An Assessment of Economic Viability of Organic Farming in Pakistan

Recebimento dos originais: 11/07/2018
Aceitação para publicação: 25/02/2019

Muhammad Waqar Akram
Ph.D candidate in Agricultural Economics
Institute: Northeast Forestry University
Address: 26 Hexing Rd, Xiangfang District, Harbin, Heilongjiang, China, 150040
E-mail: **waqar.akram13@nefu.edu.cn**

Nida Akram
Ph.D candidate in Agricultural Economics
Institute: Northeast Forestry University
Address: 26 Hexing Rd, Xiangfang District, Harbin, Heilongjiang, China, 150040
E-mail: **nida.akram88@yahoo.com**

Wang Hongshu*
(Corresponding Author)
Professor, doctoral supervisor Agricultural Economics & Theory and Ecological Economy
Institute: Northeast Forestry University
Address: 26 Hexing Rd, Xiangfang District, Harbin, Heilongjiang, China, 150040
E-mail: **lwanghongshu@163.com**

Ayesha Mehmood
MS Strategic Human Resource Management
Institute: University of Management and Technology
Block C-II ,Johar Town, Block C 2 Phase 1 Johar Town, Lahore, Punjab, Pakistan
E-mail: **ayeshamehmood@ikl.ae**

Abstract

Despite the recognised advantages of organic farming, concerns remain over the differences in organic farms' productivity and financial sustainability compared to conventional farming competitors. We analyse primary data obtained from 301 farms—148 organic and 153 conventional—across three districts of central Punjab, Pakistan, in order to assess the aforementioned concern in the specific country context. This is undertaken through evaluating the yield and viability of both farming methods' cultivation of wheat as a major crop under two types of irrigation sources. We identified that cultivating organic crops is at least as advantageous as traditional crops regardless of the former's low yields, given the lower production expenditure and higher commodity prices. Nevertheless, both kinds of farming suffer from a 'middle man' cartel. Furthermore, organic crops' return on investment of organic crops is also significant, indicating that farmers may obtain loftier returns through transitioning from conventional crops to organic crops. Overall, organic wheat's input costs are 19.09% lower than conventional crops. Moreover, canal irrigation has a significant positive effect on maintaining soil fertility and system sustainability as opposed to ground water. Regarding organic farming's individual and social advantages, we propose that facilitating organic farming can guarantee sustainable agricultural farming methods through enhancing surface water storage and supply. Organic farming's initial acceptance by farmers commercially will be fundamentally affected by organic consumer demand and market prices, which will ultimately determine whether organic farming production endures.

Keywords: Farm input. Agricultural investment. Agricultural productivity. Organic farming.

1. Introduction

Agriculture is acknowledged as one of Pakistan's most significant economic sectors, contributing 19.3% to the GDP and employing over 42% of the country's labour force. Agriculture makes a tremendous contribution in Pakistan, given that it sustains approximately 65% of the population either directly or indirectly, while ultimately comprising 59% of overall export earnings (MOF, 2016-2017). Compared to other countries internationally, Pakistani agriculture is predominantly dependent on irrigation, resulting in 80% of Pakistan's arable land using irrigation to produce 90% of food and feed (GOP, 2010-11).

Unfortunately, the need for irrigation exceeds its magnitude. Presently, insufficient surface water availability via canal irrigation is resulting in farmers exploiting unregulated groundwater resources. Combined use of surface and groundwater occurs over 70% of Pakistan's irrigated land (Qureshi, Turral, & Masih, 2004). However, secondary salinization associated with lower groundwater irrigation use poses a severe threat to irrigated agriculture's sustainability. Presently, Pakistan may be facing the gravest salinity challenge internationally (Kirby, Mainuddin, Khaliq, & Cheema, 2017). Profitable irrigation involves surface and groundwater resources' collective management (Qureshi, McCornick, Sarwar, & Sharma, 2010). Given that water for irrigation is the principle driver of agricultural growth and poverty elimination, water resource scarcity poses a challenge of formidable proportions, with grave repercussions for cultivators. Moreover, inefficient farming methods adopted in Pakistan, alongside exclusive reliance on biochemical inputs and highly productive crop ranges alone have actually resulted in significant problems. Firstly, substantial soil productiveness reductions; secondly, damage to top soil irrespective of the leguminous crops that may be planted subsequently, while lastly, the loss of the soil's inherent potential for producing an array of crops (Khan, 2009, 2010; Khan, Mahmood, & Damalas, 2015; Samie, ABEDULLAH, AHMED, & KOUSER, 2010; Wood, Lenzen, Dey, & Lundie, 2006).

The aforementioned challenges are especially urgent in relation to the 'breadbasket' region of Pakistan, Northern India and its inhabitants; this is a reputed wheat belt spread over 12 million hectares of land, providing sustenance to 500 million people who reside there. Water issues now pose a serious risk to the entire region's food security in the near future, hence necessitating a search for agricultural practices that may prove sustainable and viable over the longer term (Samie et al., 2010). Furthermore, one should be mindful that agriculture, specifically cash crops such as rice, cotton and wheat, no longer provide profitable business for farmers due to myriad factors, for example government interventions, relative price patterns, exploitation by middleman cartels, alongside complex and unfavourable buyer preferences (Butt et al., 2011; Quddus & Mustafa, 2011).

If we consider the available remedial measures for resolving the aforementioned issues, one option is organic farming (OF), which is capable of addressing at least some of the hazards posed to Pakistan's agricultural viability (Lotter, 2003; Ramesh, Singh, & Rao, 2005). OF's adoption may enable diminishment of expensive artificial input consumption, including fertilisers, pesticides, herbicides and allied chemical components, thus strengthening agriculture's ecological viability and economic sustainability. Furthermore, OF enables the soil to absorb and retain a greater volume of water compared to traditional cultivation arrangements (Müller, 2009; Poudel, Horwath, Lanini, Temple, & Van Bruggen, 2002). Research has confirmed that OF's integrated approach is more demanding in terms of labour inputs (Demiryurek & Ceyhan, 2008), although private OF methods demands reduced labour, thus diminishing total expenditure (Wynen, Merrigan, and Sciallaba (1998). Finally, organic certification and reduced input costs may create higher sale prices, thus strengthening farming incomes, enabling the greater amount of returns and reduced input costs of OF to pose a viable alternative to farm size expansion (Beuchelt & Zeller, 2011; Bolwig, Gibbon, & Jones, 2009).

