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AN ASSESSMENT OF PUBLIC AND PRIVATE BENEFITS OF ORGANIC FARMING IN PAKISTAN

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ABSTRACT

Despite the acknowledged advantages of organic farming, questions remain about its productivity differential and financial viability to its counterpart conventional farming. We test this claim in Pakistan, by comparing the productivity and profitability of organic and conventional farms that grow two major crops, wheat and rice, based on primary data collected from 444 (220 organic & 224 conventional) farms located in three districts of Punjab province. We find that growing organic crops is at least as profitable as conventional crops despite their low yields due to lower input costs and higher commodity prices. The Benefit Cost Ratio is also higher for organic crops which suggest that farmers can get higher profits by moving from conventional to organic crops. Overall, input costs are 20% and 10% lower in organic wheat and rice farms relative to their conventional counterparts. Soil nutrient tests show that organic farms tend to better conserve soil fertility and system stability than conventional farms. Based on these private and public benefits, we argue that organic agriculture should be encouraged to ensure sustainable agricultural practices in Pakistan. Farmers' tentative adoption of commercial organic farming will largely depend on how demand for organically farmed food continues to grow.

Key words: Organic Farming, Conventional Farming, Wheat, Rice, Fertilizers, Pesticides.

INTRODUCTION

Agriculture is an important sector of Pakistan's economy. It contributes 21 per cent to the GDP and employs more than 43.7 per cent of the country's total labor force. It supports directly or indirectly about 68 per cent of the population for their sustenance and 60 per cent to total export earnings (MoF, 2014).

Current farming practices in Pakistan heavily rely on the use of chemical inputs and high yielding varieties which has led toa decline in soil fertility and loss in topsoil, organic matter and the crop production potential of soils (Wood *et al*., 2006; Khan, 2009, 2010 2011; Samie *et al*., 2010). These problems are especially important in the wheat-rice belt, the breadbasket of northern India and Pakistan, which covers over 12 million ha and provides food security for some 500 million people. This could be a serious threat to future food security and has led to the quest for sustainable agricultural systems (Samie *et al*., 2010). Furthermore, conventional farming brings small profits due to continued increases in inputs costs and stagnant market prices of agricultural outputs (especially major crops like wheat, rice and cotton) resulting from government interventions that distort relative prices (Quddus and Mustafa, 2011).

Organic agriculture (OA) has the potential to address some of the threats to agricultural sustainability in the country (Lotter *et al*., 2003; Ramesh *et al*., 2005). OA is a well-defined method of production that tends to minimize the use of costly synthetic inputs, such as fertilizers, pesticides, herbicides and medical products as well as making agriculture environmentally sustainable and economically viable. It avoids nutrient exploitation and increases soil organic matter content. Soils under OA capture and store more water than soils under conventional cultivation (Poudel *et al*., 2002;Muller, 2009). Integrated organic approaches are also more demanding of labor inputs(Demiryurek and Ceyhan, 2008). In addition, higher prices can be realized via organic certification. Higher farm incomes are thus possible due to lower input costs and higher sale prices. Increased revenue combined with low input costs may offer a feasible alternative to expanding farm size(Bolwig and Gibbon, 2009;Beuchelt and Zeller, 2011).

Despite the acknowledged advantages of organic farming, questions remain about its economic viability. Many express concerns about the productivity differential and financial viability of organic farming relative to conventional methods (Sahs *et al*., 1998; Liebhardt, 2001; de Ponti *et al*., 2012). They argue that profitability may be lower because of low productivity or costs may be high because of the more intensive use of labor. These may be why farmers have not yet taken up organic methods on a large scale. However, there is not much evidence in Pakistan, in particular, to clarify whether there are huge profitability differences between organic

and regular farming. Therefore, understanding the economic performance of OA is crucial. Conventional agriculture is subsidized world-over in many ways and receives significant policy and corporate research and development support. Organic production is a more sustainable method of farming. However, if it is to be successful, corporate farming and policy stakeholders need to understand the economic private and public potential of organic farming.

This study compares organic and conventional wheat and rice production, in terms of yield, production characteristics and economic performance in three districts in Punjab, Pakistan. Punjab is the leading province producing wheat and rice in Pakistan, and accounts for 80 and 58 percent of total national productions of wheat and rice respectively (Samie *et al*., 2010). Wheat is also the single largest consumption item among rural households (Sher and Ahmad, 2008). In view of their importance, it is useful to examine the economic performance of wheat and rice from the farmer's as well as national perspective. Thus, in this paper, we seek to understand the economic differences between organic and conventional wheat and rice farming. We also seek to identify what some of the public benefits are of undertaking organic agriculture.

