively. The average number of bags of DAP applied to the farms are 1.754 bags/acre with standard deviation of 0.33. Its minimum and maximum values are 1 and 2 bags/acre, respectively. The average number of bags of Potassium Sulphate applied to the farms is 1.179 bags/acre with standard deviation of 0.31. Its minimum and maximum values are 0 and 1.88 bags/acre, respectively. Mean inorganic wheat yield produced is 40.28 maunds/acre with standard deviation of 6.33. Its minimum and maximum values are 28 and 55 maunds/acre.

Cropping Pattern Adoption by Organic Farmers

Table-3 shows the Rabi crops grown by the organic farmer were wheat, fodder and vegetable. Among these, wheat and fodder where the most important in term of their share towards total cropped area. Wheat was cultivated on 37.32 percent of the cropped area where as; the share of fodder crop was 13.07 percent.

The Kharif crop ground by the organic farmer where maize, sugarcane, fodder, till and vegetables. In Kharif season maize was grown on a large position of the cropped area and contributed 6.17 percent the share of other crops like sugarcane till, fodder and vegetable was 0.73, 2.25, 5.87 and 1.94 percent.

Table-4 shows the organic and inorganic farmers were also growing the same crops in rabi season but their share toward the total cropped area was different. In this case, wheat contributed 42.33 percent whereas; fodder and vegetables contributed 9.36 and 2.51 percent. In Kharif season maize contributed most to the total cropped area; it was grown on 5.52 percent. The share of other crops like sugarcane, fodder and vegetables was 2.02, 8.43 and 3.10 percent. Inorganic farmers were not growing till.

Source of Traction power, Irrigation and Seed

Table-5 shows the use of bullocks alone was similar i.e. 3.33 percent for both groups of the farmers. The share of owned tractor was 26.67 percent and 23.33 percent for organic and inorganic groups while the share of tractor hired was 70 percent and 73.34 percent for organic and inorganic.

There was no difference in sowing method for organic and inorganic. Both the groups adopted 100 percent broadcasting method. None of the farmers used drill for wheat sowing. When compared both organic and inorganic farmers based on mode of irrigation, it is shown in the table 5 that only 1.67 percent inorganic farmers were using canal alone as a water source and no organic farmer was relying on using only canal water for irrigation. As underground water in the study area was fit for irrigation, that's why most of them in both the categories i.e. organic and inorganic farmers, were using both canal and tube-well water for irrigation. There were also individuals who were using only tube-well as a water source and those were 18.33 percent for organic and 16.67 percent for inorganic farmers. Majority of the farmers in both the categories owned tube-wells, more precisely 55 percent and 58.33 percent of organic and inorganic farmers, respectively had their own tube-well whereas 26.67 percent and 23.33 percent respectively used purchased tube-wells along with the canal water.

The major sources of seed supply in the study area were fallow farmers, relatives and NGO (for organic farmers) but mostly farmers were using owned source of seed. The remaining 90 percent and 98.33 percent of organic and inorganic farmers respectively were using owned source of seed.

Comparison of Mean Wheat Yields

To compare the mean yields of the organic and inorganic farming, an independent sample T-test was conducted. Numbers were assigned to both the groups (Organic and inorganic). The group one (organic) was, assigned by 1 and second group (inorganic) was, assigned by '0'. The results obtained are presented in tables 6 and 7.

The table 6 shows that the mean yield of organic farming is 34.95 maunds/acre with standard deviation of 4.97 and standard error mean of 0.64. On the other hand, the mean yield of inorganic farming is 40.28 maunds/acre with standard deviation of 6.33 and standard error mean of 0.82. It shows that the mean yield of inorganic farming group is 5.33 maunds/acre higher than the organic farming group. The reason for negative sign with mean difference implies that the yield of first group i.e. organic farming group is less ‘than that of the second group i.e. inorganic farming group as shown in table 7.

The test has two different specifications; one assumes equal variance between the two groups while other assumes difference in variances. So before conducting T-test, we compare the variance of wheat yield in organic and inorganic fanning groups by Levine’s P-test. The table 7 shows that Levine’s test statistic for equality of variances is 2.02, which is significant at 0.159 that is greater than 0.05, this indicates that the variances of organic and inorganic yields are equal.

After confirming that: both the groups have equal variance in wheat yield, T-test assuming equal variances specification was conducted and its results are presented in table 7. He calculated t-value is -5.131, which is statistically significant at less than 1 percent level of significance. It implies that there exists a significant, difference between organic and inorganic yields. The same conclusion i.e. significant difference in yields exists in two groups can be drawn from the 95 percent confidence interval for wheat mean yield. As the lower limit and upper limits of this interval are -3.25 and -7.39 maunds and zero does not lies in it. The results are in line with Ahmed *et al.* *(*2001).

