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The Public and Private Benefits from Organic Farming in Pakistan

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Contents

Abstract

Wheat and Rice are major crops grown in Pakistan. This paper compares mean differences in the productivity and profitability of organic and conventional farms that grow these crops based on primary data collected from 444 farms. We find that growing organic crops is atleast as profitable as conventional crops because of lower input costs and higher output prices. Overall, per hectare input costs are 20% and 10% lower in organic wheat and rice farms relative to their conventional counterparts. These lower costs, however, are likely to be related to the lower yields associated with organic farms. Soils data show that the availability of nutrients such as Potassium, Phosphorous and Nitrogen is significantly higher in organic fields relative to conventional fields. Thus, 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 through reductions in subsidies for conventional farming and more careful zoning and market development. Farmer's adoption of commercial organic farming, however, will largely depend on how demand for organically farmed food continues to grow in Pakistan.

Key words: Pakistan, Organic Farming, Wheat, Rice, Profits, Soil Nutrients.

The Public and Private Benefits from Organic Farming in Pakistan

1. Introduction

Agriculture is an important sector of Pakistan's economy. It contributes 21 percent to the GDP and employs more than 43.7 percent of the country's total labor force. It supports directly or indirectly about 68 percent of the population for their sustenance and 60 percent 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 to a 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).[1] 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 (Ramesh *et al.,* 2005; Letter *et al.,* 2003). 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; 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 production of wheat and rice respectively (Quddus and Mustafa, 2011). 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

[1] The environmental price of current agriculture practices includes increased soil erosion, surface and ground water contamination, release of greenhouse gases, increased pest resistance, and loss of biodiversity (Badgley *et al.,* 2006).

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.

2. 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.[2] 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 (see Table 1 on the extent of organic agriculture promoted by different companies and organizations).

As a response to environmental and economic challenges in the agricultural sector and because imports of chemical fertilizer and synthetic pesticides are expensive, the Government of Pakistan has become an advocate of OA. A separate Directorate of OA at the National Agriculture Research Centre (NARC) was established in 2008.[3] In addition to many other functions, the Directorate of Organic Farming seeks to ensure that appropriate technology is disseminated to farming communities. Under this Directorate, 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.[4]

Pakistan's organic farms are certified by Control Union Certifications Zwolle, the Netherlands for organic production methods according to regulation (EEC NO.2092/91) and for USDA-NOP[5] standards.[6] 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 are 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[7] or directly to larger certified firms - Panda, Prince Departmental Store, Sultan Son's (Sarafraz and Abdullah, 2014). Hotels, foreigners and affluent households are major consumers of organic food. Marriot and Serena hotels in Islamabad are prime examples of organic buyers. Formal markets for organic farm inputs are almost non-existent and most of the farmers rely on own production (supported by NARC training) to increase land fertility and control weeds and pests.

3. Methods and Data

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. We 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 that can be used, in this paper, we provide initial analyses of mean differences. We establish the strength of the mean differences by using a t-test to check whether the differences are statistically significant.

We estimate costs and revenues by multiplying market prices by input and output quantities. To estimate profits,

[2] http://loksanjh.org/project-3/index.html
[3] http://old.parc.gov.pk/NARC/Organic/Pages/CurntRch.html, May 17, 2015
[4] http://www.parc.gov.pk/. Accessed April 15 2015
[5] The National Organic Program (NOP), standards describe the specific requirements that must be verified by a USDA-accredited certifying agent before products can be labeled USDA organic in the United States.
[6] http://www.pakof.com/ May 18, 2015.
[7] Government organizations sell these products in their own outlets but private farms sell these commodities to authorized shops.

we first divide gross revenues by the total hectares of cropland to obtain per hectare revenues. We 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.

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 agroecosystem (Altieri, 1999; Van Elsen, 2000). To understand if soil quality differences exist between organic and inorganic farms, we examine mean differences in soil indicators among these farms.

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 about the presence of organic farming.[8]

We purposively identified 500 farmers (Organic and Conventional) from the three districts for our study, who farmed in some proximity to each other. The names of these farmers were sorted by alphabetical order and assigned a number. Then the random sampling technique was used to select a sample of farmers for our study. Table 2 provides details on the sampling plan. Our final data set 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 gathered 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.

In order to assess the soil health of the wheat-rice cropping system in our study districts in Punjab, we collected soil samples from three locations from every post-crop selected field and calculated the 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), available phosphorous (kg) and available potassium percentage of the soil.

3.1 Summary Information

Farmers typically grow two crops during the year in the study area. Rabi and Kharif are the two main seasons[9] 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.

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. 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.

Table 3 provides demographic information. 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. As Table 3 shows, organic farmers perform better in all higher education categories relative to conventional farmers.

[8] 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.

[9] 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.

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)[10] (see Table 3). Household monthly income is proxied using the expenditure method. 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[11] agriculture products used for consumption.[12]

4. 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.

4.1 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).