Organic Agriculture in Pakistan: The contemporary history of OA in Pakistan can be traced back to 1996 when Lok Sanjh, a non-profit organization, started working with farmers at grass roots level to persuade them to adopt ecological approaches to production. [1] Farmers Field Schools (FFS) were conducted to build the capacity of the farmers and train them on alternative approaches. More than 10,000 farmers have been trained using FFS methods. Lok Sanjh is an NGO that has brought together organic farmer committees to form Organic Farmer's Associations (OFAs). With its support, the OFAs have become responsible for establishing a Farmer's Guarantee System to ensure the quality of organic produce in their areas. Other organizations have also tried to promote organic agriculture in their programs.

The Government of Pakistan also became an advocate of OA in response to environmental and economic challenges in the agricultural sector and because imports of chemical fertilizer and synthetic pesticides are expensive to the Pakistan economy. A separate Directorate of OA at the National Agriculture Research Centre (NARC) was established in 2008.[2] In addition to many other functions, the Directorate of Organic Farming is ensuring that the technology is disseminated to farming community across Pakistan. Some 5000 farmers and students have been trained in organic practices and a Network of Organic Agriculture in Pakistan (NEOAP) has been launched to register organic farmers and traders.[3]

Pakistan's organic farms are certified by Zwolle, of the Netherlands for organic production methods according to regulation (EEC NO.2092/91) and USDA-NOP standards[4]. These farms are involved in identifying new production technology and disseminating new knowledge to the small farmers across the country. NARC and Pakistan Agriculture Research Council (PARC) are the leading supporters of organic food and also involved in production. Many private farms located in the vicinity of Islamabad also produce organic food, particularly fresh fruits and vegetables for local markets, and get technical support from NARC.

In terms of markets, organic producers either sell their products at specified outlets [5] or provide it directly to larger certified firms-Panda, Prince Departmental Store, Sultan Son's (Sarafraz and Abdullah, 2014). Hotels, foreigners and affluent households are the major consumer of organic food across Pakistan. Marriat and Serena hotels in Islamabad are the prime examples of organic buyers. Formal markets for organic farm inputs are almost non-existent and most of the farmers rely on their own production methods (supplemented by training from NARC) to increase land fertility and control weeds and pests.

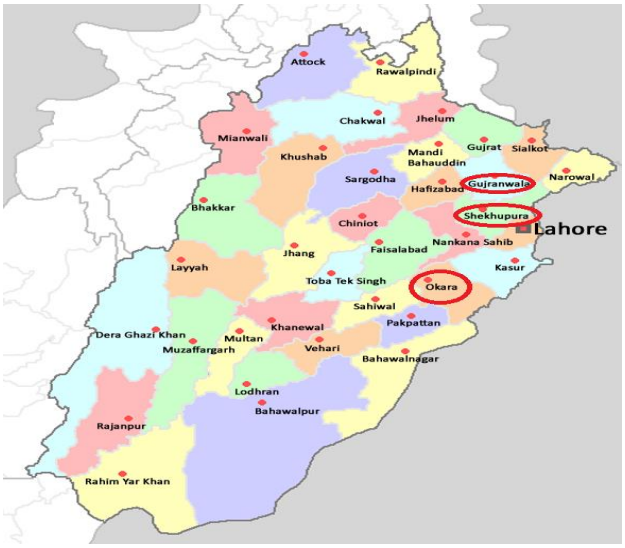

Figure 1. Map of Pakistani Punjab showing sample areas in red circles

[1]http://loksanjh.org/project-3/index.html April 10, 2015.
[2]http://old.parc.gov.pk/NARC/Organic/Pages/CurntRch.html, May 17, 2015.

[3]http://www.parc.gov.pk/. Accessed April 15, 2015.
[4] http://www.pakof.com/ May 18, 2015.
[5] Government organizations sell these products in their own outlets but private farms sell these commodities to authorized shops.

