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Economic Analysis of Organic Wheat Production in Pakistan: Adoption and Return on Investment

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Abstract

The rising concern of conventional farming emphasized the need of organic farming which utilizes environment-friendly and economically-viable production methods. Pakistan has great potential but organic farming is not in practice. This study examined the constraints in adopting organic wheat and its impact on return on investment by employing farm level data of 300 wheat growers. We employ endogenous switching regression (ESR) approach that accounts for selection bias**.** The results show that organic wheat has significant and positive impact on the returns but adoption is slow due to number of limiting factors. Illiteracy, lack of information, liquidity constraint, complicated and costly certification process, absence of organic market and small land holdings are the major limiting factors for the adoption. Policy makers should focus to overcome the constraints of organic farming by providing easy, timely and adequate credit. Awareness and motivation of farmers should be done through education, training and extension services.

Keywords: Organic farming, Impact Assessment, Wheat, Endogenous Switching Regression, Pakistan

Introduction

With the emergence of green revolution, agricultural productivity increased many folds in Pakistan during 1960’s. Economically it was a big achievement for a poor country but at the cost of environmental degradation. The externalities of this green revolution included loss of biodiversity, soil degradation, low food quality, increased soil, water and air pollution effecting human and animal health and higher cost of production as a result of chemical fertilizers, pesticides and herbicides use. In depth research found the residues of these chemicals in different agricultural products causing different social and medical issues like underage puberty, cancer and loss of immunity. The Green Revolution left many poor people and regions behind, an outcome that was aggravated by continuing population growth. The situation can be more alarming in future because half of the increase in world’s population will materialize in Asia by the years 2015 and 2030, further stressing the land, water and biodiversity resources (FAO, 2002).

This rising concern of conventional farming on humans, animals and environment emphasized the importance and need of sustainable agriculture through organic farming. Organic farming utilizes environment friendly and economically viable production methods by eliminating the use of synthetic chemicals.

In general, organic agriculture provided an opportunity to combat the aftereffects of Green Revolution by boosting the eco-friendly techniques, promoting agro-diversity and using indigenous knowledge. Realizing this many Farmer's Organizations, NGOs and other institutions started working with farmers in South Asia to transform their farming systems from conventional to organic. According to FAO (2002), organic agriculture is a holistic production management system which promotes and enhances agro ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions and locally adapted systems. Diversity in plants and farming systems creates diverse ecological niches leading to abundance of natural enemies of plant pests. By following diverse cropping pattern farmers can minimize the additional expenditures on synthetic and chemical fertilizers (Pretty, 1995).

The agricultural land under organic farming is nearly 2.9 million hectares in Asia which constitutes almost nine percent of the world's organic agricultural land. Among south Asian countries, the leading counties are China and India. Table 1 shows the organic area in south Asia.

Table 1. Certified Organic Area in South Asia

Region	**2009**		**2008**		**2007**		**2006**	
	Area(ha)	**% of total area**	**Area(ha)**	**% of total area**	**Area(ha)**	**% of total area**	**Area(ha)**	**% of total area**
Pakistan	20321	0.08%	24466	0.09%	25001	0.09%	25001	0.09%
India	1180000	0.66%	1018470	0.57%	1030311	0.57%	432259	0.24%
Bangla-desh	1162	0.01%	526	0.005%	No Data Available	0.00%	No Data Available	
Nepal	8059	0.19%	8498	0.20%	8194	0.19%	7762	0.18%
Sri Lanka	21156	0.80%	22347	0.85%	17000	0.72%	17000	0.72%

Pakistan is an agricultural country and instead of having great potential, organic farming is not in practice. The country practice organic rice, wheat, cotton, sesame seeds and some other agri-products to some extent on farms certified by Control Union Certifications Zwolle.