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.[13] As Table 4 shows, the per hectare irrigation cost is slightly lower in organic wheat and rice compared with their conventional counterparts. Average expenses on irrigation are PKR 10,483 and PKR 10,885 for organic and conventional wheat respectively. For the organic and conventional rice farms these expenses amount to PKR 35,659 & PKR 36,035 respectively, though these differences are statistically insignificant. 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. These fertilizers are available in some limited stores that also sell conventional fertilizers.[14] In addition, farm (cows, sheep, goats and buffalo) and poultry manure were heavily used in organic farming. Field discussions, suggest that organic fertilizers are popular due to their easy availability, while organic pesticides are in less use due to their scarcity and higher cost. Conventional producers applied pesticides like Logran, Bernoxil, Safinor and Proton to control pests, which some users may consider as hazardous.[15] 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 4 presents the monetary value of the fertilizer and pesticides used of per hectare. We used market prices to estimate the costs of both conventional and organic fertilizers and pesticides. For conventional and organic fertilizers that were sold in shops, we used the prices obtained from shop keepers. There are local within village sales of poultry and farm manure. We used the local prices identified in the household surveys to value this manure. The quantity of fertilizer used was also identified through the surveys. As Table 4 shows, conventional fertilizers cost, on average, more than twice as much as the fertilizer costs of organic farms. Pesticides are also significantly more expensive as an input into conventional farms.

Higher labour intensity is a typical characteristic of organic agriculture (Demiryurek and Ceyhan, 2008). Labor

10 Exchange rate with respect to the US dollar in 2010 was 1USD = PKR 84.33

11 Household grown products include livestock and dairy products.

12 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.

13 Peter and bore are locally used terminologies for drawing ground water with engine and tractor respectively.

14 Fertigrain, Vokozom, Tecamin and Grozen are commonly used organic fertilizers available in the market, while Mera, Bonus, Tumma and Aak are used to control pest attack (information extracted from survey).

15 "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" (Eddleston *et al.,* 2002).

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, 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.[16]

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 crops, the per hectare cost of labor is 14% higher in organic relative to conventional farms (see Table 5). Our findings are similar to many others studies (IFAD, 2005; Lhor and Parker, 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 5). 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.[17] The difference in permanent and family labor is 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 so other 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).

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. Figure 2 shows the different costs for wheat and rice. As the Figure 2 and Table 4 suggest, that total per hectare cost of inputs is higher in conventional agriculture. Organic wheat is 20% less expensive to produce relative to conventional wheat, while organic rice is 10% less expensive relative to conventional rice.

4.2 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; Ponti *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 4040 kg respectively, while for organic and conventional rice it is 2680 kg and 4240 kg. 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 been in organic farming for 4 to 10 years,

[16] Temporary labor is available, to some extent, on per hour wage but permanent labor is usually hired on a monthly basis.

[17] 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.

i.e. these farms have transitioned from conventional farming., some 30% of the farms have a shorter experience with organic farming.

Table 7 shows 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 counter parts (see Table 6). It seems that price premiums are adequate to offset the disadvantage of low yield. The per hectare estimated economic profits for organic and conventional wheat are PKR 30,482 and PKR 28,216 respectively. The profit in producing organic rice is PKR 33,880 while for conventional rice it is PKR 32,990. However, the profit difference is statistically insignificant for wheat as well as rice. The managerial profits, which reflect returns on own capital, show similar trend. Managerial profits for organic and conventional wheat are PKR 35,066 & PKR 33,430 per hectare respectively while it is PKR 38,431 for organic rice and PKR 38,051 for conventional rice (see Table 7). However the difference in profits is insignificant as anticipated. Similar findings have been reported by previous studies like Reganold *et al.* (2001) and Smith *et al.* (2004).

4.3 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 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. Gurmani *et al.,* (2006) and 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. Mehmood *et al.* (2011) also report a higher BCR for organic rice as compared to conventional rice. However, t-tests of differences between conventional and organic outputs suggest that there is no significant difference in the benefit cost ratios between conventional and organic rice and wheat.

5. 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 higher organic matter and higher biological activity (Pimentel, 2005). One of the advantages of OA is 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.

5.1 Nutrient Status of Soils

Our survey reveals that the available nitrogen (kg) is significantly higher at each layer/depth in organic field soils than in conventional farms (Table 8). Nitrogen decreased with the increase in soil depth in both organic and conventional fields (Figure 3). The higher concentration of Nitrogen at surface levels may be due to accumulation of leaf litter and its gradual decomposition and mineralization.

The analyses of Phosphorous presented in Table 9 shows available Phosphorus in each layer of organic fields is statistically significant and higher than non-organic fields. The higher concentration of Phosphorous in the upper layer of the soil profile may be related to presence of more organic matter in the upper layer of the soil profile.

The concentration of Potassium in organic farm soils is also significantly higher relative to conventional ones (see Table 10). This concentration declines with an 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.

6. Conclusions and Policy Implications

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 yields, organic crops are at least as profitable as conventional farms. If there was 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 pesticide subsidies for conventional agriculture are withdrawn or a subsidy for organics is introduced, there may be a natural shift from conventional to organic farming. On the other hand, if more farmers enter the organic farming business, this would likely reduce the output prices of organic produce and thereby reduce profits.

Organic farms compare well 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. On average, the organic farms in our sample incurred a per hectare production cost that was 20% less for wheat and 10% less for rice in comparison to conventional wheat and rice farms. However, these lower costs may be related to the lower productivity of organic farms.