Notwithstanding OF's accepted advantages, its commercial sustainability is generally questioned by researchers, who have raised concerns over OF's crop output and financial feasibility compared with traditional farming practices (De Ponti, Rijk, & Van Ittersum, 2012; Liebhardt, 2001). It is understood that reduced output with higher input costs can contribute to decreased profitability, given that labour requirements are more intensive. This may explain why farmers' large-scale adoption of OF methods has not been seen. Despite Pakistan having offered scant evidence confirming OF and conventional farming's significant variations in profitability, it remains crucial to comprehend OF's economic performance. Internationally, conventional farming is adequately subsidised in various ways and has attracted important policies, corporate research and funding for development initiatives. Such steps have increased OF's viability compared to all other farming techniques. Therefore, OF's economic, social and personal potential must be comprehended by policy makers and other stakeholders.

Accordingly, this present research compares organic and conventional farming methods in terms of wheat yield. It investigates the characteristics of production, economic performance and effect of surface water availability via canal irrigation across three different districts in Punjab Province, Pakistan. Punjab Province accounts for 80% of Pakistan's wheat production, positioning the province as a major source of the crop (Samie et al., 2010). Wheat serves as a major consumer product for residents of Pakistan's rural areas (Sher & Ahmad, 2008). Consequently, from the national food consumption perspective, it is extremely significant to investigate the variables underlying wheat's economic viability and sustainability. Presently, Pakistani farmers are predominantly reliant upon traditional farming methods, however, there is a degree of acknowledgement of such methods' weaknesses and the potential for their resolution through OF.

Resultantly, this paper investigates CF and OF techniques' distinctions, alongside economic benefits that farmers may acquire through adopting OF's modern techniques.

2. Literature Review

OF's economic effect in relation to various dimensions has been analysed in certain previous studies. Adhikari (2009) observed how conventional farming has high input costs and yield, whereas the costs associated with organic production systems compared to their benefits are relatively high. (Clark, 2009) assessed the current net value of the net yield index as a means of analysing organic and traditional production systems' profitability on typical farms in Indiana. Their research indicated that organic crops with yield losses may prove profitable and competitive with traditional crops. Lower organic input costs associated with a sufficiently high price provide a competitive edge to OF with regard to profitability. Charyulu and Biswas (2010) identified that organic agriculture's cotton and sugar cane crop production costs per unit are lower than for conventional farming, although unit costs are lower for conventional soil cultivation of rice and wheat crops.

A further perspective concerning OF's low productivity suggests that it is a consequence of the 'transition effect', the conversion process from conventional to OF, (Martini, Katerere, & Eloff, 2004; Neera, Katano, & Hasegawa, 1999). Leifeld (2012) confirmed that certain organic soils are less efficient in use, thus the researchers questioned OF systems' general sustainable use of soil stocks. However, it has been noted that OF methods permit soil to absorb and retain a greater water volume in contrast to conventional farming (Müller, 2009). Although OF has a positive attitude towards ecosystem services, it has no significant effect on decision making in terms of the distinction between organic agriculture and traditional agriculture. Rather, what appears to affect farmers' environmental approaches is the economic motivation level provided by programmes, for example payments for ecosystem services. In brief, organic agriculture appears not to have been adopted by farmer primarily due to any environmental concerns they have (Poppenborg & Koellner, 2013). Ponisio et al. (2015) indicated that sound investment in agro-ecological research to enhance biological management systems may markedly diminish or eliminate apparent yield differences of certain crops or regions. Profitability is a fundamental economic variable enticing farmers away from conventional farming, Organic farmers' average profit competency is relatively higher than for traditional farmers (Yasin, Ashfaq, Adil, & Bakhsh, 2014). Reganold and Wachter (2016) evidenced that OF systems produce lower yields than traditional agriculture. Nevertheless, OF's comparable advantages are greater profitability, ecological sustainability and provision of equivalent or more nutritious foodstuffs with fewer (or absent) pesticide residues.

The extant literature has focused on three basic economic variables pertaining to OF: 1. low input costs; 2. low productivity and 3. premium price. However, OF is posed with supplementary challenges such as labour intensity, a dearth of training, ineffective marketing, absence of government subsidies, certification problems and, most significantly, surface water scarcity. This research seeks to evaluate the aforementioned challenges' complexity and their effect on profitability. We have undertaken a comparison with conventional farming, aiming to analyse its economic viability in relation to OF's social and personal benefits.

3. Organic Farming in Pakistan

OF's modern history in Pakistan dates back to 1996, when the non-governmental organisation (NGO) and non-profit organisation Lok Sanjh initiated collaboration with grass-roots farmers, attempting to convince them to adopt ecological production methods. Farmers Field Schools (FFS) were established to strengthen farmers' capacity and undertake training in this regard, enabling them to learn alternative techniques. Approximately 10,000 farmers have received training through the FFS approach. Lok Sanjh brought together organic farmer committees to develop OFAs (Organic Farmer's Associations). OFAs have been duly supported by Lok Sanjh to establish a guaranteed system for farmers, so as to maintain the quality of the region's organic agricultural products. Numerous identical bodies exist taking equivalent initiatives to promote OF.

Furthermore, the Pakistani government has strongly supported OF primarily for two reasons. Firstly, they have sought to diminish the additional pressure on foreign currency exchange resulting from expensive fertiliser and synthetic pesticide imports, while secondly, the government has aimed to tackle economic and ecological challenges confronting the agricultural sector. In 2008, an Independent Executive Committee of OF was established by the National Agriculture Research Centre (NARC). Alongside other features, this executive committee has ensured technology dissemination across Pakistan's agricultural community. Approximately 5,000 students and farmers have received training in OF practices. Additionally, Pakistan has introduced an OF system for registering organic farmers and traders. Pakistan's OF production methods have been certified by Zwolle, Netherlands, being certified according to (EEC NO. 2092/91) and USDANOP standards. Registered organic farms participate in identifying new production technologies and disseminating new information to small farmers across Pakistan. The NARC and Pakistan Agricultural Research Council (PARC) have been major proponents of organic food, while also participating in organic food production. With the NARC's technical assistance, numerous private farms in the Islamabad region have begun producing organic foodstuffs, particularly fresh fruit and vegetables for nearby markets.