Comparison of Mean Gross Margins

To compare the mean gross margin of the organic and inorganic farming, independent sample T-test was conducted. Numbers were assigned to both the groups (organic and inorganic). The group one (organic) was, assigned by 1 and second group (inorganic) was, assigned by ‘0’. The results obtained are presented in tables 8 and 9.

The table 8 shows that the mean gross margin of organic farming is 42700.00 Rs/acre with standard deviation of 1220.00 and standard error mean of 905.8. *On* the other hand, the mean gross margin of inorganic farming is 48000.00 Rs/acre with standard deviation of 1200.00 and standard error mean of 902.27. It shows that the mean gross margin of inorganic farming group is 5300.00 Rs/acre higher than the organic farming group. The reason for negative sign with mean difference implies that the gross margin of first group i.e. organic farming group is less than that of the second group i.e. inorganic farming group as shown in table 9.

The test has two different specifications; one assumes equal variance between the two groups while other assumes difference in variances. So before conducting t-test, we compare the variance of wheat gross margins in organic and inorganic farming groups by Levine's F-test. The Table 9 shows that Levine's test statistic for equality of variances is 0.321, which is significant at 0.57 that is greater than 0.05, this indicates that the variances of organic and inorganic gross margins are equal.

After confirming that both the groups have equal variance in gross margin, t-test assuming equal variances specification was conducted and its results are presented in Table 4.9. The calculated t-value is -0.65, which is statistically no significant. It implies that there exists no significant difference between organic and inorganic gross margin. The same conclusion can be drawn from the 95 percent confidence interval for mean gross margin. As the lower limit and upper limits of this interval are -3361.6 and 1701.9 Rs/acre and zero lies in it.

Comparison of Mean Wheat Seed Rates

To compare the mean seed rates of the organic and inorganic farming, independent sample T-test was conducted. Numbers were assigned to both the groups (organic and inorganic). The group one (organic) was, assigned by 1 and second group (inorganic) was, assigned by '0'. The results obtained are presented in tables 10 and 11.

The table 10 shows that the mean seed rate of organic farming is 41.58 Kgs/acre with standard deviation of 2.42 and standard error mean of 0.31. On the other hand, the mean seed rate of inorganic farming is 44.17 Kg/acre with standard deviation of 4.33 and standard error mean of 0.56. It shows that the mean seed rate of inorganic farming group is 2.85 Kg/acre higher than the organic farming group. The reason for negative sign with mean difference implies that the seed rate of first group i.e. organic farming group is less than that of the second group i.e. inorganic farming group as shown in table 1 1.

The test has two different specifications; one assumes equal variance between the two groups while other assumes difference in variances. So before conducting t-test, we compare the variance of wheat seed rates in organic and inorganic farming groups by Levine's F-test. The table 11 shows that Levine's test statistic for equality of variances is 28.5 which are significant at less than 0.01 that is less than 0.05; this indicates that the variances of organic and inorganic seed rates are not equal.

After confirming that both the groups have unequal variance in wheat seed rates, t-test assuming unequal variances specification was conducted and its results are presented in table 11. The calculated t-value is -4.03, which is statistically significant at less than 1 percent level of significance. It implies that there exists a significant difference between organic and inorganic seed rates. The same conclusion i.e. significant difference in seed rate exists in two groups can be drawn from the 95 percent confidence interval for wheat mean seed rates. As the lower limit and upper limits of this interval are -3.85 and -1.31 legs and zero does not lies in it.

Comparison of Mean Number of Irrigations Applied to Wheat Farms

To compare the mean number of irrigations of the organic and inorganic farming, independent sample T-test was conducted. Numbers were assigned to both the groups (organic and inorganic). The group one (organic) was, assigned by 1 and second group (inorganic) was, assigned by '0'. The results obtained are presented in tables 12 and 13.

The table 12 shows that the mean number of irrigations of organic farming is 2.85 with standard deviation of .66 and standard error mean of 0.085. On the other hand, the mean number of irrigations of inorganic farming is 3.52 with standard deviation of 0.97and standard error mean of 0.125. It shows that the mean number of irrigations of inorganic farming group is 0.67 higher than the organic farming group. The reason for negative sign with mean difference implies that the number of irrigations of first group i.e. organic farming group is less than that of the second group i.e. inorganic farming group as shown in table 13.

The test has two different specifications; one assumes equal variance between the two groups while other assumes difference in variances. So before conducting t-test, we compare the variance of number of irrigations applied to an acre of wheat in organic and inorganic farming groups by Levine's F-test. The table 13 shows that Levine's test statistic for equality of variances is 13.5 which is significant at less than 0.01, that is less than 0.05; this indicates that the variances of organic and inorganic number of irrigations are not equal.