STUDY AREA, DATA AND METHODS

Description of the Study Area: Our study is based on data from three districts, Sheikhupura, Gujranwala and Okara, in semi-arid areas of Punjab. We selected these districts based on consultations with stakeholders including farmers, village leaders, NGOs and agricultural officers in the organic industry. The selection of these districts was also based on prior information about the presence of organic farming in these districts. Many non-government organizations and firms have been undertaking Farmers Field School (FFS) training in organic methods in these districts. Because of this, our expectation was that some data of farmers currently using organic method would be easily available in these districts. Farmers typically grow two crops during the year in the study area. Rabi and Kharif are the two main seasons[6] and the main crops grown in these two seasons are wheat and rice. The temperature is hot (48°C) in the summer but chilly (1 °C) and dry in winter. The area is largely canal irrigated. In addition, ground water is also extensively used for irrigation. Flood irrigation is the dominant strategy, whereby a field is essentially flooded with water which is allowed to soak into the soil to irrigate plants.

Data: We purposively sampled and selected 500 farmers (Organic and Conventional) from the three districts for our study. The names of farmers were sorted by alphabetical order and assigned a number. The random sampling technique was used to select sample farmers which ensures that every household must has an equal probability of being included in the sample irrespectively of his/her farm size in the study area. In order to identify closely conventional farmers, we set the proximity as the basic criteria. Our final dataset includes information from 224 conventional and 220 organic farmers. Data were collected through a survey of the heads of the farm households conducted during the months of May and June 2011.A farm questionnaire was used to obtain information on household characteristics, land ownership, cropping methods and practices, inputs and outputs. This questionnaire was administered to 444 farmers or heads of the household.

Soil organic matter provides the base for productive organic farming and sustainable agriculture. It is an important source of nutrients and can help increase biodiversity, which provides vital ecological services including crop protection. For example, adding compost and other organic matter reduces crop diseases, and also increases the number of microbe species in the agro ecosystem (Altieri1999; Van-Elsen, 2000). In order to assess the soil health of the wheat-rice cropping system in our study districts in Punjab, we collected soil samples for our study from three locations from every post crop selected field and considered mean of these 3 values. The samples were drawn at the depth of 0-15, 15-30, 30-60 and 60-90cm from each location. Thus, we collected a total 800 samples from 200(100 organic and 100 conventional) farm plots. Three soil nutrients viz., Nitrogen, Potassium and Phosphorous- (NPK)were the focus of the soil tests. Samples from each location and depth were analyzed for available nitrogen (kg $\boldsymbol{ha^{-1}}$), available phosphorous (kg$\boldsymbol{ha^{-1}}$) and available potassium percentage of the soil.

Methods of Analysis: In order to examine differences between organic and conventional farms, we look at three main indicators: a) costs of inputs; b) yield and profitability; and c) soil health. Thus, we focus on both the private (profitability and yield) benefits of organic farming and the public (soil) benefits. To understand why farmers may be interested in organic versus conventional farming, we ask if there are significant difference in private returns to these two practices and establish the differences between organic and conventional farming by looking at mean differences in input costs, yields and profits. While there are other econometric approaches[7] that can be used, in this paper, we provide initial analyses of mean differences. The strength of mean differences is established by using a t-test to check whether the differences are statistically significant. Costsand revenues are estimated by multiplying market prices by input and output quantities. An important input to agriculture is water in irrigation. To estimate the value of the water used, data were collected on the number of cycles of irrigation, time used per cycle and per hour cost of water from different sources e.g. tube well, canal, peter and bore.

Higher labour intensity is a typical characteristic of organic agriculture (Demiryurek and Ceyhan, 2008). Labor is mainly used for planting and harvesting in our study region. The basic activities are plant nutrition and care (manuring, fertilizing, spraying, placing pest traps and preparing land) and harvest (collecting, drying and dehusking). In our study, we value family labor at the rate of permanent hired labor without meals. Family labor refers to family labor who regularly work on the farm,

[6] Rabi crops are generally sown in October/November and harvested in April/May. Wheat is the major Rabi crop across the country. Kharif season starts in May/ June and ends in September/October. Rice is the major crop of this season.

[7]Other techniques that are used in literature to compare organic and conventional farming are input-output-based life-cycle technique (wood *et al.*, 2006), exponential regression analysis (de Ponti *et al.*, 2012) among other. Our choice of comparing mean is based on our purpose of the study.

while the work done by family members that are not regularly engaged on farm is included in casual labor and valued at the rate paid to workers hired on daily wages. Typically, labor cost is computed on a per hour basis, but in this study we have used per hectare cost of labor because of limited data on per hour wages in this region. To estimate profits, we first divide gross revenues by the total hectares of cropland to obtain per hectare revenues and subtract average costs from average revenues to obtain profits. We obtain the benefit cost ratio for each crop by dividing per hectare revenues by per hectare costs.