In the market, organic farmers either sell their produce at designated stores or directly to large certified companies such as Panda, Prince Departmental Store, or Sultan Son's (Sarfraz & Abdullah, 2014). In Pakistan, hotels, foreigners and affluent families are the primary consumers of organic foodstuffs. Despite a dedicated marketplace for organic products being largely non-existent, world-renowned hotels in Islamabad such as Serena and Marriott are prominent organic customers. Likewise, given the dearth of systematic support in the field, the majority of farmers are dependent on their personal farming techniques, perhaps assisted through NARC training, to enhance agricultural land fertility and to control weeds and pests.

4. Study Area, Data and Methods

4.1. Description of the Study Area

Our research has been undertaken on the basis of data obtained from three major districts located in Punjab Province, namely Toba Tek Singh, Jhang and Khanewal. We identified these districts mindful of our consultations with principal stakeholders in our study, for example growers, villagers, NGOs and organic farmers. The selection of these areas was also based on Lok Sanjh's organic farming project.

The Lok Sanjh foundation, with the assistance of the FFSs, delivers training sessions in these areas focusing on the adoption of organic techniques. Furthermore, data pertaining to farmers in these areas who are presently adopting organic methods has been collected and analysed, with the purpose of arriving at final results. Typically, farmers grow two crops annually, with these two seasons named *rabi* and *kharif*. The major crop grown is wheat, which is cultivated by 80% of farmers during the winter *rabi* season, comprising an area of approximately 9 million hectares, which is almost 40% of the entire cultivated land area. Nevertheless, this crop constitutes 10% of the value added for agriculture and contributes 1.9% of overall GDP (MOF, 2016-2017).

The cultivated area is predominantly irrigated via a canal system. Moreover, groundwater is pervasively adopted for irrigation, apart from in Jhang District as a result of groundwater toxicity. In these areas, the flood irrigation technique is the primary strategy adopted, whereby fields are permitted to become water-logged and soaked in the soil as a means of irrigating the plants.

4.2. Data

We adopted a purposive sampling technique for identifying 400 farmers, both conventional and organic, across the three regions. The farmers' names are listed in alphabetical order and numbered. The stratified random sampling technique was adopted for selecting the sample household, so as to ensure that every household had an equivalent probability of being selected for the study, irrespective of farm size. As a means of closely identifying conventional farmers, we defined proximity as the fundamental criteria. Our final dataset comprised of information obtained from 148 organic and 153 conventional farmers. A farm household leader survey was undertaken to collect the data during the period September 2017 – February 2018, in cooperation with the Lok Sanjh Foundation. A questionnaire was adopted to acquire data regarding farm structure and management, family characteristics, farmer's opinions and practices, input and output data. The questionnaire was distributed to 301 farmers or household leaders.

Soils' organic minerals provide the basis for OF and sustainable agriculture production. They provide an essential source of nutrients for assisting and advancing biodiversity, while delivering vital environmental services alongside crop protection. Thus, it is possible to mitigate crop diseases and expand microbial species' variation within agro-ecosystems, simply through introducing compost and additional organic substances (Altieri, 1999; van Elsen, 2000). A crucial role in soil fertility is played by canal irrigation. Groundwater over-exploitation in Punjab and other areas has resulted in swift decline in water levels. Therefore, people are increasingly apprehensive about soil fertility declines, substantial drops in water levels, diminished water quality for irrigation and increased salinity, which ultimately result in detrimental effects on productivity (Aggarwal, Joshi, Ingram, & Gupta, 2004). Given that OF productivity varies according to the region and particular season in the year (Martini et al., 2004; Neera et al., 1999; Valizadeh, Ziaei, & Mazloumzadeh, 2014), our research presents a comparative study of productivity concerning various regions and numerous farming experiences and canal irrigation systems, alongside their effect on productivity.

3.3. Methods of Analysis

To analyse the differences between conventional and organic farms, we concentrated on three major dimensions: 1) input cost; 2) productivity and 3) price and profitability. Resultantly, we assessed both the personal (cost and productivity) and social benefits (price) of OF. So as to examine why OF is attractive to farmers in contrast with conventional farming, we must investigate the substantial dissimilarities in personal benefits of these two approaches, while also determining the distinctions between conventional farming and OF through assessing the mean variation in production expenditure, yield and returns. Despite other econometric methods potentially being of use for this study, we provide a preliminary analysis of the mean difference. The mean difference's intensity is determined through a t-test for statistically significant difference. Revenue and expenses are calculated through multiplying the input and output quantities' actual sale prices. Irrigation is the most significant agricultural input. As a means of calculating the used water's value, data pertaining to the irrigation cycle number, time per cycle and cost per hour of water from various sources (canal, tube well, solar energy, electricity, and peter) were collected.

More intensive labour requirements are a distinctive characteristic of OF (Demiryurek, Erdem, Ceyhan, Atasever, & Uysal, 2008). The UNDP (1992) projects have indicated that certain organic farms require a tremendous workforce, exclusively in plantations and organic farms using labour-intensive approaches. Regarding high wage costs (as on plantations), the total expenditure for organic projects is higher. However, under particular conditions there is such a low wage rate that private organic farms' total labour costs are markedly reduced (Wynen et al., 1998). van der Werf (1993) explained that the median labour force employed by seven Indian organic farms was lower than for non-organic farms. Nevertheless, this situation is not applicable to all projects involving individual farmers. Typically, the workforce is employed for planting and reaping. Regarding this study's research area, the major activity is planting, care and nutrition (including land preparation, fertilising, pest control and manuring), as well as harvesting (dehusking and dying as well as assembling). During our survey, we estimated the workforce cost at the rate of permanent employee minus meals. Usually, labour costs are calculated per hour, however for this research, we determined the labour costs per hectare given limited hourly wage data for this area. In order to calculate profit, we initially divided the gross income of the total crop by cultivated land, so as to calculate the per hectare income and deduct the mean expenses from the average income. Therefore, it was possible to calculate the Return on Investment (ROI) by dividing the average profit per hectare by average expenses per hectare.

$$ROI = \frac{Average\ profit\ per\ acre}{Average\ expenses\ per\ acre}$$

5. Results and Discussion

The survey results indicated that in the case of most farms (57%) their size was less than 4 hectares, while 27.2% were below 8 hectares and owned by the households themselves. In the absence of farmers having their own land or smallholdings, they will usually hire land from other farmers. Indeed, hiring agricultural land is a pervasive practice in Punjab. On average, conventional farmers own 5.73 hectares of land, compared to 5.47 hectares for organic farmers. NGO's primarily target small farmers. The mean age of conventional and organic farmers is 45 and 43 years respectively, while families comprise of between 6 and 10 persons per household. Concerning educational attainment, 27.70% of OF households and 33.3% of conventional farmers' households are illiterate or have completed primary education. Conversely, 35.10% of organic farmers have passed high school compared with 26.80% of conventional farmers. Therefore, organic farmers have a somewhat higher educational level compared with conventional farmers, while also having stronger representation across all higher education categories. Evidently, numerous farmers hold jobs alongside their agricultural work, however the majority of their time is spent in agriculture and accounts for a substantial proportion of their total income. However, low agricultural incomes, cyclical production, provisional unemployment, increased agricultural risk and the desire for higher incomes places pressure on farmers to search for additional work.