Organic farms are better for soil health. Soils data show that the availability of nutrients such as Potassium, Phosphorous and Nitrogen is significantly higher, at different layers of depth, in organic fields relative to conventional fields. Thus, organic farms tend to better conserve soil fertility and system stability than conventional farms. There is good reason for governments therefore to offer 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 with limited 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 is economically viable and is certainly ecologically better for agricultural lands. The more labor intensive nature of the organic farming would 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 subsidies for conventional inputs, 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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Tables

Table 1: Areas under different organic crops in Pakistan

Sr. No	Province	Area (acres)	Crops	Name of company /organization
1	Punjab	15,000	Basmati	Taj Food, Pakistan Organic Food and Hamza Food
2	Punjab	6,000	Mango, Guava, Orange	Taj Food and Pakistan Organic Food
3	Punjab	3,000	Cotton	15 private companies are involved in cotton business
4	Sindh	3,000	Dates	Taj Food, Noor Food, Sindh Food and Sardar Food
5	NWFP	5000	Dry fruits	Taj Food, Pakistan Organic Food and Hamza Food
6	NWFP	1000	Apple	Taj Food
7	Sindh	4000	Rice (IRRI 6)	Best, ECO Food
8*	Punjab	16000	Wheat	GCO, POC, Taj Food, NARC
9**	NWFP	2500	Apricot, Apple, Vegetables	Agha Khan rural support program
10*	Punjab	18000	Vegetables	GCO, POC, Taj Food, NARC, LokSanjh

Source: Survey of organic food growers in Pakistan (Hussain, I, 2006) Adopted with changes from Asim (2007)* Focus group discussions (NARC, GCO, LOCK SANJH, POC) ** Agha Khan rural support program

Table 2: Sampling plan

DISTRICTS	VILLAGES	NUMBER OF FARMS SELECTED	
		Organic Total (220)	Conventional Total (224)
SHEIKHUPURA Organic (91) Conventional (89)	Walipur Bora	30	29
	Muhammad Pura	18	22
	Kotwar	21	20
	Mulamianwal	22	18
GUJRANWALA Organic (68) Conventional (71)	Maan	20	24
	Kot Bilal	16	14
	Jajuke	14	15
	Jagowal	18	18
OKARA Organic (61) Conventional (64)	Sherinmafi	21	19
	Baker Ke Maher	15	16
	Hujra Shah Moqeem	16	17
	Batherana	9	12

Source: Own survey

Table 3: Socio-economic characteristics of survey respondents

Level of Education	Conventional Farmers	Organic Farmers
Illiterate (%)	25.4	5
Primary (%)	30.4	36.4
Middle (%)	21.0	24.1
Secondary and Higher Secondary (%)	16.5	30
Graduation & Above (%)	6.7	4.5
Age (in Years)	41	40
Family Size	7	6
Household monthly expenditures(PKR)	30170	34033
Farm Size (hectare)	4.66	4

Table 4: Per hectare cost of inputs (PKR)

Inputs cost (per hectare)	Wheat		Mean Diff (Conventional – Organic)	Rice		Mean Diff (Conventional-Organic)
	Organic N=220	Conventional N=224		Organic N=208	Conventional N=173	
Water	10438	10885	447***	35659	36035	376
Fertilizers	8733	19892	11159***	6867	13566	6699***
Pesticide	1458	3291	1833***	2819	3761	942***
Labor	11458	10951	-507***	13793	12103	-1690***
Other inputs	19358	19266	-92***	20072	22266	2194***
Total	51445	64285	12840***	79210	87731	8521***

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 5: Per hectare cost of labor (PKR) by types

Labor cost (per hectare)	Wheat		Mean Difference	Rice		Mean Difference
	Organic	Conventional		Organic	Conventional	
Casual	2520	1191	-1329***	4828	2619	-2209***
Family	4584	5214	630***	4552	5061	509
Permanent	4354	4547	193	4413	4423	10

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 6: Price per (kg) for each crop (PKR)

	Wheat		Mean Difference	Rice		Mean Difference
	Organic	Conventional		Organic	Conventional	
Mean Price	36.75	23.08	13.67***	41.88	28.1	13.7***

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 7: Production and profit (per hectare) estimates in both agricultural systems

Crop Name	Wheat			Rice		
	Production (kg)	Profit (PKR)	Managerial Profits (PKR)	Production (kg)	Profit (PKR)	Managerial Profits (PKR)
Organic	2280	30482	35066	2680	33880	38431
Conventional	4040	28216	33430	4240	32990	38051
Mean Difference	1760***	2266	1636	1560***	890	380
T. Statistics	36.57	1.30	–	12.03	0.24	–

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 8: Available nitrogen (kg/ha) in the soil in organic and conventional fields

	Mean values of Nitrogen (kg/ha) estimates at three locations in the field		
Depth (cm)	Conventional$	Organic $	Mean Difference
0-15	123.11	123.28	0.77
15-30	107.57	111.52	3.95**
30-60	92.23	93.97	1.74***
60-90	75.10	79.00	3.90***

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Table 9: Available phosphorus (kg/ha) in the soil in organic and conventional fields

	Mean value of Phosphorus (kg/ha) estimates from three different locations from the same field		
Depth (cm)	Conventional$	Organic$	Mean Difference
0-15	19.81	21.99	2.18***
15-30	14.40	19.99	5.59***
30-60	12.00	14.75	2.75***
60-90	7.14	10.97	3.83***