RESULTS AND DISCUSSION

In terms of ownership, survey results show that a majority of farms (53%) are owned by the farmers themselves. In cases, where they did not own their farms, farmers typically leased land from other farmers. Leasing of agriculture land is a years old common practice in the Punjab province. The average conventional land-owners in our sample owned 4.6 ha of land while organic farmers owned, on average, 4 ha of land. Typically, the same farmer either grew organic produce or conventional produce. 14 % of the sample farmers grew both types of crops.

The mean age of the organic and conventional farmers is similar and between 40-41 years. Family size in both cases is approximately 6 members per household. Organic farmers tend to be more educated.95% of the organic farmers are literate compared to 75 percent conventional farmers. Organic farmers perform better in all higher education categories relative to conventional farmers. Although many farmers have other jobs apart from farming, they spend most of their time in agriculture and most of their income earned from agriculture. Factors such as low farm income, seasonal production, temporary unemployment, higher risks in agriculture and desire to increase income, create pressure for farmers to seek other occupations.

The average per month income associated with organic farmers is significantly higher than conventional households (PKR 34,033 and 30,170 respectively). Household monthly income is proxied using the expenditure method. Thus, expenditure per month is defined as the monetary value of all expenditures made by the household in the farm in cash plus the value of household grown [8] agriculture products used for consumption.[9]

Private Costs and Benefits from Organic and Conventional Farms: In this section, we discuss differences in the mean values of inputs used, productivity and profits and indicators of soil health in organic and conventional farms.

Use of Inputs: This section compares organic and conventional producers in terms of input use. The type of input used is one of the main factors which differentiate organic production systems from their conventional counterparts (Rigby and Caceres, 2001).As Table 1 shows, the per hectare irrigation cost is slightly lower in organic wheat and rice compared with their conventional counterparts. Average expenses on irrigation arePKR10,483andPKR10,885for organic and conventional wheat respectively. For the organic and conventional rice farms these expenses amount to PKR35,659andPKR36,035 respectively, though these differences are statistically insignificant. In general, we found that, on average, organic and conventional farms use similar amounts of water.

Organic farmers in our sample did not use synthetic fertilizers or pesticides and relied on organic fertilizers and pesticides.[10]Farm and poultry manure were heavily used in organic farming. Field discussions, however, suggest that organic fertilizers are becoming more popular among organic producers due to its easy availability while organic pesticides are in less use due to their unavailability and higher cost. Conventional producers applied pesticides like Logran, Bernoxil, Safinor and Proton to control pests, which some users may consider as hazardous.[11]Interestingly, manure is a popular and commonly used fertilizer as both types of farmers believe that it is a source of plant nutrients and organic matter.

Table 1 presents the monetary value of the fertilizer and pesticides used of per hectare. Fertilizers and pesticides expenditures significantly differ across systems as well as crops. We used market prices to

[8]Household grown products include livestock and dairy products.

[9] Understandably, this may not be a complete accounting of household income as it does not account for savings of the households. However, it is well known that consumption is a good proxy for household welfare especially when survey questions on income result in data which can be noisy and unreliable.

[10] Fertigrain, Vokozom, Tecamin and Grozen are commonly used as organic fertilizers while Mera, Bonus, Tumma and Aak are used to control pest attack (Information extracted from survey).

[11] "Most pesticides are toxic to human beings; WHO has classified their toxic effects from class Ia (extremely hazardous) to class III (slightly hazardous) and then "active ingredients unlikely to present acute hazard".
"Most class-I technical grade pesticides are banned or strictly controlled in the regulated industrialized world, but not in developing countries, where class-I pesticides are freely available in places that do not have the resources for their safe use".

estimate the costs of both conventional and organic fertilizers and pesticides. Conventional fertilizer's cost is, on average, more than twice as the fertilizer costs of organic farms. Pesticides are also significantly more expensive as an input in conventional farms.

Table 1.Per Hectare Cost of Inputs (PKR)for Organic and Conventional Farming in Pakistan.