Organic farmers' mean monthly income is PKR 56000, which is significantly lower than for conventional farmers (PKR 73000). This monthly household income provides a proxy using the profitability approach. Consequently, monthly profit is defined as the main crop's mean profit over the total time, plus the value of the family's agricultural products grown and consumed personally by the farmer.

6. Personal Costs and Productivity of Organic and Conventional Farms

During this section, we analyse the variations in mean values of input used, irrigation's effect, the regions and their experience of prices, as well as the profits and yield of organic farms and conventional farms.

Input Use: This section compares the inputs adopted by conventional and organic producers, as this is one of the fundamental variables distinguishing organic production systems from conventional production methods (Rigby & Cáceres, 2001). As shown by the comparison in Table, we determined that the per hectare cost for organic wheat irrigation is marginally higher than for conventional wheat in the districts of T.T. Singh and Jhang. However, in Khanewal, OF's irrigation costs are below those of conventional farming. In T.T Singh, Jhang and Khanewal, the mean irrigation expenses are PKR 8434.36, 7201.39, 5631.77 for organic wheat and PKR 7771.37, 5846.15 and 5761.05 for conventional wheat respectively, with these variances being statistically significant. Overall, we determined that organic farms use an equivalent amount of water as conventional farms.

The organic farmers selected for our sample relied on organic pesticides and fertilisers as opposed to synthetic variants. We identified extended use of poultry and livestock manure as fertiliser for OF. Nevertheless, field discussions have concluded that organic fertilisers and pesticides are used in insufficient quantities due to their inaccessibility and substantial costs. Conventional farmers apply insecticides such as Bernoxil, Proton, Logran and Safinor to fight pests, with some consumers believing these pests to be harmful. Interestingly, manure is regularly adopted as a fertiliser by both organic and conventional farms, being considered as a useful source of nutrients. Most significantly, the cost of fertiliser and pesticides is prohibitive for certain farmers, thus they only use a lower combination of these.

Table 1 presents the per hectare monetary value of pesticides and fertilisers, with various systems and regions having significantly varied costs. We use market prices as a means of calculating chemical fertiliser costs, however, pesticides also include labour costs and machine rents. Conventional farms' mean fertiliser costs are significantly higher than for organic farms, while conventional farms' pesticide costs are also substantial.

Our estimates identified that OF's labour costs are 5.83% lower than for conventional farming. Furthermore, intensive fertiliser and pesticide use also increases conventional farming's labour costs. Conversely, OF's use of fertiliser and pesticide is almost zero, either because bio fertiliser and pesticides are unavailable or due to their significant costs. Our results are in accordance with Wynen et al. (1998)—who evidenced that labour and overall costs for private organic farms are low—as well as van der Werf (1993), who explained that the labour used by Indian organic farms was lower than on conventional farms. A region-wide comparison indicated similar results across the other two districts (Jhang and Khanewal), with bigger labour costs for conventionally managed farms; T.T Singh showed a 9.67% higher labour cost per hectare on organic farms compared with conventional farms' costs. Our T.T. Singh's results confirm those of other studies (Giovannucci, 2005; Lohr & Park, 2009). For example, Giovannucci (2005) showed that organic farms have higher input costs given the double labour demand. Lohr and Park (2009) evidenced that labour typically represents a variable input cost for OF which is greater than for conventional farms. In Jhang and Khanewal, the per hectare labour costs were 16.63% and 14.41% higher respectively on conventional farms compared to organic farms. One potential reason for the variable labour costs across different regions is the various working environments and working opportunities, which are dependent on numerous variables such as working conditions, wage rates and, most significantly, workers' efficiency (Nemes, 2009). Concerning 'other costs', the two agricultural systems use almost identical land preparation technology, while input costs for agricultural and dwarf harvesting are approximately equivalent, having a direct effect on yield (Lyngbaek & Muschler, 2001). Overall, irrigation as well as labour plus other input costs comprise over 75% of total production expenditure for organic and conventional crops. Pesticides costs across both agricultural systems are negligible, as wheat crops are less significant than cotton in the sampling area.

Table 1: Inputs cost (PKR) of wheat per hectare for organic and conventional farming in Pakistan

Cost/ hectare	Toba Tek Singh	Jhang	Khanewal

(PKR)	Organic$	Conventional$	Mean Difference	T-Statistics	Organic $	Conventional$	Mean Difference	T-Statistics	Organic $	Conventional$	Mean Difference	T-Statistics
Water	8434.36	7771.37	662.99	0.41	7201.39	5846.15	1355.25	1.29	5631.77	5761.05	129.27	0.15
	(1207.28)	(1084.730)			(993.32)	(338.74)			(570.00)	(612.19)		
Fertiliser	11876.08	15210.55	3334.48*	2.37	9020.66	14838.33	5817.68**	5.40	9778.47	14128.50	4350.03**	3.82
	(1088.85)	(873.24)			(731.89)	(720.147)			(784.57)	(805.90)		
Pesticide	420.47	4026.78	3606.30**	9.30	275.79	4605.82	4330.03**	6.84	1332.86	3875.82	2442.96**	4.76
	(162.81)	(351.75)			(87.44)	(627.34)			(364.27)	(384.20)		
Labour	14036.53	12797.35	1239.18	0.89	10907.55	12721.33	1813.78	1.24	11817.84	13520.77	1702.93	1.27
	(1002.23)	(965.18)			(1405.92)	(746.941)			(908.11)	(968.48)		
Other Expenses	10665.94	11444.16	778.22	0.60	8968.39	10493.77	1525.37	1.36	8558.39	9938.00	1379.61	1.64
	(858.27)	(986.65)			(942.21)	(665.85)			(552.95)	(634.68)		
Total	45433.45	51250.41	5816.96*	2.22	36373.84	48505.32	12131.48**	3.80	37119.56	47224.25	10104.69**	3.77
	(1995.68)	(1672.57)			(2168.61)	(2135.64)			(1715.17)	(2093.52)		