The calculated t-value is -4.42, which is statistically significant at less than 1 percent level of significance. It implies that there exists a significant difference between organic and inorganic number of irrigations. The same conclusion i.e. significant difference in number of irrigations exists in two groups can be drawn from the 95 percent confidence interval for mean number of irrigations applied to wheat. As the lower limit and upper limits of this interval are -0 966 and -0.367 and zero does not lies in it.

Comparison of Mean Number of Ploughings Given to Wheat Farms

To compare the mean number of ploughings of the organic and inorganic farming, independent sample T-test was conducted. Numbers were assigned to both the groups (organic and inorganic). The group one (organic) was, assigned by 1 and second group (inorganic) was, assigned by '0'. The results obtained are presented, in Tables 14 and 15.

The table 14 shows that the mean number of ploughings of organic farming is 2.98 with standard deviation of 0.75 and standard, error mean of 0.096. On the other hand, the mean number of ploughings of inorganic farming is 3.68 with standard deviation of .98 and standard error mean of 0.127. It shows that the mean number of ploughings of inorganic farming group is 0.70 higher than the organic farming group. The reason for negative sign with mean difference implies that the number of ploughings of first group i.e. organic farming group is less than that of the second group i.e. inorganic farming group as shown in table 15.

After confirming that both the groups have unequal variance in number of ploughings, t-test assuming unequal variances specification was conducted and its results are presented in table 15. The calculated t-value is -4.39, which is statistically significant at less than 1 percent level of significance. It implies that there exists a significant difference between organic and inorganic number of ploughings. As the lower limit and upper limits of this interval are -1.015 and -0.384 and zero does not lies in it.

Cost and Profit Analysis

The cost and profit comparison between organic and inorganic farming on per acre basis is presented in table 16 above. A cost analysis show that cash cost of organic farmers is less than the inorganic fanners whereas non-cash cost is greater in case of organic as compared to inorganic. This is because; the use of fertilizer has raised the expenses of the inorganic farmers, which are not, used in organic farming. Cash cost in case of organic and inorganic farming is Rs. 23053.00 and 25846.00 respectively. The non-cash cost of organic and inorganic are Rs.19389.65 and 18815.10 respectively. Total cost is the combination of cash and non-cash costs that is Rs.42442.65 and 44661.00 in organic and inorganic farming respectively. Overall, cost comparison shows that organic fanning is low cost but labor-intensive method whereas, inorganic farming implies high cost.

Gross margin (GM) is obtained by subtracting the cash cost from the gross value of product. GM is Rs.33142.65 and 36182.00 in organic and inorganic farming system. It shows that both the systems are equally profitable. The results of the t-test presented in section 4.7 clearly showed that there is no difference in their gross margins. So, *on* the basis of gross margin we can say that organic farmers perform better than inorganic farmers as they get the same gross margin with substantially much lower cash costs. But inorganic farming is more profitable than the organic farming system on the basis of net income. Net income is obtained by subtracting the total cost from the gross value of product. It is Rs.13752.35 and Rs.17367.00 in organic and inorganic farming, respectively showing a difference of Rs.2615.35. The analysis shows that low net income in organic farming than the inorganic farming is due to the low yield and high labor cost in organic system. Secondly health and environmental costs are not included in the analysis, because in the study site farmers are unaware of these costs. Similarly the end users of the product are not known so the health benefits of the product are not known. If these benefits were measured and included in the analysis the whole picture would have been entirely different.

Impact of Different Variables on Yield

Regression analysis was carried out to quantify the impact of type of farming and other inputs on yield. The results of the regression analysis are presented in table 17 above. The results showed that overall model is statistically significant as represented by the value of multiple determination (R^2) and F value. The value of II^2 is 0.62, which means that 62 % variation in yield is explained by the independent variables used. The value of F is 20.28 also shows the overall significance of the model. The detail of the significance level of independent variables is discussed below.

Area Ln

The coefficient of area is 0.03 with positive sign. Its t-value is 1.98, which indicates that this coefficient is statistically significant at 5 percent level of significance. The value of its coefficient implies that one percent increase in the area amounts 0.03 percent increase in yield. Its standard error is 0.015. No. of ploughings (Ln X_2).

The coefficient of number of ploughings is 0.168 with positive sign. Its t-value is 4.02, which indicate that this coefficient is statistically significant at less than 1 percent level of significance. The value of its coefficient implies that one percent increase in the nuinber of ploughings and plankings amounts 0.168 percent increase in yield. Its standard error is 0.042.

Seed Rate (Ln X_3)

The coefficient of seed rate is 0.233 with positive sign. Its t-value is 1.72, which indicates that this coefficient is statistically significant at less than 9 percent level of significance. The value of its coefficient implies that one percent increase in the quantity of seed amounts 0.168 percent increase in yield. Its standard error is 0.042.