Inputs cost (per hectare)	Wheat#		*Mean Difference*	*T-Statistics*	Rice#		*Mean Difference*	*T-Statistics*
	Organic$	Conventional$			Organic$	Conventional$		
Water	10438	10885	447*	3.31	35659	36035	376	0.85
	(39.32)	(48.75)			(114.26)	(138.01)		
Fertilizers	8733	19892	11159*	27.43	6867	13566	6699*	14.19
	(55.36)	(153.74)			(58.82)	(197.26)		
Pesticide	1458	3291	1833*	29.72	2819	3761	942*	7.49
	(8.87)	(23.06)			(25.08)	(46.88)		
Labor	11458	10951	507**	2.17	13793	12103	1690*	6.24
	(69.91)	(80.44)			(78.67)	(74.36)		
Otherinputs	19358	19266	92	0.29	20072	22266	2194*	7.07
	(121.67)	(43.43)			(93.41)	(79.69)		
Total	51445	64285	12840*	20.20	79210	87731	8521*	10.32
	(171.79)	(201.47)			(209.33)	(265.72)		

Note: *Standard errors are in parenthesis. $ Represent mean values.*, ** Shows level of significance at 1% and 5 % level respectively # shows number of observations. There are 220 and 224 observations respectively for organic and conventional wheat while for organic and conventional rice it is 208 and 173 respectively.*

Table 2: Per Hectare Cost of Labor (PKR) by types in Organic and Conventional Farming in Pakistan#.

Labor cost (per hectare)	Wheat		*Mean Difference*	*T-Statistics*	Rice		*Mean Difference*	*T-Statistics*
	Organic$	Conventional$			Organic$	Conventional$		
Casual	2520	1191	1329*	3.95	4828	2619	2209*	3.18
	(154.51)	(32.50)			(286.66)	(85.38)		
Family	4584	5214	630**	1.99	4552	5061	509	1.28
	(127.56)	(130.16)			(133.21)	(124.18)		
Permanent	4354	4547	193	0.61	4413	4423	10	0.14
	(134.39)	(146.45)			(152.21)	(128.39)		

Note: Standard errors are in parenthesis. *$ Represent mean values * Shows level of significance at 1% level. # Exchange rate in 2010 was (1USD=PKR 84.33)*

Our estimates confirm that per hectare labor cost is significantly higher in organic farms than conventionally managed farms. The average labor cost per hectare of wheat crop is 4% higher in organic farms relative to conventional farms. For rice crop, the per hectare cost of labor is14% higher in organic relative to conventional farms. Our findings are similar to many other studies (IFAD, 2005; Lohr and Park, 2009). For example, (IFAD, 2005), reports say that due to double labor requirement input costs are higher in OA. Lohr and Park (2009) report that labor typically constitutes a higher level of variable input costs on organic than on conventional crop farms.

It is interesting to note that when labor is disaggregated by types, viz., -casual, family and permanent-, a different picture emerges. Only casual hired labor costs differ significantly across agriculture systems and crops (see Table 2). It is almost double in organic system than conventional ones. The fundamental reason behind this is the high dependence of organic farmers on manual methods to control weeds and pests.[12]The difference in permanent and family labor cost insignificant even though higher in conventional systems. One explanation for this observation may be that organic farmers are more educated and find other opportunities outside agriculture while conventional farmers, relatively less educated, have less employment opportunities outside agriculture.

In terms of 'other costs', both farming systems use the same kind of technology for land preparation, ploughing, and harvesting soother input costs do not differ much. Conventional rice exhibits a higher "other input" cost compared with organic rice due to the higher harvesting cost, which is directly proportional to productivity (Lyngbaek *et al*., 2001).

[12] Pest control and weed management are seasonal phenomenon, therefore, hired labor is preferred instead of permanent labor in organic farming. In conventional farms the permanent hired labor can spray chemicals on crops and there is no need to use hired labor.

In general, labor, irrigation and other input costs constitute more than 70% of the total production cost for organic as well as non-organic crops. Labor costs constitute a higher share of total input, but high unemployment and low wages keep these relatively low. Pesticides costs are small in the both agricultural systems as pest attacks on rice and wheat crops are not as severe as on cotton in the sample area. Organic wheat is 20% less expensive to produce relative to conventional wheat, while it is 10% less expensive relative to conventional rice.