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

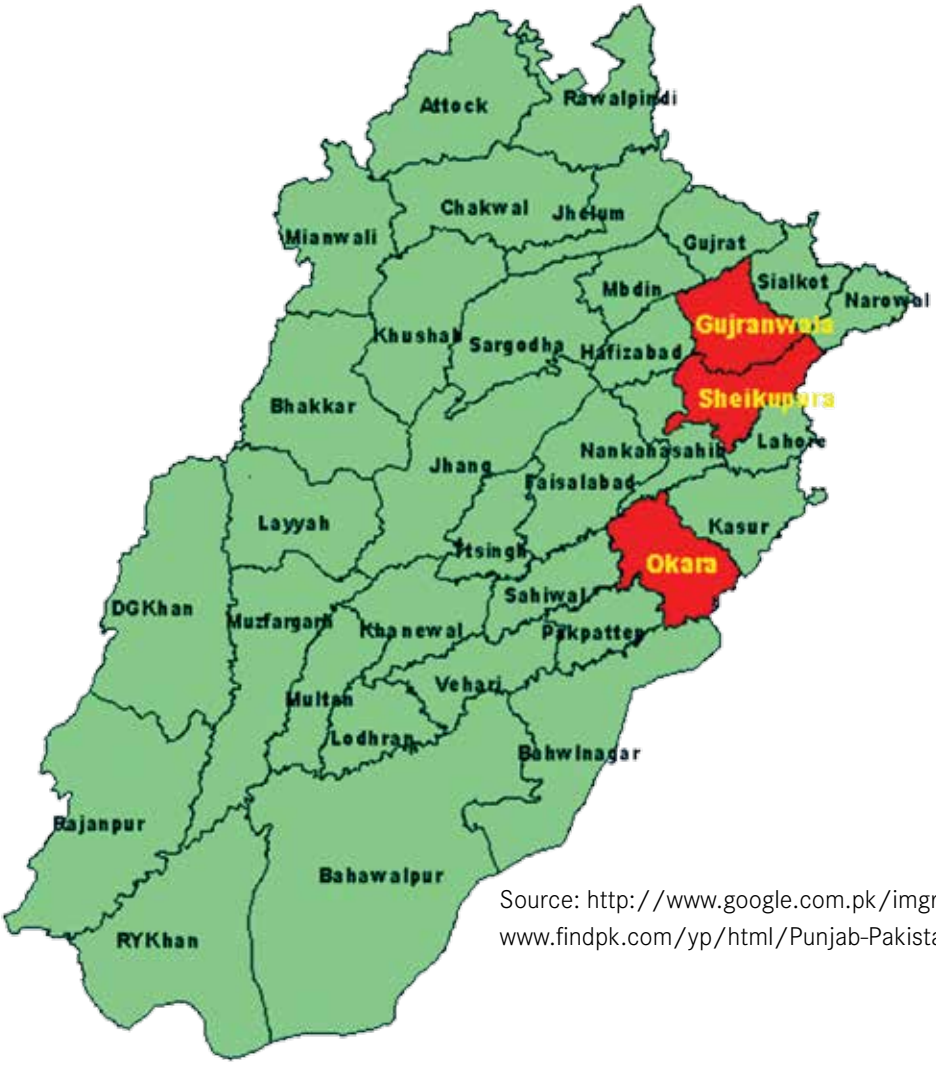
Table 10: Available Potassium (%) of the soil in organic and conventional fields

	Mean value of Potassium (%) estimates from three different locations from the same field		
Depth (cm)	Conventional	Organic	Mean Difference
0-15	1.58	1.63	0.05***
15-30	1.49	1.57	0.08**
30-60	1.44	1.50	0.06***
60-90	1.38	1.44	0.06**

Note: ***, ** and * denote significance at 1%, 5% and 10%, respectively.

Figures

Figure 1: Study area



Source: http://www.google.com.pk/imgres?imgurl=http://www.findpk.com/yp/html/Punjab-Pakistan

Figure 2: Per hectare cost of inputs in wheat and rice crops (PKR) in both agriculture systems