No. of irrigations (Ln X4)

The coefficient for number of irrigations is 0.078 with positive sign. Its t- Value is 1.64, which indicates that this coefficient is statistically significant at 10 percent level of significance. The value of its coefficient implies that one percent increase in the number of irrigations amounts 0.078 percent increase in yield. Its standard error is 0.048. o Nutrients (NPK) *(Ln* X_5).

The coefficient for amount of nutrients is 0.036 with positive sign. Its t-value *is* 3.09, which indicate that this coefficient is statistically significant at less than 1 percent level of significance. The value of its coefficient implies that one percent increase in amount of nutrients increase the yield by 0.036 percent. Its standard error is 0.011. o Farming experience (Ln *X<,)*.

The coefficient for farming experience is 0.003 with positive sign. Its t-value is 1.83, which indicates that this coefficient is statistically significant at 7 percent level of significance. The value of its coefficient implies that one percent increase in the farming experience amounts 0.003 percent increase in yield. Its standard error is 0.001. o Type of farming (Dj)

To assess the impact of type of farming on yield, dummy variable is used. The value for this dummy variable was one if organic farming and zero if inorganic farming. The coefficient for this dummy variable is -0.234 with negative sign. The negative sign for this coefficient indicate that organic farms on an average obtained .234 percent less yield than the inorganic farms. The t-value for this coefficient is -3.88, which indicate that this coefficient is statistically significant at less than 1 percent level of significance. From this, it is concluded that type of farming has significant impact on yield. . Its standard error is 0.06. o Sowing Time (D2).

To assess the impact of sowing time on yield, dummy variable is used. The value for this dummy variable was one if timely sowing and zero for untimely sowing. The coefficient for this dummy variable is 0.111 with positive sign. The positive sign for this coefficient indicate that timely sown farms on an average obtained 0.131 percent more yield than the untimely sown farms. The t-value for this coefficient is 3.44, which indicate that this coefficient is statistically significant.

Use of Detrimental Inputs

The use of fertilizers, pesticide and weedici.de are considered to be detrimental for both human health and environment. The expenditures on pesticide was negligible i.e. Rs.31 per acre only. The average and optimum fertilizer use per acre for the sampled inorganic farming was calculated and presented in Table 4.18 below along with the recommended doses of fertilizer given by PARC, 2008. Farmers practicing inorganic farming in the study area were mostly using three fertilizers, namely; urea, DAP and potassium sulphate. On an average, they were using 2.092 bags of urea, 1.754 bags of DAP and 1.149 bags of potassium sulphate as compared to the recommended 1.25, 1.5 and 1 bags/acre respectively. However, the optimum levels of fertilizer use are 1.15 bags of urea, 1.028 bags of DAP and 0.789 bags of potassium sulphate. It is clear from the Table 4.18 that inorganic farmers were using higher doses of fertilizer than the recommended standard as well as from the optimum level. This higher use of fertilizer is proved to be detrimental for environment and soil health by Lagat *et al.* 2007. Less than 1 percent level of significance. From this, it is concluded that sowing time lias significant impact on yield. Its standard error is 0.032.

Green Manuring (Dj)

To assess the impact of green manuring on yield, dummy variable is used. The value for this dummy variable was one if green manuring is clone on the farm and zero otherwise. The coefficient for this dummy variable is 0.107 with positive sign. The positive sign for this coefficient indicate that farms with green manuring on an average obtained 0.107 percent more yield than farms without green manuring. The t-value for this coefficient is 2.48, which indicate that this coefficient is statistically significant at less than 2 percent level of significance. Its standard error is 0.043.

Advantages of Organic Farming

Table 19 the numbers of ploughings given to an acre of wheat on organic farm are less by 0.70 or 19 percent than the inorganic farm. The organic farmers saved 7.42 ploughings on per inorganic farm basis, 6.76 ploughings over the sampled farms and 9.90 million over the Punjab irrigated wheat area. This less no of ploughings used by organic farmers is helpful in saving 1.75 liters of diesel on per acre basis, 18.55 liters on per inorganic farm basis, and 16.91 liters over the sampled farms and 24.74 million liters over the Punjab irrigated wheat area, as one ploughing consumes 2.5 liters of diesel.