Yield and Profitability Estimates: The literature suggests that there is no unanimity on the issue of productivity with respect to OA. Some studies have found that OA systems have lower yields than CA (Lyngbaek *et al*., 2001; Liebhardt, 2001; Carpenter, 2003; IFAD, 2005; McBride and Greene ,2009; dePonti *et al*., 2012), while many others have found the opposite result(IFAD, 2003; Eyhorn *et al*., 2005).Our findings support the former view that organic crops have significantly lower yields compared with conventional ones. Per hectare yield for organic and conventional wheat is 2280 kg and 4040kgrespectively,while for organic and conventional rice it is 2680 and 4240 kg. Thus, on average, wheat yield is 14% and rice yield is 45% higher under conventional versus organic farming.

One reason often offered for the lower yield of organic crops could be the so-called "organic transition effect." Generally, when there is transition from conventional methods to organic methods, the yield declines in the first 1 to 4 years, followed by an increase when soils have developed adequate biological activity (Neera *et al*., 1999; Martini *et al*., 2004). In our sample, about 70% of the organic farms have a long history (4 to 10 years) of organic farming, i.e. these farms have transitioned; some30 %of the farms are relatively new.

Table3 and 4show that despite the low yield, organic crops are more profitable due to higher price. The prices for organic products are almost double and significantly higher than their counterparts. It seems that price premiums are adequate to offset the disadvantage of low yield. However, the profit difference is statistically insignificant for wheat as well as rice. The per hectare estimated economic profits for organic and conventional wheat arePKR30,482 and PKR28,216respectively.

The profit in producing organic rice is PKR33,880 while for conventional rice it is PKR32,990.The monetary profits show similar trend. The per hectare estimated monetary profits is defined as revenue minus explicit cost. monetary profits for organic and conventional wheat are PKR 35, 066 and PKR 33, 430per hectare respectively while it is PKR 38,431 for organic and PKR 38,051 for conventional rice (see Table 4). However, the difference in profits is in-significant as anticipated.Similar findings have been reported by previous studies like (Reganold*et al*., 2001; Smith *et al*., 2004).

Benefit Cost Ratio: The Benefit Cost Ratio (BCR), which is the ratio of the benefits of an activity or production, relative to its costs, both expressed in monetary terms (Mehmood *et al*., 2011), suggests which crop provides more benefits to the farmers (Gurmani *et al*., 2006). The BCR of both farming systems is estimated to be 1.63 and 1.45 for organic and conventional wheat respectively. Due to lower cost of production and higher price premium the BCR is higher for organic wheat. The ratio suggests that farmers can get higher profits by moving from conventional to organic wheat. (Gurmani *et al*., 2006; Hisbani, 2000) also find higher BCR for organic wheat in Pakistan. The Benefit Cost Ratio is 1.42 and 1.36 for organic and conventional rice respectively, which mean growing organic rice is more profitable than conventional rice. Mehmood *et al*., (2011) also report a higher BCR for organic rice as compared to conventional rice.

Our discussion shows that organic crops are more profitable than conventional crops based on their high price premium that they earn from the markets. However, according to Sanders *et al*., (2008) this reliance on premium price may jeopardize the economic viability of organic farms in the medium/long-term. Therefore, these results could be interpreted with caution to reach a meaningful policy in context of organic farming.

Sustainability and Organic agriculture: The impact of OA on soil properties has been researched comprehensively (Poudel *et al*., 2002; IPCC, 2007a; Leifeld, 2012). Results show that OA tends to conserve soil fertility and system stability better than conventional systems. This is due to mostly higher organic matter contents and higher biological activity in organically farmed soils than in conventionally managed ones (Pimentel, 2005).One of the advantages of OA is that it builds living soil and provides nutrients to the plants but also favors conditions for efficient growth of micro-organism. To understand the soil health of the wheat-rice system in our study area, we assessed the status of three important soil nutrients required for healthy crops – nitrogen, potassium and phosphorous.

Nutrient Status of soils: Our survey reveals that the available nitrogen (kg$\boldsymbol{ha^{-1}}$)[13] is significantly higher at each layer/depth in organic field soils than in conventional farms. Nitrogen decreased with the increase in soil depth in both organic and conventional fields. The higher concentration of Nitrogen at surface level may be due to accumulation of leaf litter and its gradual decomposition and mineralization, particularly in organic fields.

[13]Kilogram per hectare.