Among agricultural products, cereals are an important ingredient of daily food requirements of Pakistan population. Forty seven percent of the per capita calories and forty six percent of the per capita protein requirements are met by the cereals (FAO, 2011). Among cereals, wheat contributes more than 60 percent of the daily food. About 70 percent of the wheat produced in the country is used in making domestic bread and the rest is used in different bakery products (Rahman *et al.*, 2014). Apart from being essential part of the daily food, wheat crop also plays an important role in the economy. It contributes about 10 percent of the value added in agriculture sector of the country and 2.2 percent in GDP. The area under wheat crop cultivation was recorded 8,693,000 hectares in the year 2012-13 with grain yield of 24.2 million tons (GOP 2013) and 25.9 million tons is expected in the current year (GOP, 2015).

Several empirical literatures compared the economic performance of organic and conventional farming (Samie *et al.,* 2010), adoption of organic vegetables (Thapa and Rattanasuteerakul, 2011) and factor affecting the adoption of organic farming by employing correlation. There are limited studies that examined the constraints of adoption of organic crop and impact of adoption on the returns on investment by taking into account the selection bias.

Keeping in view this research gap and importance of organic farming in developing countries, the present study examined the constraints in adopting organic wheat and impact of adoption on return on investment by employing farm level data of 300 wheat growers from four districts of Punjab province of Pakistan.

Review of Literature

Tzouvelekas *et al.,* (2001) conducted a study to compare the technical, allocative and economic efficiencies of organic and conventional cotton farms in Greece. They used the stochastic production frontier to determine the efficiencies. The results revealed that both organic and conventional farms examined in the study were technically, allocatively and economically inefficient. The average gross revenue for organic and conventional farms remained 74428 and 86700 drachmas per stremma respectively while the average profit was 7133 and 16082 drachmas per stremma for organic and conventional cotton farms, respectively. The results indicated that conventional cotton farms were technically, allocatively and economically more efficient with efficiency scores 80.40, 82.04 and 65.96 respectively as compared to organic cotton farms with technical, allocative and economic efficiency scores 71.63, 80.25 and 57.48, respectively. The study concluded that inefficiency in both farming approaches was due to the interventional policies of last twenty years especially the protective schemes enjoyed by the Greek cotton farmers. The study suggested that alternative strategies should be employed to sustain the economic viability of sector.

Lohr and Park (2004) assessed the production efficiency of organic farms by using a stochastic distance function approach. They evaluated the effects of farm specific attributes by using the data of national survey of organic farmers from Organic Farming Research Foundation, United States. Regional and farm specific variables like use of soil-improving inputs, farmer's participation in research and farmer's experience of doing organic farming were included in the model. The results revealed that input use and farm effects created differences in productivity across farmers. It was observed that participation in research significantly contributed to decrease the level of technical inefficiency. The farmers who participated in research projects had mean technical efficiency 25 percent higher than the non-participating farmers while research commitment increased the overall technical efficiency from 75 to 87 percent. The results about self-sufficiency in soil improving inputs and organic farming experience were not significant as newly converted organic farmers were more efficient than original organic farmers. The study suggested that farmer participatory research programs should be launched to improve the efficiency of organic farms.

Cisilino and Madau (2007) concluded in a study on comparison of organic and conventional production systems that overall average gross production of conventional farms were better than the organic farms but the net income of the organic farms was averagely little higher than conventional ones but comparable. That showed a similarity in two groups in utilizing the factor resources to produce yield and finally income. They also indicated another quality of organic farms that they utilized the labor force more efficiently and contributed to increase livelihood opportunities for farm labor. They also conducted an efficiency analysis to assess the performance of two farming systems and found that organic olive farms remained more efficient in using the disposable and on-farm resources. The high efficiency on organic farms (0.709) also allowed them to compensate more labor as compared to conventional farms (0.581). The study further identified that the aspect of transition period required to convert the conventional farming