The numbers of irrigations applied to an acre of wheat on organic farm are less by 0.67 or 19 percent than the inorganic farm. Thus, organic farmers saved 7.10 irrigations on per inorganic farm basis, 6.47 irrigations over the sampled farms and 9.47 million irrigations over the Punjab irrigated wheat area. This less no of irrigations are helpful not only in the saving of irrigations but also in saving liters of diesel in case of diesel tube-well and units of electricity in case of electric tube-wells. As canal water availability at farm is not sufficient to meet a crop water requirement, that is why almost all the farmers in the study area used underground tube-well water; which are either diesel or electric operated. If it is assumed that all these tube-well are diesel operated then it can be calculated that organic farmers saved 3.35 liters of diesel on per acre basis, 35.51 liters on per inorganic farm, and 32.36 liters over the sampled farms and 47.35 million liters over the Punjab irrigated wheat area as irrigation consumes 4-5 liters of diesel. Similarly, if it is assumed that all these tube-wells are electric operated then it on be calculated that organic farmers saved 5.36, 56.82, 51.78 units of electricity on per acre, per inorganic farm basis, over the sampled farms respectively and 75.76 million units of electricity over the Sindh Irrigated wheat area, as one irrigation consumes 7-8 units of electricity. The saved water can help us to bring more area under cultivation or increasing our cropping intensities. If we not do so, it can have significant positive effect on groundwater depletion and sustainability of Agriculture and the environment. As fertilizer is not applied to the organic farms, so organic farmers save many bags of fertilizers (Urea, DAP and Potassium sulphate) that are used in inorganic farming system. Organic formers saved 2.094 bags of urea, 1.754 bags of DAP and 1.149 bags of Potassium sulphate on per acre basis and 22.20 bags of urea, 18.59 bags of DAP and 12.18 bags of potassium sulphate on per inorganic farm basis. Similarly, organic farming can save 20.23 bags of urea, 16.94 bags of DAP and 11.10 bags of potassium sulphate over the sampled farms and 29.6 million bags of urea, 24.79 million bags of DAP and 16.24 million bags of potassium sulphate over the Punjab irrigated wheat area. This will not only reduce farmer's cash requirement, but also have positive impacts on soil health, biodiversity and environment.

It is also noted from Table 16 that organic farming is low cost method as organic farmers are getting gross margin comparable to that of inorganic farmers with significantly lower cash costs. Gross margin per rupee invested in organic farming is Rs.2.23 while in inorganic farming it is Rs.1.71. So organic farming can save small farmers from the clutches of the informal moneylenders, as small farmers mostly borrow funds from moneylenders to meet their cash requirements.

Constraints in Organic Farming

The transition to organic production is not an easy job. In addition to the major challenges of low yield facing all farmers, there are other constraints as well. These constraints are presented in Table 20 above along with number and percent of the farmers facing it.

Discussion

This study was based on the comparison of organic wheat growers with their conventional counterparts on the basis of economic returns per acre of each category. Information was gathered in a survey of 60 wheat growers, one half of which followed organic cultivation practices, the other half of which followed conventional practices. The organic growers differed from their conventional counterparts in that they dedicated more time to the farming practices and used crop residuals, FYIVT or green Mannering as a source of plant nutrient instead of chemical fertilizers.

Comparison of organic and inorganic was made on the basis of yield and gross margin, it is clear that the average inorganic yield is higher than the organic yield because organic farming is a slow process and shows good results in long run. In the study site Testily farmers were in their transitional phase i.e. they were practicing organic farming for less than 1-2 years but those who entered in the. Long run (3-4 years) were getting higher yield as compared to the short run.. For cost analysis, all known costs per acre in conventional and organic farming systems were estimated. Profitability analysis was carried out first by subtracting only the cash costs and then by subtracting the total cost (cash plus non cash cost) from the gross income. It is found that inorganic system gives greater net income than the organic system. This is not because, the total cost is less in inorganic farming but it is due to the low yield and absence of price premiums to the organic farmers. However the gross margin was comparable in both the systems. Organic farmers were obtaining this gross margin with significantly lower cash costs. We can say that organic farming is more profitable than the inorganic farming as the farming community made their decisions on the basis of gross margin not on the net income. Greater awareness about this fact i.e. similar gross margin with low cash cost, resource savings and environmental benefits would turn more and more inorganic farmers to organic farming.

Regression analysis was carried out to see the impact of various factors on yield under the organic and inorganic farming system for wheat crop.

Table 1. Descriptive statistics of organic farmers

Factor	Min	Max	Mean	Std. deviation
Farm size (Acre)	2.00	30.00	8.72	5.78
Cropped area (Acre)	4.00	60.00	16.53	10.93
Livestock(animal units/acre)	0.1	6.6	1.8	1.36
Age (Year)	25.00	70.00	45.70	10.7
Education (Year)	0.00	12.00	7.95	3.38
Farming Exp (Year)	5.00	54.00	23.30	11.50
Organic farming Exp (Year)	1.00	32.00	4.35	4.39
Wheat Area (Acre)	1.25	24.00	6.17	4.24
Ploughing (Number)	2.00	4.00	2.98	0.75
Planking (Number)	1.00	5.00	1.98	0.72
Seed rate (Kg/acre)	40.00	50.00	41.58	2.41
Irrigation (Number)	2.00	4.00	2.85	0.66
FYM (Trolley/acre)	1.00	4.00	2.48	0.89
Yield (Maund/acre)	21.00	45.00	34.95	4.97