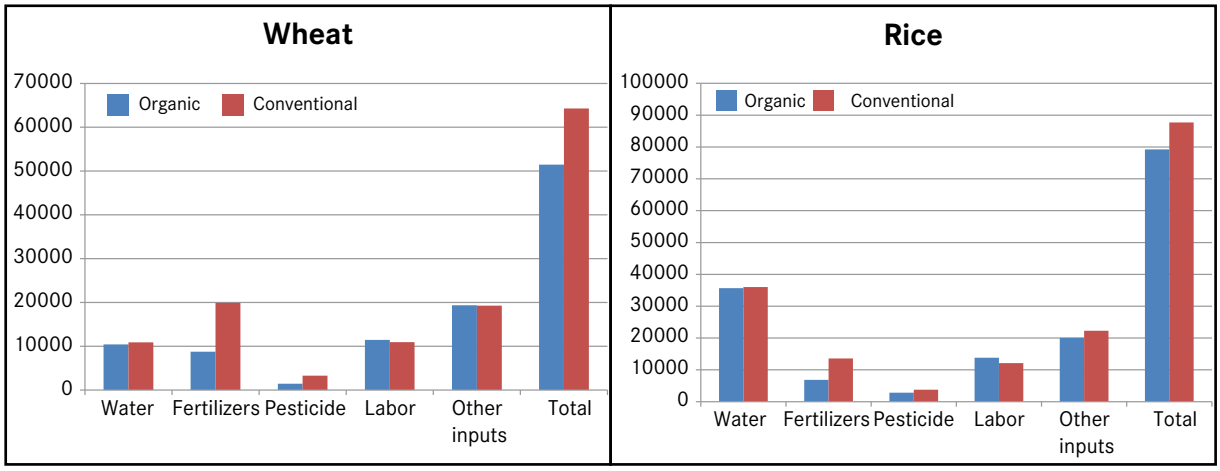
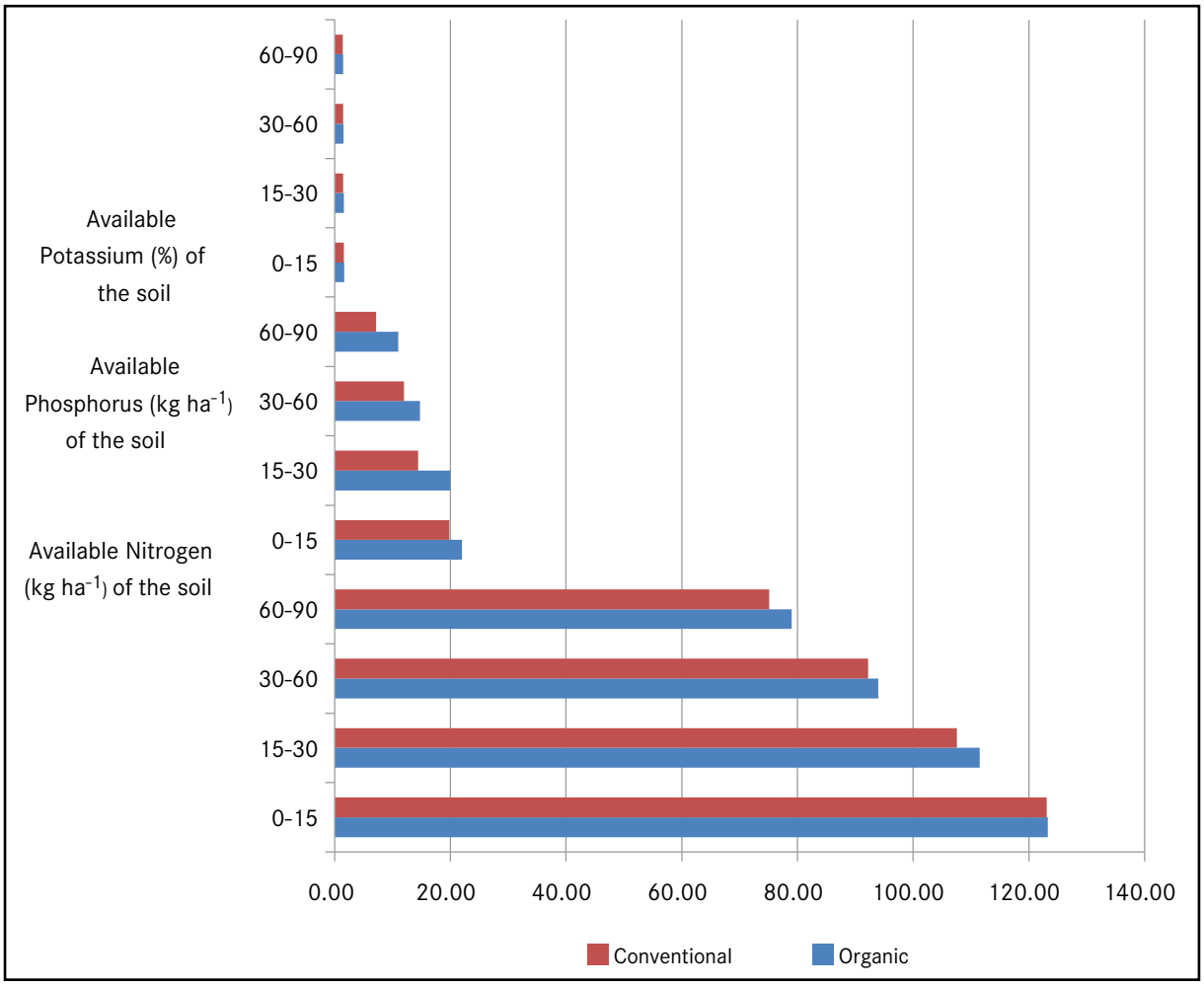


Figure 3: Available Nitrogen (kg ha^{-1}) of the soil, Phosphorus (kg ha^{-1}) and Potassium (%) of the soil in organic and conventional fields



Appendix

Organic and Conventional Agriculture Survey Questionnaire

My name is_____ and I am from (FUUAST) School of Economic Sciences, Federal Urdu University of Arts, Science& Technology Islamabad. The purpose of this questionnaire is to investigate the sustainability of organic farming in Pakistan by comparing output and input use in both conventional and organic farming systems. It is for research purposes only. Please answer the questions to the best of your knowledge. Answers will be kept completely confidential and will only be presented in a summary format.

Do you agree to participate in this survey? 1. Yes ☐ 2. No ☐

If yes, continue the survey

Interviewer ID: _____

Time started: _____

Name _____

Village _____

Address _____

Section 1: Socio-Demographic Information of Household*

A.1. Are you household head? Yes ☐ No ☐

A.2. If no, what is your relation to HH _____

A.3. Do you make all the decision on the farm? Yes (please go to A.3) NO

A.4. If no, please explain, who makes the decision (enter HH code_____)

A.5. Please provide information of other household members.