Singh and Grover (2011) assessed the economic viability of organic wheat farming in comparison with conventional wheat farming in Punjab, India. The data was collected from eighty five organic and seventy five conventional farmers in thirty villages of districts, Patiala and Faridkot. The major share of total operational area of organic farms was covered by wheat crop which was accounted 15 percent. It was observed that organic fields had wide varietal distribution than conventional farms. The average variable cost for organic wheat was found to be less than conventional wheat while net returns over variable cost for organic wheat came out to be Rs. 21985/acre as compared to conventional that was Rs. 16700/acre. The crop yield of organic wheat remained 6.7q/acre less than conventional wheat but it was well compensated by premium market price received by the organic farmers. The results indicated that one percent increase in farmyard manure, jeevamrit and machine labor would increase the wheat productivity by 0.114, 0.703 and 0.556 percent, respectively. The study concluded that though the profitability of organic wheat is better than conventional wheat but significant reduction in its yield could pose serious challenge of food security at national level.

McBride *et al.,* (2012) examined the profitability of organic wheat crop production in comparison with conventional wheat crop. They used the data from Agricultural Resource Management Survey of United States of America for 2009 crop. They used the treatment effects models to analyze the data. The results based on long-term experimental trials indicated that similar yields with lower cost of production were possible by organic method as compared to conventional but little information were available about the relative costs and returns on commercial farms. Average conventional wheat yields were much higher than for organic wheat, but per acre operating plus capital costs were lower for organic wheat. The results indicated that operating costs per bushel for conventional wheat were higher than for organic wheat, but total economic costs were about \$2 to \$4 per bushel higher for organic wheat. Average price premium for organic wheat remained \$3.79 per bushel in 2009 and that was enough to compensate the difference in operating and capital costs of organic and conventional wheat. The study suggested that the results were based on only a single year data and a thorough study based on multi-year data was needed to assess the economic returns of organic systems.

Tzouramani *et al.,* (2010) assessed the economic viability of organic and conventional sheep farming in Greece where sheep rearing is an importance activity especially in mountainous and semi-mountainous areas. They estimated the financial aspects and risk associated with the organic sheep farming by conducting a stochastic efficiency analysis. They found that there were high net returns of organic sheep farming with no negative outcome. They also mentioned that net returns of organic sheep farming depended on the prices of grain. They concluded that organic farming was the best alternative of conventional farming and would be a powerful tool to face the global competition. They suggested for the farmers to shift towards the organic farming in order to cope world competition.

Methodology

The households' decision adopt organic farming can be demonstrated by a random utility framework. To the extent that adoption of organic farming falls within the binary choice framework in which farmers weigh up the expected net utility and choose to either adopt or not adoptorganic farming. We assume that farmers are risk neural and decision ofadoption is based on the random utility framework. Farmers take into consideration the expected utility. Let's assume the utility that farmer ***i*** derives from adoption of organic farming is U_{iP} and the utility derived from non-adopter is U_{iN}. $U^*(\pi)$ Is the difference in utility derived from adoption and non-adoption.

$$U_{iP}(\pi) - U_{iN}(\pi) = U^*(\pi) \tag{1}$$

Since we can only observe adoption but not the utility, the decision to adopt can be expressed as a latent variable, M_i^*

$$M_i^* = \alpha X_i + \mu_i \tag{2}$$

Such that:

$$M_i^* = 1 \quad if \quad U^*(\pi) > 0 \quad when \quad U_P(\pi) > U_N(\pi) \tag{3}$$

$$M_i^* = 0 \quad if \quad U^*(\pi) \leq 0 \quad when \quad U_P(\pi) \leq U_N(\pi) \tag{4}$$

Where M_i^* is a binary variable and equals to 1 if households adopt organic farming and zero otherwise,

α = is the vector of parameters to be estimated,

X_i = is a vector of individual, household and locational characteristics,

μ_i = is error term assumed to have normal distribution with zero mean and equal variance.

The probability of adoption can then be expressed as:

$$\Pr(M_i = 1 \mid X_i) = \Pr(M_{1i}^* > M_{2i}^*) \tag{5}$$

$$= \Pr(M_i^* > 0)$$

$$= \Pr(\alpha X_i + \mu_i > 0)$$

$$= \Pr(\mu_i > -\alpha X_i)$$

$$= F(\alpha X_i)$$

Here F is the cumulative distribution function of μ_i .