$= mean values; Standard errors are in parenthesis; * = Significant (P < 0.05); ** = Highly Significant (P < 0.01)

6. Irrigation, Region and Experience Effects on Yield:

The literature indicates no consistent results for organic farming's performance. Several studies have explained that OF's productivity is lower than for conventional farming (Carpenter, 2003; De Ponti et al., 2012; Giovannucci, 2005; Liebhardt, 2001; Lyngbaek & Muschler, 2001; McBride & Greene, 2009). Regardless, a significant amount of other research has provided contradictory results (Damiani, 2003; Eyhorn, Mäder, & Ramakrishnan, 2005). Our findings support the former perspective that organic yields are significantly lower than conventional crops. Organic wheat's mean per hectare yield is 3517.57 KG, compared with conventional wheat that provides a 4298.66 kg per hectare yield. Therefore, on average, conventional farming's wheat yield is 20.12% higher than that of organic farming.

Table 2: Yield (KG) of wheat per hectare for organic and conventional farming in Pakistan

Yield/Hectare (KG)	Canal Irrigation facility			
	YES$	NO$	Mean Difference	T-Statistics
Organic	3719.58 (63.88)	3155.48 (124.83)	564.10**	4.02
Conventional	4539.37 (88.72)	3915.15 (125.08)	624.22**	4.18

$= mean values; Standard errors are in parenthesis; * = Significant (P < 0.05); ** Significant (P < 0.01)

Table 3: Yield (KG) of wheat per hectare for organic and conventional District wise

Yield/Hectare (KG)		Toba Tek Singh				Jhang				Khanewal			
		Organic	Conventional	Mean Difference	T-Statistics	Organic	Conventional	Mean Difference	T-Statistics	Organic	Conventional	Mean Difference	T-Statistics
Canal Irrigation facility	Yes	3747.01	4826.22	1079.21	8.748**	3575.35	4047.45	472.10	1.961*	3818.90	4957.31	1138.41	10.268**
		(75.54)	(99.70)			(171.13)	(163.10)			(73.36)	(83.28)		
	No	3182.71	4131.60	948.88	3.653**	2943.29	3402.99	459.70	1.16	3212.37	4272.17	1059.80	3.704**
		(204.79)	(159.80)			(256.15)	(235.05)			(198.67)	(197.13)		

$= mean values; Standard errors are in parenthesis; * = Significant (P < 0.05); ** Significant (P < 0.01)

Irrigation plays an essential role in fertility (Aggarwal et al., 2004). Pakistan's groundwater quality varies extensively regarding the water table and aquifer movement pattern (Qureshi, McCornick, Qadir, & Aslam, 2008).

Furthermore, Qureshi et al. (2010) explained in relation to the groundwater that a thin fresh water layer floats on saline water, with its excessive extraction exacerbating the sinking slope, thus resulting in salty water entering fresh parts of the groundwater. Consequently, the groundwater's poor quality has diminished soil productivity and exacerbated salinity issues. Our results have confirmed these findings. Table 2 illustrates that canal irrigation is highly significant for both organic and conventional farming's productivity. Moreover, organic wheat productivity within the canal irrigation area is almost equivalent to conventional wheat productivity outside of the canal irrigation region.

Crop production alterations are highly apparent across the three regions, which potentially affects agricultural production's sustainability even further (Valizadeh et al., 2014). Table 3 examines region-wide wheat productivity. We determined that Jhang district has an almost 13% lower productivity compared with other regions, while marginal difference is apparent concerning productivity of both farming methods. One reason for organic crops' low yield may be the so-called 'organic transient effects'. Typically, during the transition from conventional to organic methods, the yields diminished over the initial 1 to 4 years, followed by an increase once the soil had developed sufficient biological activity (Martini et al., 2004; Neera et al., 1999). In our sample, approximately 67.5% of organic farms have an established history of organic farming (between 0 and 10 years), meaning that these farms have long since been converted, whereas approximately 29.7% of farms are rather new.

6. Price & profitability

Regardless of deficient farm management and low yields, organic crops earn higher prices; although organic product prices are not as high as claimed in the literature they are slightly greater than their conventional counterparts. Evidently, the premium price to a certain extent compensates for the unfavourable conditions associated with low yield. Nevertheless, hostile price patterns, as well as the buyer and 'middleman cartel', exercise a negative effect on agriculture's profitability (Butt et al., 2011). The mean price of organic and conventional wheat is PKR 1197.58 and 1189.92 per 40 KG respectively, however, it remains lower than the government's fixed support price (PKR 1300/40KG).

Table 4: Mean price per 40KG of wheat for organic and conventional farming in Pakistan

Price (40KG)	**Organic$** **148**	**Conventional$** **157**	**Mean Difference**	**T-Statistics**
price per (40KG)	1,197.58 (15.51)	1,189.92 (18.38)	7.66	0.32

$= mean values; Standard errors are in parenthesis; ;* = Significant (P < 0.05); ** Significant (P < 0.01)

Table 5: Mean profit per hectare of wheat for organic and conventional farming in Pakistan

Profit per hectare	**Wheat**			
	Organic$	**Conventional$**	**Mean Difference**	**T-Statistics**
Profit per hectare	63805.74 (1950.61)	76380.84 (2307.93)	12575.10**	4.16

$= mean values; Standard errors are in parenthesis; * = Significant (P < 0.05); ** Significant (P < 0.01)

Wheat's profit margin is statistically significant. The estimated economic profit per hectare for organic and conventional wheat is PKR 63805.74 and 76380.84 respectively. The estimated monetary profit per hectare is determined to be revenue minus direct costs. Nevertheless, the profit variance is significant due to price exploitation, although we identified a low yield and high price for OF in accordance with our predictions. Similar results were identified in previous studies (Reganold, Glover, Andrews, & Hinman, 2001; Smith, Edwards, Robinson, & Dworkin, 2004).