1	2	3	4	5	6	7	8
SN	**Gender 1=Male 0=Female**	**Age (yrs)**	**Relation to HH head A**	**Marital status B**	**Primary** occupation C**	**Secondary** occupation C**	**Education (Completed degree) D**

*Household: is a person or group of people sharing accommodation and food for at least 3 months over the past 12 months calculatingfrom the time of the survey. These people also share a collective fund.

**Occupations are defined on the basis of time spent in an occupation during the employment period. Main occupation is defined as the profession in which the household spent more than half during the employment period.

Codes for Section 1

Code A: 1-Self, 2-Wife/Husband, 3-Son/daughter (incl. Adopted), 4-Son/daughter in law, 5-Father/mother, 6-Father/mother in law, 7-Sister/brother, 8-grandchild, 9-nephew/niece, 10-cousin, 11-other relatives, 12-non-relative.

Code B: 1-Unmarried, 2-Married, 3-Widow, 4-Divorced/separated.

Code C: 1-Engaged in own agriculture, 2-Off-farm owned business, 3-Causual off-farm labor in agriculture, 4-Causual labor in non-agriculture, 5-Permanantly employed in agriculture, 6-Permanantly employed in non-agriculture, 7-Government official, 8-Housewife, 9-Student/pupil, 10-Child below school age, 11-Unemployed, 12-Performing only occasional and light work, 13-Retired/pensioner, 14-Other, please specify…….

Code D: General: 0-Illiterate, 1-Literate (read and write without grade), 2-Primary, 3-Secondary, 4-High school (SLC passed), 5-Intermediate, 6-Graduate, 7-Post-graduate, 8-Other, please specify……..Technical/ Professional: 9-Certificate (Polytechnic), 10-Diploma (Polytechnic), 11-Degree (agriculture, forest, engineering, medicine veterinary, etc.), 12-Teacher's training, 13-Nurse training, 14-Diploma in Pharmacy, 15-Other, please specify…….

Section 2: Farming and Live Stock

Part A: Farm size and ownership

A.1 Please provide information about farm size (acres) and ownership

Ownership ID A	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Total

Part B: Crop production

B.1 In the past year did you grow [crops] on your own land or land rented or share cropped from others.

Crop ID A	Season ID B	Plot ID C	Size (acres)	Production (kg)	Amount Sold	Price (Rs/kg)	Market ID D

Part C: Live stock

Please provide information about the livestock:

SN	1	2
	Livestock	Number
1.	Buffalo	
2.	Cows/ox	
3.	sheep/Goat	
4.	Chicken	
5.	Duck	
6.	Other (please specify).....	
7.		
8.		

Codes for Section 2:

Part A:

Code A: 1- Owner, 2- Tenant, 3- Share cropping, 4- Others

Part B:

Code A: 1- Wheat, 2- Barley3- Gram4- Masoor 5- Mustards 6- Onion 7- Rice7 8- Mash 9- Mong 10-Sunflower 11- Soyabeen 12- Maize 13- Cauliflower 14- Cabbage 15- Turnip 16- Raddish 17-Tomoto 18-Potato 19-Ginger 20-Garlic

Code B: 1- Rabi 2- Kharif

Code C: 1- Plot 1, 2- Plot 2, 3- Plot3, 4- Plot 4

Code D: 1-Self consumption 2- Directly to the Local Market 3- Intermediaries 4- Other towns within the District 5- District market 6- Other districts

Section 3: Expenditure on Agri Inputs

Part A: Irrigation

A. 1 What is per hour cost of irrigation in your area?

Tube well	(a) High Horse Power (Rs_____)	(b) High Horse Power(Rs_____)
Bore	(a) Horse Power (Rs_____)	(b) Low Horse Power
Peter	(a) High Horse Power (Rs_____)	(b)Low Horse Power
Canal	(Rs_____)	

A.2 Please provide information about irrigation of crops in the following table (use additional sheet if required):

Crop ID*	Season ID*	plot ID*	Size (acres)	Irrigation code A							Time consumed in irrigation (hours) A						
				1.a	1.b	2.a	2.b	3.a	3.b	4	1.a	1.b	2.a	2.b	3.a	3.b	4

* Codes for crop season & plots are the same as in section 2 part A.

Codes for Section 3, Part A

Code A: 1.a- High Horse power tube well, 1.b- Low Horse Power Tube well, 2.a- high horse power bore, 2.b- low horse power bore, 3.a high horse power peter, 3.b- low horse power peter, 4- Canal Water

Part B: Use of fossil fuel

Please provide information about the Fossil Fuel consumed by irrigation source:

	Irrigation source	Liter/hour
Bore	(a) High Horse Power	..... (b) Low Horse Power.....
Peter	(a) High Horse Power	..... (b) Low Horse Power.....

Part C: Farm employment

C.1 Permanent workers employed on your farm in (a) Rabi..... (b) Kharif .....?

C.2 Wage rate/month: 1. With meal _____ 2. Without meal _____

C.3 Family members permanently engaged on farm in (a) Rabi.....(b) Kharif.....?