The empirical specification applied to estimate the impact of organic farming on return on investment is described in the next section.

The impact of organic farming on return on investment can be expressed as a linear function:

$$Y_i = \beta Z_i + \gamma M_i + \varepsilon_i \tag{6}$$

Here,

Y_i Denotes outcome variables,

Z_i shows household, locational and personal characteristics,

M_i is a dummy variable and represents adoption of organic farming,

β and γ are parameters to be estimated and ε_i is a random error term.

In case of randomized control experiment, the information about the counterfactual situation is easily obtained by the difference among treatment and control groups. But in case of quasi experimental trails like this study, rural household are partitioned into adopters (treatment) and non-adopters (control), based on observed and potential unobserved characteristics to provide reasonable information on the counterfactuals.

Estimation of impact organic farming on the welfare is very substantial because we need to have information about the counterfactual situation: what could have happened if the adopters had not adopted organic farming.

In fact, the adoption of organic farming depends on the expected utility or benefits from adoption. In this case, the adopters and non-adopters are systematically different. So selection bias occurs when unobserved factors influence μ_i, the error term of adoption equation and ε_i , the error term of outcome equation giving rise to correlation of error terms. When there is correlation between the error terms, the estimates of the parameters will not give consistent results.

We employed endogenous switching (ESR) model in this study in order to account for selection bias. The ESR is a parametric approach and accounts for observable and unobservable factors, influencing outcome. ESR has two separate regimes for adopters and non-adopters. Inverse mill ratio is calculated by adoption equation to control for selection bias.

The binary choice decision can be specified as:

$$M_i^* = \alpha X_i + \mu_i \tag{7}$$

$$M_i^* = 1 \quad if \quad U^*(\pi) > 0$$

$$M_i^* = 0 \quad if \quad U^*(\pi) \leq 0$$

Here,

M_i^* Depends on a vector of variables X_i

and error term μ_i assumed to have zero mean and equal variance.

The error term is composed of measurement errors and unobserved factors.

As stated earlier, to account for selection bias, endogenous switching regression model is applied and the households face two regimes: 1, to participate and 2, not to participate.

$$Y_{1i} = \beta_1 Z_i + \gamma_1 M_{1i} + \varepsilon_{1i} \tag{8a}$$

$$Y_{2i} = \beta_2 Z_i + \gamma_2 M_{2i} + \varepsilon_{2i} \tag{8b}$$

Here,

Y_i Is a net return on investment for adopters and non-adopters,

Z_i Represents a vector of individual, household and locational characteristics.

β_1, β_2, γ_1 and γ_2 are parameters to be estimated and ε_1 and ε_2 are the error terms.

For the ESR model to be correctly specified, Z contains the same variables as X plus at least one suitable instrument that is correlated with the adoption but uncorrelated with outcome.

Estimating β_1 and β_2 by ordinary least squares would produce inconsistent estimates, because the expected values of the error terms, conditional on the sample selection criterion, are non-zero (Maddala, 1986).

Lee (1978) treats sample selection as a missing-variable problem. The error terms μ_i, ε_1 and ε_2 assumed to have a tri-variate normal distribution with zero mean and non-singular covariance

Matrix articulated as:

$$\Sigma = \text{cov}(\mu_i, \varepsilon_1, \varepsilon_2) = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{1\mu} \\ \sigma_{12} & \sigma_2^2 & \sigma_{2\mu} \\ \sigma_{1\mu} & \sigma_{2\mu} & \sigma^2 \end{bmatrix} \tag{9}$$

where

$\sigma_1^2 = \text{var}(\varepsilon_1)$; $\sigma_2^2 = \text{var}(\varepsilon_2)$; $\sigma^2 = \text{var}(\mu_1)$; $\sigma_{12} = \text{cov}(\varepsilon_1, \varepsilon_2)$; $\sigma_{1\mu} = \text{cov}(\varepsilon_1, \mu_i)$; ; $\sigma_{2\mu} = \text{cov}(\varepsilon_2, \mu_i)$;

σ^2 represents variance of the error term in the adoption equation and σ_1^2, σ_2^2 represent variance of the error term in the outcome equations, σ_{12} is the covariance of ε_1 and ε_2, $\sigma_{1\mu}$ is the covariance of ε_1 and μ_i and $\sigma_{2\mu}$ is covariance of ε_2 and μ_i.