Return on Investment: ROI is the ratio of an activity or output's profit proportionate to the input cost, which is conveyed in monetary terms (Mehmood, Anjum, & Sabir, 2011). This indicates that crops provide greater income to farmers (Gurmani, Zia-ul-Hassan, Imran, Jamali, & Bashir, 2006). The return on investment for organic and conventional wheat systems has been estimated as 0.62 and 0.54 respectively. Given the lower input costs and higher prices, organic wheat provides a higher return on investment. This ratio indicates that farmers can attain greater profits through switching from conventional to OF. Gurmani et al. (2006) and Hisbani (2000) identified similar findings in their research concerning Pakistan's return on input.

Our research and discussion has confirmed that conventional crops are less profitable than organic crops, due to fetching higher prices at low input costs. Even so, as Saunders and Barber (2008) established, such dependence on premiums may endanger economic sustainability of organic farms over the medium and long-term. Consequently, these results should be interpreted cautiously, so as to devise and implement meaningful policies in relation to OF.

7. Conclusion

Our research aim was to investigate economic and productivity dynamics of OF and conventional farming systems in the context of water quality. For this purpose, we investigated the wheat crop across TT Singh, Jhang and Khanewal districts in Punjab, Pakistan. We adopted traditional methods of physical and financial reporting to assess the differences between conventional and organic farms.

We determined that the mean conventional farm yield is 14% greater than that of organic farms. Nevertheless, irrespective of low yields, organic crops provide greater returns on cost in contrast with conventional crops. Regardless of the significant profit difference between the two farming methods, we anticipate an overall migration from conventional to OF modes. Organic farms have been running with assistance from the Lok Sanjh Foundation, indicating the challenge of autonomously sustaining organic agriculture. Indeed, if fertiliser and pesticide subsidies are withdrawn for conventional farms, or comparable subsidies are provided for OF resources, the transition from conventional farming to OF may be accelerated, given that the profit balance will be inclined towards OF.

Regarding the mean profit margin, organic farms have significantly diminished returns compared with conventional farms, although low yields are compensated by OF's lower input costs and subsequent higher prices for OF products within the niche market. Organic farms have reduced labour costs and substantially lower fertiliser and pesticides costs, whereas water-associated expenditure is almost equivalent to conventional farms. Organic wheat farms' costs in our sample accounted for 20% of conventional wheat farms' costs.

Canal irrigation systems exercises a significant effect on both conventional and organic farming systems, because canal irrigation is extremely beneficial for soil health. Our results indicated that canal irrigation enhances soil fertility and system stability compared to other forms of irrigation arrangements. Sound reasons exist for governments to introduce solid irrigation plans and construct new dams as a means of overcoming energy and water problems; if not problems currently, these are bound to be exacerbated in the coming years. During meetings and interviews, stakeholders have identified five challenges facing OF. First, the organic market remains under-developed. Second, given the high prices and dearth of supply channels in small towns and villages, farmers face challenges in obtaining organic raw materials. Therefore, as a means of controlling pests and weeds, farmers may only adopt physical and biological techniques that are easily accessible. Third, no state assistance for OF exists, as neither subsidies nor financial aid is available for organic products. Fourth, absence of OF zoning can result in pest migration from conventional to organic farmland, which may seriously damage OA crop production. Finally, a question over water is apparent. In certain areas, groundwater is harmful for crops, meaning that only canal water may be relied upon. Lamentably, canal water availability is diminishing daily, resulting in reduced productivity in Jhang district as we witnessed. Over the coming years, this issue will pose a grave threat not just to agriculture sustainability but the very survival of humans residing in these areas. Organic farming requires promotion in Pakistan due to its economic and ecological feasibility. This guarantees sustainable use of natural resources, while also establishing new agriculture avenues and providing greater employment prospects for rural workers, particularly women. Transitioning to OF may assist Pakistan with saving valuable foreign currency exchange that is being consumed through fertiliser and pesticide imports, thus allowing funds to be diverted to fulfil the dire needs of the population's impoverished people. Nevertheless, if OF is to succeed in Pakistan, it is imperative to resolve the challenge of water scarcity and establish zoning and market development. As it is generally believed that OF is unable to meet the food requirements of the global population, the food security challenge remains a matter for future research.

8. References

Adhikari, R. K. (2009). Economics of organic vs inorganic carrot production in Nepal. *Journal of Agriculture and Environment, 10*, 27-33.

Aggarwal, P. K., Joshi, P. K., Ingram, J. S., & Gupta, R. K. (2004). Adapting food systems of the Indo-Gangetic plains to global environmental change: key information needs to improve policy formulation. *Environmental Science & Policy, 7*(6), 487-498.

Altieri, M. A. (1999). The ecological role of biodiversity in agroecosystems *Invertebrate Biodiversity as Bioindicators of Sustainable Landscapes* (pp. 19-31): Elsevier.

Beuchelt, T. D., & Zeller, M. (2011). Profits and poverty: Certification's troubled link for Nicaragua's organic and fairtrade coffee producers. *Ecological Economics, 70*(7), 1316-1324.

Bolwig, S., Gibbon, P., & Jones, S. (2009). The economics of smallholder organic contract farming in tropical Africa. *World Development, 37*(6), 1094-1104.

Butt, T. M., Hassan, M. Z. Y., Sahi, S. T., Atiq, M., Jabbar, A., Ahmad, I., . . . Shafique, W. (2011). Role of rural youth in agricultural and rural development: A self perceived case study of Okara District, Punjab, Pakistan. *Journal of Agricultural Extension and Rural Development, 3*(2), 23-28.

Carpenter, D. (2003). An investigation into the transition from technological to ecological rice farming among resource poor farmers from the Philippine island of Bohol. *Agriculture and human values, 20*(2), 165-176.

Charyulu, D. K., & Biswas, S. (2010). *Economics and efficiency of organic farming vis-à-vis conventional farming in India*: Indian Institute of Management.

Clark, S. F. (2009). The profitability of transitioning to organic grain crops in Indiana. *American journal of agricultural economics*, *91*(5), 1497-1504.

Damiani, O. (2003). The adoption of organic agriculture among small farmers in Latin America and the Caribbean: Thematic evaluation. *Rome: IFAD*.

De Ponti, T., Rijk, B., & Van Ittersum, M. K. (2012). The crop yield gap between organic and conventional agriculture. *Agricultural systems*, *108*, 1-9.