C.4 Please provide information about labor provided by casual laborers, including unpaid family members:

Crop ID*	Season ID*	No. of workers	Male			Female		
			Labour code A	Wage/day	No. of days worked	Labour code A	Wage/day	No. of days worked

* Codes for crop & plots are the same as in section 2 part A.

Codes for section 3 part C

A- 1. Hired laborers, 2.Family members, 3. Unpaid worker

Part D: Fertilizers and pesticides

D.1. Please provide information about fertilizers and nutrients used in the production of crops in the following table including manure (use additional sheet if required):

Crop ID*	Name of fertilizer/ nutrient	Area (acre)	Quantity used (kg)	Cost/unit

* Codes for crop are the same as in section 2 part A.

D.2 Please provide information about pesticide used on this farm in the following table (use additional sheet if required):

Crop ID*	Name of pesticide	Chemical name	Area (acre)	Quantity used (kg)	Quantity used (litre)	Total Price (Rs)

* Codes for crops are the same as in section 2 part A.

D.3 Please provide information about other inputs used in the production of crops in the following table (use additional sheet if required):

Crop ID*	Area (acre)	Seed cost	Soil testing & other services	Ploughing including land preparation	Sprayer cost	Thrashing /Other machinery

* Codes for crop & plots are the same as in section 2 part A.

Section 4: Household Income

1- What is the approximate monthly cash expenditure of the household?.....

2- What is the approximate quantity of all household grown products including livestock used ONLY for household consumption during last year?

Product Name	Quantity kg	Price/kg	Product Name	Quantity kg	Price/kg

Section 5: Organic Farming

1.1 How long have you been applying organic practices? _____ Years

1.2 How much proportion of your friends (farmers) was already doing organic farming? ...

1.3 How many live stock (cows & buffaloes) you had when you adopted organic farming?.....

2. Have you ever received basic training of organic methods?

1. ☐ Yes 2. ☐ No

3.a. If NO basic training, do you have access to someone who provides such training?

1. ☐ Yes 2. ☐ No

3.b. If yes who provides such training? _____

4. Why do you adopt organic farming?

1. ☐ Profitable
2. ☐ Reduce cost of inputs e.g. Pesticides & Fertilizers
3. ☐ Suggested by neighbor/friend
4. ☐ Suggested by Agri. Official
5. ☐ Suggested by NGOs
6. ☐ Good for health and environment
7. ☐ Adapt to climate/ weather variation
8. ☐ For sustainable production (healthy soil)
9. ☐ For higher yield
10. ☐ Others (please specify .....)

5.a Do you face any problem regarding organic crops?

1. ☐ Yes 2. ☐ No

5.b If yes, please mention.

1. ☐ Input Availability
2. ☐ Lack of Certification
3. ☐ Absence of Market
4. ☐ Lack of zoning
5. ☐ Others, please specify_____

Section 6: Health & Protection

Part A: Health

This section is related to health. Please recall the best you can about any problem that you may have experienced/ noticed.

A.1. Do you smoke? 1. ☐ Yes 2. ☐ No

3. ☐ No, but ex-smoker

A.2 Did you visit doctor/Herbalist (Hakeem) during the last year?

1. ☐ Yes 2. ☐ No

A.3a If yes, what did he diagnose (code of disease*)?

1. _____ 8. _____

2. _____ 9. _____

3. _____ 10. _____

4. _____ 11. _____

5. _____ 12. _____

6. _____ 13. _____

7. _____

* 1. Eye irritation., 2.Headache., 3.Dizziness., 4.Vomiting., 5.Diarrhea., 6.Fever., 7.Shivering., 8.Shortness of breath., 9.Skin irritation., 10.nose irritation., 11.Fatigue., 12.Stress/depression/ anxiety., 13. Others

A.3b How much it costs you (including Doctor's fee+ medicine cost + transportation cost)? _____

A.3c If no, what first aid method you adopted for curing that disease?

1. _____ 2. _____

3. _____ 4. _____

5. _____

A.4 How long did that (those) symptoms last? (In days).

1. _____ (days) 8. _____

2. _____ 9. _____

3. _____ 10. _____

4. _____ 11. _____

5. _____ 12. _____

6. _____ 13. _____

7. _____

A.5 How many days you spent in bed because of illness? _____

A.6 How many days did this illness prevent you from going to work?_____

A.7a Did you eat differently (more vegetables, take vitamins, etc.), or take anything else to relieve the symptoms?

1. ☐ Yes, 2. ☐ No

A.7b If yes, How much money did you spend in total?_____ (Rupees)

Part B: Protection

B.1.a When you mix/use pesticide, does the liquid/powder come into contact with any part of your body?

1. ☐ Yes 2. ☐ No

B.1.b. If yes, which part?

1. ☐ Hands 2. ☐ Feet 3.☐ Mouth 4. ☐ Chest/belly

5. ☐ Others (please specify)_____

B.2. Which of the following protective measures do you usually use?

Protective measure	Use	Reason if protective measures not used				
		Costly	Not available	Unnecessary	uneasy	Others
Boot	1.☐ yes 2.☐ no					
Hat	1.☐ yes 2.☐ no					
Shirt/qamis	1.☐ yes 2.☐ no					
Gloves	1.☐ yes 2.☐ no					
Eye glasses /goggles	1.☐ yes 2.☐ no					
Shalwar/lungi	1.☐ yes 2.☐ no					
Mask	1.☐ yes 2.☐ no					
Others	1.☐ yes 2.☐ no					

B.3 Do you take bath right after spraying?