As Y_{1i} and Y_{2i} are cannot be observed simultaneously therefore the covariance between ε_1 and ε_2 is not defined (Lokshin and Sajaia, 2004). It is also assumed that $\sigma^2=1$, since α can be estimated up to a scalar factor. Given these assumptions, the expected values of ε_1 and ε_2 can be estimated as:

$$E(\varepsilon_{1i}|M_i=1)=E(\varepsilon_{1i}|\mu_i>-X_i\alpha)=\sigma_{1\mu}\left[\frac{\phi(X_i\alpha/\sigma)}{\Phi(X_i\alpha/\sigma)}\right]\equiv\alpha_{1\mu}\,\lambda_1 \quad (10a)$$

$$E(\varepsilon_{2i}|M_i=0)=E(\varepsilon_{2i}|\mu_i\leq-X_i\alpha)=\sigma_{2\mu}\left[\frac{-\phi(X_i\alpha/\sigma)}{1-\Phi(X_i\alpha/\sigma)}\right]\equiv\alpha_{2\mu}\,\lambda_2 \quad (10b)$$

Here ϕ and Φ are the probability density and cumulative distribution functions of the standard normal distribution, respectively. The ratio of ϕ and Φ evaluated at $X_i'\alpha$, represented by λ_1 and λ_2 in equations (10a) and (10b) is referred to as the inverse mills ratio (IMR) which denotes selection bias terms.

In the first stage, a Probit model of the criterion equation is estimated and the inverse Mills ratios λ_1 and λ_2 are derived according to definitions in equations (10a) and (10b). In the second stage, these predicted variables are added to the appropriate equation in (8a) and (8b) respectively to yield following sets of equations:

Adopters: $$Y_{1i}=\beta_1 Z_i+\alpha_{1\mu}\lambda_1+\gamma_1 M_{1i}+\upsilon_1 \quad (11a)$$

Non- adopters: $$Y_{2i}=\beta_2 Z_i+\alpha_{2\mu}\lambda_2+\gamma_2 M_{2i}+\upsilon_2 \quad (11b)$$

Here υ_1 and υ_2 have zero conditional mean.

Some previous studies have employed two-stage method to estimate causal effects of program adoption. This method includes the estimation of inverse mills ratios λ_1 and λ_2 from the adoption equation in the first stage and subsequently incorporating these ratios in the second stage estimation. This method may generate heteroskedastic residuals that cannot be used to estimate consistent standard errors without adjustments (Maddala, 1986). Full Information Maximum Likelihood (FIML) method proposed by Lokshin and Sajaia (2004) fits the adoption and outcome equations simultaneously and yield consistent standard errors.

In STATA, full information maximum likelihood method is employed by using the movestay command. This method simultaneously estimates probit for adoption equation and the outcome equations to yield consistent standard errors. Logarithmic likelihood function for the equations 3.2, 3.8a and 3.8b is as follows:

$$\ln M_i=\sum_{i=1}^{N}\left\{\begin{array}{l} M_i w_i\left[\ln F\left(\frac{(X_i'\alpha+\rho_{1\mu}(Y_{1i}-Z_{1i}'\beta/\alpha_1))}{\sqrt{1-\rho_{1\mu}^2}}\right)+\ln(f(Y_{1i}-Z_{1i}'\beta/\alpha_1))\right] \\ +(1-M_i)w_i\left[\begin{array}{l}\frac{\ln(1-F(X_i'\alpha+\rho_{2\mu}(Y_{2i}-Z_{2i}\beta)/\gamma_2)}{\sqrt{1-\rho_{2\mu}^2}}) \\ +\ln(f((Y_{2i}-Z_{2i}\beta)/\gamma_2)\end{array}\right]\end{array}\right\} \quad (12)$$