Table 2. Descriptive statistics of inorganic farmers

Factor	Min	Max	Mean	Std. deviation
Farm size (Acre)	1.00	50.00	10.60	9.65
Cropped area (Acre)	2.00	100.0	20.29	18.97
Livestock(animal units/acre)	0.00	4.4	0.99	0.82
Age (Year)	25.00	75.00	48.50	11.53
Education (Year)	0.00	12.00	5.03	4.73
Farming Exp (Year)	10.00	50.00	23.13	10.25
Organic farming Exp (Year)	6.00	50.00	21.15	10.07
Wheat Area (Acre)	0.50	45.00	8.59	8.23
Ploughing (Number)	2.00	6.00	3.68	0.98
Planking (Number)	1.00	5.00	2.07	0.68
Seed rate (Kg/acre)	2.00	6.00	3.52	0.96
Irrigation (Number)	2.00	6.00	3.52	0.96
FYM (Trolley/acre)	0.00	1.88	1.178	0.31
Yield (Maund/acre)	28.0	55.00	40.28	6.33

Table 3. Cropping pattern of organic farmers

Crop	Area (acres)	Percent of cropped area
Wheat	6.17	37.33
Rabi fodder	2.16	13.07
Rabi vegetables	1.44	7.66
Maize	1.02	7.17
Sugarcane	3.12	18.73
Till	0.37	2.24
Kharif fodder	0.97	5.87
Kharif vegetables	0.32	1.94
Total	16.53	100.00

Table 4. Cropping pattern of inorganic farmers

Crop	Area (Acres)	Percent of cropped area
Wheat	8.59	42.33
Rabi fodder	1.9	9.36
Rabi vegetables	0.51	2.51
Maize	1.12	5.52
Sugarcane	0.41	2.02
Kharif fodder	1.71	8.43
Kharif vegetables	0.63	3.10
Total	15.29	100.00

Table 5. Source of inputs for organic and inorganic farms in percentage

S. No	Variable inputs	Percent of Organic	Percent of Inorganic
1	Traction power • Bullocks (alone) • Tractor (owned) • Tractor (hired)	 3.33 26.7 70.00	 3.33 23.33 73.34
		100.00	100.00
2	Sowing method • Drill sowing • Broadcasting	0.00 100	0.00 100
3	Mode of irrigation • Canal (alone) • Tube-well (alone) • Canal+Tube-well (owned) • Canal+Tube-well (hired)	0.00 18.33 55.00 26.67	1.67 16.67 58.33 23.33
		100.00	100.00
4	Seed source • Owned • Purchased	90.00 10.00	98.33 1.67
		100.00	100.00

Table 6. Mean yields of organic and inorganic farming

Type of farming	N	Mean	Std. deviation	Std. Error Mean
Organic farming	30	34.95	4.97	0.64
Inorganic farming	30	40.28	6.33	0.82

Table 7. Results of the F-test and t-test used for the equality of variances and difference in mean yields

	levene's Test for equality of Variances		t-test for Equality of means						
	F	Sig	T	Df	Sig	Mean difference	Std. error difference	95% confidence interval	
								lower	upper
Equal variance assume	2.02	.159	-5.13	118	.000	-5.33	1.039	-7.39	-3.28

Table 8. Means gross margins of organic and inorganic farming

Type of farming	N	Mean	Std. deviation	Std. Error Mean
Organic farming	30	42700.00	1220.00	905.8
Inorganic farming	30	48000.00	1200.00	902.27

Table 9. Results of the F-test and t-test used for the equality of variances and difference in mean gross margins

	Levene's Test for equality of variances		t-test for Equality of means						
	F	Sig	T	Df	Sig	Mean difference	Std error difference	95% confidence interval	
								lower	upper
Equal variance assume	.32	.57	-.649	118	.518	-829.83	1278.5	-3361.6	1701.9

Table 10. Means seed rates of organic and inorganic farming

Type of farming	N	Mean	Std. deviation	Std. Error Mean
Organic farming	30	41.58	2.42	0.31
Inorganic farming	30	44.17	4.33	0.56

Table 11. Results of the F-test and t-test used for the equality of variances and difference in mean seed rate

	Levene's Test for equality of variances		t-test for Equality of means						
	F	Sig	T	Df	Sig	Mean difference	Std error difference	95% confidence interval	
								lower	upper
Equal variance assume	28.5	.000	-4.03	92.5	.000	-2.58	.64	-3.85	-1.31

Table 12. Mean No. of irrigations of organic and inorganic farming

Type of farming	N	Mean	Std. deviation	Std. Error Mean
Organic farming	30	2.85	.66	.085
Inorganic farming	30	3.52	.97	.125

Table 13. Results of the F-test and t-test used for the equality of variances and difference in mean No. of irrigations

	Levene's Test For equality of variances		t-test for Equality of means						
	F	Sig	T	Df	Sig	Mean difference	Sid. error difference	95% confidence interval	
								lower	upper
Equal variance not assumed	13.5	.000	-4,42	104.2	.000	-.67	.151	-.966	-.367