1. ☐ yes 2. ☐ No

B.4 Do you change clothes right after spray?

1. ☐ yes 2. ☐ No

B.5 How long after the application of pesticide you re-enter the field? Hours_____days_____

Section 7: Environment and Climate Change

Part A: Environment

A.1 Do you realize that use of pesticides and chemical fertilizer are the major sources of water contamination?

1. ☐ yes 2. ☐ No

A.2a Have you ever witnessed/noticed that pesticide use polluted the air?

1. ☐ yes 2. ☐ No

A.3b If yes, Please specify_____

A.4a Have you ever witnessed/noticed that pesticide and fertilizer use caused the death of fish, frog or any other aquatic organism in your area?

1. ☐ yes 2. ☐ No

A.4b If yes, Please specify_____

A.5a Have you ever witnessed/noticed that pesticide and fertilizer use caused the death of birds in your area?

1. ☐ yes 2. ☐ No

A.5b If yes (please specify) _____

A.6a Have you ever witnessed/noticed that pesticide and fertilizer use caused the reduction of any flora (any tree) in your area?

1. ☐ yes 2. ☐ No

A.6b If yes (please specify) _____

A.7 Do you think that pesticide use is responsible for reduction in the population of honey bees in your area?

1. ☐ yes 2. ☐ No

(For organic farmers only)

A.8 After switching from conventional to organic, how would you characterize the change in soil quality?

	A lot worse	A bit worse	Unchanged	A bit better	A lot better	Don't know
Soil						

A.9 After switching from conventional to organic, how would you characterize the health of workers?

	A lot worse	A bit worse	Unchanged	A bit better	A lot better	Don't know
Health						

Part B: Perception on climate change

B.1a Have you known/heard of the impacts of climate change on agriculture?

1. ☐ yes 2. ☐ No

B.1b If yes (Tick one): ☐ Clearly Ambiguously ☐ A little bit ☐ Not known

B.1c Source (Tick one): ☐ Self experience ☐ Media ☐ Neighbors ☐ Organizations ☐ Others (specify)...

B.2 Rank the major climatic hazards in order of priority for action needed:

1: Long term, 2: Medium term, 3: Urgent and immediate (Encircle the appropriate response)

Floods/Riverbank Erosion	1 2 3
Drought	1 2 3
Drying springs	1 2 3
Disease outbreak (specify)	1 2 3
Occurrence of new invasive weeds and pest	1 2 3
Other climatic abnormalities	1 2 3

B.3 Perception on temperature

Particulars	Before 10 years, specify month	At present, specify month	No. of colder days as compared to past years Increase... Same...Decrease...
Winter/coldness start			
Winter/coldness end			
Summer /hotness start			No. of hotter days as compared to past years Increase...Same... Decrease...
Summer /hotness end			

B.4 Perception on rainfall and hailstorm

Particulars	Before 10 years, specify month	At present, specify month	No. of Rainy days as compared to past years Increase... Same...Decrease...
Rainfall start			
Rainfall end			
No. of hailstorm per year			No. of winter rainfall as compared to past years Increase...Same... Decrease...

B.5 What are the adaptation strategies to changing climate that you are following in your farm?

A) Strategies to minimize the risk of crop failure: (tick 1 for first rank and so on)

1. Use of short duration variety of crops. ( )
2. Use of hybrids/improved crop varieties. ( )
3. Diversified cropping to the vegetable/fruits production instead of rice and cereals crops. ( )
4. Organic farming ( )
5. Adoption of agro forestry practices
6. Others (please specify .....)

B) Strategies to conserve moisture and ensure water supply: (tick 1 for first rank and so on)

1) Use of drought tolerant crop/varieties ( )
2) Use of mulching material in crop fields. ( )
3) Minimum tillage/zero tillage operation ( )
4) Establishment of irrigation infrastructure ( )
5) Organic farming ( )

Soil test

Note: The data in the following tables will be obtained for different crops

Table 1: Available Phosphorus (kg/acre) of the soil in post harvested organic and non organic wheat field.

Organic			Non Organic			
Depth cm	L1	L2	L3	L1	L2	L3
0-15						
15-30						
30-60						
60-90						
Mean						
Mean Difference						
SE						
t- Statistics						

Note: L denote Location

Table 2: Nitrogen (%) of the soil in post harvested organic and non organic wheat field.

Organic			Non Organic			
Depth cm	L1	L2	L3	L1	L2	L3
0-15						
15-30						
30-60						
60-90						
Mean						
Mean Difference						
SE						
t- Statistics						

Note: L denote Location

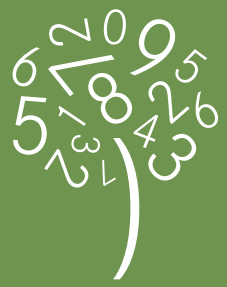
Table 3: Available Potassium (%) of the soil in post harvested organic and non organic wheat field.

Organic			Non Organic			
Depth cm	L1	L2	L3	L1	L2	L3
0-15						
15-30						
30-60						
60-90						
Mean						
Mean Difference						
SE						
t- Statistics						

Note: L denote Location

TIME FINISHED_____

THANK YOU FOR CO-OPERATION



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