The signs and significance of correlation coefficients, $\rho_{1\mu}$ and $\rho_{2\mu}$ gives the interpretation of the model (Fluglie and Bosch, 1995). If $\rho_{1\mu}$ or $\rho_{2\mu}$ are significant, it means there is presence of endogenous switch in the model. Alternate signs of $\rho_{1\mu}$ and $\rho_{2\mu}$ show that individuals adopt organic farming on the basis of comparative advantage. In other words, those who adopt, have above average returns from adoption and those who do not adopted, have above average returns from non-adoption. There is a hierarchical sorting in case if the $\rho_{1\mu}$ and $\rho_{2\mu}$ have the same signs: it is better for the individuals to adopt, who have higher than average returns and those who already have lower than average returns, it is better for them not to adopt.

The ATT τ_{ATT}^{ESR} of adoption of organic farming can be calculated as follows:

$$\tau_{ATT}^{ESR} = E(Y_{1i} - Y_{2i} | M_i = 1) = Z_i'(\beta_1 - \beta_2) + (\sigma_{1\mu} - \sigma_{2\mu})\lambda_1 \tag{13}$$

Here $E(Y_{1i}|M_i = 1) = Z_i'\beta_1 - \sigma_{1\mu}\lambda_1$ represents the expected outcome of individuals who adopted, had they chose to adopt organic farming; $E(Y_{2i}|M_i = 1) = Z_i'\beta_2 - \sigma_{2\mu}\lambda_1$ represents the expected outcome for households who adopted; had it been they chose not to adopt organic farming.

Socio-economic characteristics of the organic and conventional farmers in the study area are given in Table 2. All variables are expressed in terms of means while access to credit and linkages with extension services are presented in percentages

Table 2. Comparison of the Socio-economic Characteristics of Farmers in Pakistan

Pakistan		
Characteristics	**Organic Farmers (Mean/%age)**	**Conventional Farmers (Mean/%age)**
Age of household head (Years)	45.76	44.93
Education (Schooling Years)	5.84	4.77
Experience (Years)	23.70	24.09
Credit Access (%age)	52	46
Linkages with extension Services (%age)	72	52
Land holdings (Acres)	5.32	6.05
Linkages with extension Services (%age)	53	36
Total Area (Acres)	1.73	1.86

The mean age of organic farmers in the study area is at 46 years as compared to 45 years mean age of conventional farmers. There is significance difference in the level of education between the both types of farmers, 6 and 5 years of schooling for organic and conventional farmers respectively. The data shows that organic farmers are more educated than conventional farmers which reflect the efficient allocation of resources towards better farming system. Regarding the farming experience, both groups of farmers have almost the same level of farming experience. Compared to conventional farmer, organic farmer have better access to credit.

Similarly, organic farmers have better linkages with extension services than the conventional one which is probably due to the fact that organic farmers are working with companies, NGOs and farmer groups to enhance organic agriculture. The average landholding for organic wheat farmers was slightly lower compared to conventional one i.e. 5.32 and 6.05 acres respectively.

Results and Discussion

The results of endogenous switching regression are reported in Table 3. The second column of the Table 3 showed the estimated coefficients of adoption equation while the third and fourth column presented the estimates of outcome equation.