Table 14. Mean No. of ploughings of organic and inorganic farming

Type of farming	N	Mean	Std. deviation	Std. Error Mean
Organic farming	30	2.98	.75	.096
Inorganic farming	30	3.68	.98	.127

Table 15. Results of the F-test and t-test used for the equality of variances and difference in mean No. of ploughings

	Levene's Test for equality of variances		t-test for Equality of means						
	F	Sig	T	df	Sig	Mean difference	Std. error difference	95% confidence interval	
								lower	upper
Equal variance not assumed	5.04	.027	-4.39	110.2	.000	-.70	.159	-1.015	-.384

Table 16. Cost and profit analysis of organic and inorganic farming

No.	Factor -	Organic	Inorganic
1	Value of grain yield (Rs/acre)	42700.00	48000.00
	Value of wheat straw (Rs/acre)	13495.0	14028.00
	Gross value of product (GVP)	56195.00	62028.00
	Variables costs (Rs/acre)		
	• Ploughing	2096.0	2177.37
	• Planking	1353.5	1405.17
	• Seed cost	2000.00	1900.00
	• Fertilizer	-	4849.18
	• Pesticide	-	-
2	• Weedicide	-	1281.83
	• Green maturing	3723.33	-
	• Irrigation	575.0	991.17
	• Harvesting	3830.83	3997.75
	• Threshing	5400.0	5458.87
	• Transportation cost	2349.33	2566.17
	• Marketing cost	1727.2	1222.6
3	Total Variables cost (Rs/acre)	23053.00	25846.00
	Fix costs (Rs/acre)		
	• Land value	9000.00	9000.00
4	• Owned seed Value	1870.00	1993.8
	• Family labor cost	9519.65	7821.30
5	Total non cash cost (Rs/acre)	19389.65	18815.10
6	Total cost = cash + non cash cost	42442.65	44661.00
7	Gross margin = (GVP- cash cost)	33142.65	36182.00
8	Net income* = (GVP - total cost)	13752.35	17367.00

Table 17. Estimates of the model for field wheat yield

Variable	Coefficient	Std Error	T-value	Significant
LnX_1	0.03	0.015	1.98	0.050
LnX_2	0.168	0.042	4.02	0.000
LnX_3	0.233	0.136	1.72	0.088
LnX_4	0.078	0.048	1.64	0.104
LnX_5	0.036	0.011	3.09	0.003
LnX_6	0.003	0.001	1.83	0.070
D_1	-0.234	0.060	-3.88	0.000
D_2	0.111	0.032	3.44	0.001
D_3	0.107	0.043	2.48	0.015
R square	0.624			
Adjusted R square	0.593			
F-ratio	20.281			.000

Table 18. Recommended dozes, applied dozes and optimum level of different fertilizers in inorganic farming

Fertilizer	Optimum level of fertilizer use (bags/acre)	Recommended dozes (bags/acre)	Applied dozes (bags/acre)
Urea	1.15	1.25	2.092
Dia-ammonium phosphate (DAP)	1.028	1.5	1.754
Potassium Sulphate	0.789	1	1.149

Table 19. Input savings in organic farming

Saving on					
Operation		**Per acre**	**Per inorganic farm (10.6 acre)**	**Over sample (9.66 acres)**	***Sindh wheat irrigation area (3.135 million acres)**
Ploughing	No	0.7	7.42	6.76	9.90
	Diesel (liters)	1.75	18.55	16.91	24.74
Irrigation	No	0.67	7.10	6.47	9.47
	Diesel (liters)	3.35	35.51	32.36	47.35
	Electric (Units)	5.36	56.82	51.78	75.76
Fertilizer	Urea (Bag/acre)	2.098	22.20	20.23	29.60
	DAP (Bag/acre)	1.754	18.59	16.94	24.79
	Potassium sulphate (bag/acre)	1.149	12.18	11.10	16.24
Seed rate (kg)		2.59	27.45	25.02	23.61

Table 20. Constraints in organic farming

Constraint	Number of farmers	Percent to the total organic farmers
Low yield	27	45.0
Separate markets for organic products	10	16.67
Labor shortage	4	6.67
High labor cost	5	8.33
Unavailability of FYM	2	3.33

The results showed that all the variables used have the expected signs. It is noted that one percent increase in area, no. of ploughings, no. of irrigations, seed rate, nutrients, time of sowing, green mannering and farming experience increases the yield by 0.03, 0.168, 0.078, 0.233, 0.036, 0.111, 0.107 and 0.003 respectively. Intercept differential coefficient with value 0.234 indicates that mean yield without variable input in inorganic farming is more than organic farming. The assessment was also made from a grower's point of view about the environmental protection, soil health and fertility, production of healthy products, etc. With respect to their opinions, organic farming gave more environmental and economic benefits and increases the population density of soil useful organisms like earthworm and nitrogen fixing bacteria that improves the soil structure and fertility. The same results were found by Reganold *el al.* 2006 and Siegrist *et al.* 1998.