Demiryurek, K., & Ceyhan, V. (2008). Economics of organic and conventional hazelnut production in the Terme district of Samsun, Turkey. *Renewable Agriculture and Food Systems*, *23*(3), 217-227.

Demiryurek, K., Erdem, H., Ceyhan, V., Atasever, S., & Uysal, O. (2008). Agricultural information systems and communication networks: the case of dairy farmers in Samsun province of Turkey. *Information Research*, *13*(2), 13-12.

Eyhorn, F., Mäder, P., & Ramakrishnan, M. (2005). The Impact of Organic Cotton Farming on the Livelihoods of Smallholders. Evidence from the Maikaal bioRe poject in central India.

Giovannucci, D. (2005). Organic agriculture and poverty reduction in Asia: China and India focus. *IFAD Office of Evaluation, February*.

GOP. (2010-11). *Agricultural statistics of Pakistan*. Islamabad, Pakistan: Government of Pakistan.

Gurmani, Z., Zia-ul-Hassan, M., Imran, M., Jamali, A., & Bashir, M. (2006). Cost benefit analysis of wheat, barley and oat crops for grain production. *Journal of Agricultural Research (Pakistan)*.

Hisbani, S. (2000). *Cost Benefit Ratio obtained from Sarsabz variety of wheat in KandiaroTaluka*. M. Sc. thesis (unpublished). Sindh Agri. Univ. Tandojam.

Khan, M. (2009). Economic evaluation of health cost of pesticide use: willingness to pay method. *The Pakistan Development Review*, 459-470.

Khan, M. (2010). Using the health belief model to understand pesticide use decisions. *The Pakistan Development Review*, 941-956.

Khan, M., Mahmood, H. Z., & Damalas, C. A. (2015). Pesticide use and risk perceptions among farmers in the cotton belt of Punjab, Pakistan. *Crop Protection, 67*, 184-190.

Kirby, M., Mainuddin, M., Khaliq, T., & Cheema, M. (2017). Agricultural production, water use and food availability in Pakistan: Historical trends, and projections to 2050. *Agricultural Water Management, 179*, 34-46.

Leifeld, J. (2012). How sustainable is organic farming? *Agriculture, Ecosystems & Environment, 150*, 121-122.

Liebhardt, W. (2001). Get the facts straight: organic agriculture yields are good. *Organic Farming Research Foundation Information Bulletin, 10*, 1-4.

Lohr, L., & Park, T. A. (2009). Labor pains: valuing seasonal versus year-round labor on organic farms. *Journal of agricultural and resource economics*, 316-331.

Lotter, D. W. (2003). Organic agriculture. *Journal of sustainable agriculture, 21*(4), 59-128.

Lyngbaek, A. E., & Muschler, R. G. (2001). Productivity and profitability of multistrata organic versus conventional coffee farms in Costa Rica. *Agroforestry systems, 53*(2), 205-213.

Martini, N., Katerere, D., & Eloff, J. (2004). Biological activity of five antibacterial flavonoids from Combretum erythrophyllum (Combretaceae). *Journal of ethnopharmacology, 93*(2-3), 207-212.

McBride, W. D., & Greene, C. (2009). The profitability of organic soybean production. *Renewable Agriculture and Food Systems, 24*(4), 276-284.

Mehmood, Y., Anjum, B., & Sabir, M. (2011). Benefit cost ratio analysis of organic and inorganic rice crop production; evidence from district Sheikhupura in Punjab Pakistan. *Pakistan Journal of Medical Sciences, 63*(3), 174-177.

MOF. (2016-2017). Pakistan Economic Survey 2016-2017. *Government of Pakistan, Finance Division, Economic Affairs Wing, Islambad*.

Müller, A. (2009). Benefits of organic agriculture as a climate change adaptation and mitigation strategy in developing countries.

Neera, P., Katano, M., & Hasegawa, T. (1999). Comparison of rice yield after various years of cultivation by natural farming. *Plant production science, 2*(1), 58-64.

Nemes, N. (2009). Comparative analysis of organic and non-organic farming systems: A critical assessment of farm profitability. *FAO, Rome, Italy*.

Ponisio, L. C., M'Gonigle, L. K., Mace, K. C., Palomino, J., de Valpine, P., & Kremen, C. (2015). Diversification practices reduce organic to conventional yield gap. *Proc. r. soc. b, 282*(1799), 20141396.

Poppenborg, P., & Koellner, T. (2013). Do attitudes toward ecosystem services determine agricultural land use practices? An analysis of farmers’ decision-making in a South Korean watershed. *Land Use Policy, 31*, 422-429.

Poudel, D., Horwath, W., Lanini, W., Temple, S., & Van Bruggen, A. (2002). Comparison of soil N availability and leaching potential, crop yields and weeds in organic, low-input and conventional farming systems in northern California. *Agriculture, ecosystems & environment, 90*(2), 125-137.

Quddus, M. A., & Mustafa, U. (2011). Comparative advantage of major crops production in Punjab: An application of policy analysis matrix. *The Lahore Journal of Economics, 16*(1), 63.

Qureshi, A. S., McCornick, P. G., Qadir, M., & Aslam, Z. (2008). Managing salinity and waterlogging in the Indus Basin of Pakistan. *Agricultural Water Management, 95*(1), 1-10.

Qureshi, A. S., McCornick, P. G., Sarwar, A., & Sharma, B. R. (2010). Challenges and prospects of sustainable groundwater management in the Indus Basin, Pakistan. *Water resources management, 24*(8), 1551-1569.

Qureshi, A. S., Turral, H., & Masih, I. (2004). *Strategies for the management of conjunctive use of surface water and groundwater resources in semi-arid areas: a case study from Pakistan* (Vol. 86): IWMI.

Ramesh, P., Singh, M., & Rao, A. S. (2005). Organic farming: Its relevance to the Indian context. *Current science, 88*(4), 561-568.

Reganold, J. P., Glover, J. D., Andrews, P. K., & Hinman, H. R. (2001). Sustainability of three apple production systems. *Nature, 410*(6831), 926.

Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. *Nature plants, 2*(2), 15221.

Rigby, D., & Cáceres, D. (2001). Organic farming and the sustainability of agricultural systems. *Agricultural systems, 68*(1), 21-40.