Phosphorous analysis shows that soils under higher concentration of Phosphorous in the upper layer of soil profile may be related to presence of more organic matter in upper layer of soil profile.

The concentration of Potassium in organic farm soils is also higher than in conventional ones. Once again, the concentration of Potassium decreased with the organic fields are healthier than non-organic fields. The increase in depth. These results are in conformity with other studies(Clark *et al*., 1998;Armstrong *et al*., 2000). The results show that organic farming uses soil nutrients in a more judicious way ensuring the sustainable fertility of land.[14]

Table 3. Per (Kg) Price for each crop (PKR)in Organic and Conventional Farming Systems in Pakistan.

Wheat		*Mean*	*T-*	Rice		*Mean*	*T-*
Organic[$]	**Conventional[$]**	***Difference***	***Statistics***	**Organic[$]**	**Conventional[$]**	***Difference***	***Statistics***
36.75	23.08	13.67*	74.17	41.88	28.1	13.7*	58.24
(7.20)	(1.56)			(5.36)	(7.82)		

Note: Standard errors are in parenthesis.*$ Represent mean values.* * *Shows level of significance at 1% level*

Table 4: Production and Profit (per Hectare) estimates in both agricultural systemsin Pakistan.

Crop Name	**Wheat**			**Rice**		
	Production (kg)	**Profit (PKR)**	**Monetary Profits (PKR)**	**Production (kg)**	**Profit (PKR)**	**Monetary Profits (PKR)**
Organic	2280	30482	35066	2680	33880	38431
	(0.392)	(607.32)		(0.350)	(684.20)	
Conventional	4040	28216	33430	4240	32990	38051
	(0.302)	(377.67)		(1.396)	(1411.75)	
Mean Difference	1760*	2266	1636	1560*	890	380
T- Statistics	36.57	1.30	----------	12.03	0.24	----------

**Shows level of significance at 1% level*

Conclusions: The purpose of our study was to examine the economics and productivity of two systems of agriculture i.e. organic and conventional. In order to do so, we studied two crops, wheat and rice, in three districts, Sheikhupura, Gujranwala and Okara, of Pakistani Punjab. We used conventional physical and financial accounting methods to examine differences between regular and organic farms.

We found that the average organic farm produced 14% less wheat and 44% less rice per hectare relative to the average conventional farm. However, despite lower yield, organic crops are at least as profitable as conventional farms. If there is a significant difference in profits, we would expect an en-masse move from one system to the other, which has not been observed. In fact, if fertilizer and pesticides subsidies for conventional agriculture are withdrawn or a subsidy for organics is introduced, there may be a natural shift from conventional to organic farming as this would tilt the profit balance.

Organic farms compare with conventional farms in terms of average profits because of the higher prices obtained for organic produce in niche markets and because organic farming is less costly. Fertilizers and pesticides costs are significantly lower in organic farms, water costs are similar to conventional farms and labor costs are higher. However, on average, the organic farms in our sample produced wheat per hectare at 20% and rice at 10% of the costs of typical conventional wheat and rice farms.

Organic farms are better for soil health. Soil nutrient tests show that organic crops tend to better conserve soil fertility and system stability than conventional farming systems. There is good reason for governments therefore to offer financial incentives to encourage OA long term sustainable use of soils.

During meetings and interviews, stakeholders pointed to four problems that organic agriculture confronts. First, markets for organic products are not well developed. Secondly, the organic inputs are not easily available to farmers due to their high prices and the lack of supply outlets in smaller cities and villages. Consequently, for pest and weed control, farmers are constrained to use only mechanical and biological methods to which they have immediate access. Third, there is little institutional support for organic farming as no subsidies are available for organic products. Lastly, the lack of zoning for organic farming may lead to pest migration to organic fields from conventional ones, which could severely damage OA crops.

Organic agriculture needs to be encouraged as it is economically as well as ecologically viable in Pakistan. It can ensure sustainable use of natural resources. The more labor intensive nature of the organic farming would

[14]All these finding are based on the simple mean test.

also provide employment for rural unskilled workers, especially women. By switching to organic farming Pakistan can save valuable foreign exchange used to import chemical fertilizers and pesticides and direct it towards other social needs. However, for organic agriculture to succeed in Pakistan, issues such as zoning and market development need to be aggressively pursued. The question of food security remains a matter of future research as there is a popular belief that organic agriculture cannot feed the world's population.

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