Significant differences were also found in the farming practices adopted by the farmers, such as, number of ploughing, number of irrigations and quantity of seed. Saving of these operations on per acre, per farm, over the sampled farms and over the Punjab irrigated farms was also calculated. It is found that organic farmers saved 2.59 kg/acre of seed rate, 0.7 no. of ploughing/acre, 1.23 liters of diesel/acre/ploughing, 0.67 no. of irrigations/acre, 1.26 liters of diesel/acre/irrigation, 2.24 units of electricity/acre/irrigation, 2.094 bags/acre of urea, 1.754 bags/acre of DAP and 1.149 bags/acre of potassium sulphate. Similarly, the inorganic farmers can also make large savings by shifting towards organic farming. Organic farmers also reported some constraints like low yield, lack of premium prices and markets for organic products, unavailability of FYM, shortage of labor and high labor cost. In addition to this, personal views of the farmers about the influence of fertilizer application on health were also taken. According to some of the farmers, eye redness, skin allergy, headache and stomach pain were the diseases that can happen during fertilizer and weedicide /pesticide application. From the survey data, 23.33 percent of respondents suffered by skin allergy, 10 percent by headache, 25 percent by eye redness and 6.67 percent said that consumption of food grown inorganically has caused stomach diseases while majority did not report any health effect. Of the total inorganic fanners, 68.33 percent were of the opinion that soil becomes hard when managed inorganically which affected the health of the soil. On the other side, the organic farmers that have entered into the long run period noticed the improved taste of cooked food produced organically especially rice and vegetables and also reported improved soil structure and fertility. CONCLUSION AND

Suggestions

Profitability is a principal economic motive for a farmer to continue to conduct a business. As conventional crop farming suffers from rising fertilizer costs, small farmers look in the direction of new cropping practices that are not economically prohibitive. As these small farmers evaluate other cropping alternatives, organic cropping systems was examined as an option in achieving farm profitability objectives.

From the empirical results obtained by the regression analysis, it is concluded that increasing the number of inputs like area, seed rate, number of ploughings, number of irrigations* farmer's experience and number of nutrients (NPK) can increase the yield. Time of sowing and green mannering also shows positive impacts on yield. Whereas, yield declines when, shifting from inorganic farming system to the organic system especially in the initial period. The results obtained from the cost and profit analysis shows that although the organic farming has decreased the fertilizers cost but still inorganic farming is found to be more profitable in terms of net income because of the low organic yield that makes less income to the farmers. But if the health and environmental cost will also be taken into consideration then organic farming will gave more benefits. Whereas, in terms of gross margin organic farming perform better than inorganic farming as they are getting comparable gross margin with lower cash cost. It is also concluded that organic farmers made lager savings by using less quantity of seed rate, less units of electricity and less liters of diesel.

The survey revealed that some of the farmers had given consideration to organic farming, while some were in the process of transitioning some of their land and some were totally against the concept of organic farming. Reasons for considering organic fanning were largely no cost of fertilizers, availability of FYM, surplus family labor and motivation by organization. Some farmers adopting organic were those who have no financial constraints so they can bear the risks of lower yield. Most of the conventional farmers decided not to pursue organic farming, based on the factors like lower yields, weather-related production risks, high labor costs (for weeding and FYM application), lack of premium prices and markets for organic products and a lack of information regarding how to successfully transition to organic farming. Some of the farmers were found to be more profit conscious, they only want to get high output and have no concern about the health and environmental benefits. Another reason which I found therewas that the tenants were not shifting to the organic farming. They accept the importance and benefits provided by the organic method but because of high rents they have to pay and lack of land reliability, they were not shifting to organic system and tried to get the highest productivity in the short run. Some of them show unwillingness to spend more time and effort needed monitor fields and manage organic production However, organic agriculture offers numerous environmental, economic and social benefits and makes good sense from a public policy perspective. To address the problems faced by the organic farmers, certain recommendations can be adopted as a jumping off point in that regard. Those recommendations are as follows

• Integrated use of organic and inorganic farming should be practiced in the initial period of transition.

• Financial support scheme should be introduced to cope with the problem of lower yield and reduced farmer's income.

• Organic markets should be established and premium prices should be given to the organic growers to compensate the lower yield.

• Maintenance payments as a reward should be provided to the organic growers for maintaining good environment

• Awareness about the health and environmental benefits through educational campaigns should be created among the organic growers and end users of the organic products

• Policies should be made to internalize the health and environmental hazards of inorganic farming system that will raise the social costs of products grown inorganically to reflect their proper costs

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