Samie, A., ABEDULLAH, AHMED, M., & KOUSER, S. (2010). Economics of conventional and partial organic farming systems and implications for resource utilization in Punjab (Pakistan). *Pakistan Economic and Social Review*, 245-260.

Sarfraz, M., & Abdullah, M. I. (2014). Buying of Organic Food in Multan (Pakistan) â€ œA Case Study of Consumerâ€™ s Perceptionsâ€. *International Journal of Economics and Empirical Research (IJEER), 2*(7), 288-293.

Saunders, C., & Barber, A. (2008). Carbon footprints, life cycle analysis, food miles: global trade trends and market issues. *Political Science, 60*(1), 73-88.

Sher, F., & Ahmad, E. (2008). Forecasting wheat production in Pakistan.

Smith, M. T., Edwards, R. R., Robinson, R. C., & Dworkin, R. H. (2004). Suicidal ideation, plans, and attempts in chronic pain patients: factors associated with increased risk. *Pain, 111*(1-2), 201-208.

UNDP. (1992). Benefits of Diversity, United Nations Development Programme, New York.

Valizadeh, J., Ziaei, S., & Mazloumzadeh, S. (2014). Assessing climate change impacts on wheat production (a case study). *Journal of the Saudi Society of Agricultural Sciences, 13*(2), 107-115.

van der Werf, E. (1993). Agronomic and economic potential of sustainable agriculture in South India. *American journal of alternative agriculture, 8*(4), 185-191.

van Elsen, T. (2000). Species diversity as a task for organic agriculture in Europe. *Agriculture, ecosystems & environment, 77*(1-2), 101-109.

Wood, R., Lenzen, M., Dey, C., & Lundie, S. (2006). A comparative study of some environmental impacts of conventional and organic farming in Australia. *Agricultural systems, 89*(2-3), 324-348.

Wynen, E., Merrigan, K., & Sciallaba, N. (1998). Evaluating the potential contribution of organic agriculture to sustainability goals. *Environment and Natural Resources Service, Research, Extension and Training Division, Sustainable Development Department, Food and Agriculture Organization of the United Nations, Rome*.

Yasin, M. A., Ashfaq, M., Adil, S. A., & Bakhsh, K. (2014). PROFIT EFFICIENCY OF ORGANIC VS CONVENTIONAL WHEAT PRODUCTION IN RICE-WHEAT ZONE OF PUNJAB, PAKISTAN. *Journal of Agricultural Research (03681157)*, *52*(3).

APPENDIX

Appendix 1 Descriptive statistics

	Mean		Std. Deviation	
	Organic	**Conventional**	**Organic**	**Conventional**
Age of the respondent	43.20	45.14	12.74	12.71
Education of the Respondent	1.41	1.35	1.15	1.22
Size of the farm	5.47	5.73	5.64	8.26
Farm land owned by the respondent	1.37	1.39	0.78	0.82
Farm land rented by the respondent	0.59	0.70	0.93	0.95
Soil fertility of farm	2.18	2.05	0.81	0.83
Canal irrigation facility	0.36	0.39	0.48	0.49
water expenses per hectare	7,038.41	6,438.25	6,730.16	5,136.95
Fertilizer expenses per hectare	10,335.07	14,753.41	6,491.59	5,669.67
Pesticide expenses per hectare	734.72	4,210.44	1,918.37	3,608.68
Labor expenses per hectare	12,378.65	12,975.58	7,570.80	6,261.42
Other expenses per hectare	9,418.39	10,638.31	5,462.70	5,546.36
Total expenses per hectare	39,905.36	49,016.05	14,169.75	14,377.28
Total sale per hectare	103,711.14	125,396.92	21,998.36	26,707.23
Profit per hectare	63,805.74	76,380.84	23,730.17	28,547.50
Rate for 40kg wheat	1,197.59	1,189.92	188.69	227.35
Monthly Income	56,040.01	73,026.05	57,914.20	94,161.73
Yield per Hectare KG	3,517.57	4,298.66	783.38	947.52

Appendix 2 Education Frequency distribution

		N	Column N %
Organic	Illiterate/Primary	41	28
	Middle School	35	24
	High School	52	35
	Undergraduate/graduate	11	7
	Post graduate	9	6
	Total	148	100
Conventional	Illiterate/Primary	51	33.3
	Middle School	34	22.2
	High School	41	26.8
	Undergraduate/graduate	18	11.8
	Post graduate	9	5.9
	Total	153	100.0

Appendix 3 Experience in Agriculture Frequency distribution

		N	Column N %
Organic	0 to 5 years	44	29.73
	6 to10 years	56	37.84
	11 to15 years	19	12.84
	16 to 20 years	7	4.73
	More than 20 years	22	14.86
	Total	148	100
Conventional	0 to 5 years	13	8.50
	6 to10 years	26	16.99
	11 to15 years	27	17.65
	16 to 20 years	20	13.07
	More than 20 years	67	43.79
	Total	153	100.00

Appendix 4 Land owned Frequency distribution

		N	Column N %
Organic	No land	11	7.43
	Less than 4 hectares	85	57.43
	4 to 8 hectares	41	27.70
	9 to 12 hectares	8	5.41
	More than 12 hectares	3	2.03
	Total	148	100
Conventional	No land	12	7.84
	Less than 4 hectares	87	56.86
	4 to 8 hectares	41	26.80
	9 to 12 hectares	9	5.88
	More than 12 hectares	4	2.61
	Total	153	100.00

Appendix 5 Land rented Frequency distribution

		N	Column N %
Organic	No land	90	60.81
	Less than 4 hectares	40	27.03
	4 to 8 hectares	10	6.76
	9 to 12 hectares	4	2.70
	More than 12 hectares	4	2.70
	Total	148	100
Conventional	No land	79	51.63
	Less than 4 hectares	55	35.95
	4 to 8 hectares	11	7.19
	9 to 12 hectares	2	1.31
	More than 12 hectares	6	3.92
	Total	153	100.00

Appendix 6 Soil fertility Frequency distribution

Type of farm		N	Percentage
Organic	Very low fertile	4	2.7
	Low fertile	20	13.5
	Normal Fertile	76	51.4
	High Fertile	42	28.4
	Very high fertile	6	4.1
	Total	148	100.0
Conventional	Very low fertile	9	5.9
	Low fertile	19	12.4
	Normal Fertile	84	54.9
	High Fertile	38	24.8
	Very high fertile	3	2.0
	Total	153	100.0