Table 3. Estimates of ESR for the adoption and impact of adoption on returns on investment

Variables	Adoption of organic wheat	Return on investment	
	Organic (Coefficients)	Organic (Coefficients)	Conventional (Coefficients)
Constant	0.268*** (0.148)	0.254 (0.256)	0.502* (0.063)
Education(number of years of schooling)	0.067*** (0.019)	0.422** (0.201)	0.254** (0.124)
Experience of farming	-0.034 (0.06)	0.261 (0.445)	0.094 (0.067)
Access to Credit	0.058*** (0.021)	0.450** (0.210)	1.155* (0.581)
Extension services/Awareness	-0.114 (0.140)	0.048* (0.028)	0.424* (0.241)
Certification	-0.072** (0.03)	0.193 (0.423)	0.775 (0.67)
Land holding in acre	0.413*** (0.14)	0.084*** (0.02)	0.077* (0.042)
Presence of organic market in area	0.089*** (0.016)	0.069 (0.195)	0.099 (0.112)
Environmental protection	0.442*** (0.181)		
σ_{ei}		1.895(0.012)***	0.769(0.052)***
ρ_j		0.633(0.60)	0.985(0.78)

Note: Significance of t-statistics of mean difference is at the *10%, **5% and ***1% levels.
Figures in the parentheses are standard errors
σ_{ei} denotes the square root of the variance of the error terms in the outcome equations
ρ_j denotes correlation coefficient b/w the error term of adoption equation and error term of outcome equation.

The adoption equation indicates that level of education significantly increases the adoption decision of farmer since the importance of organic farming requires certain amount of awareness about the health issues and environmental protection. Thus education is a powerful tool to shift farming community towards high value and harmless farming system. Experienced farmer are reluctant to adopt organic farming since young farmers are risk averse and tends to invest in new system.

Lack of access to credit serves as an entry barrier to organic farming since it requires substantial amount of funds for initial investment. Certification has significant negative impact on the adoption of organic wheat as it is lengthy, complicated and costly to get organic certification in developing countries. The coefficient of landholdings is positive and highly significant indicating that big farmers with ownership security tend to invest in long term organic farming. These results are consistent with the findings of Abdulai and Goetz (2013).The results also reveal that the lack of information through extension services and access to organic market are also limiting factors for the adoption of organic farming.

The results of the second stage estimation is shown in column third and fourth of Table 3. Importance of environmental protection in view of farmer was used as instrument in the study which is significant in the first stage regression.

Education of the farmer exerts a positive effect on returns to investment for both organic and conventional farmers indicating that education tends to enhance welfare of the farmers by increasing the efficiencies of activities. Access to credit and extension services tends to enhance returns on investment for both groups. The coefficient of landholdings is positive and significant for both organic and conventional farmers.

The non-significance of covariance terms ρ_j shows the absence of endogenous switching in both cases. The covariance terms ρ_j have same signs which shows that adopters have above average return whether they adopt organic wheat or not, but they are better off by adoption, whereas non-adopters have below average return in either case, but they are better off not adopting.

Table 4. Impact of adoption on returns on investment

Mean of returns on investment		**ATT**	**t-Statistics**
Adopters	Non-adopters		
4.265	3.472	0.793	4.12***

Note: significance of t-Statistics of mean difference is at 10%, **5% and ***1% levels

The results in Table 4 show the impact of organic wheat on returns on investment by using ESR. We find that growing of organic wheat has significant and positive impact on the returns depicting great potential for organic farming in Pakistan. Moreover we found that the return on investment of the organic crop is higher than the conventional crop but the shift from conventional to organic is very slow due to number of limiting factors already discussed in the adoption equation.

Conclusions

Given the externalities of green revolution in the face of human health and environmental protection, there is need to focus on the sustainable agriculture through adoption of organic farming in developing countries. Pakistan is an agricultural country and wheat has significant role in the daily consumption as well as in the economy. Keeping in view the importance of organic wheat production, the present study examined the constraints of adoption of organic wheat and impact of adoption on the returns on investment by employing farm level data of 300 wheat growers from four districts of Punjab province of Pakistan.

The results show that growing of organic wheat has significant and positive impact on the returns, depicting great potential for organic farming in Pakistan. Moreover we found that the return on investment of the organic crop is higher than the conventional crop but the shift from conventional to organic is very slow due to number of limiting factors. The adoption equation shows that illiteracy, lack of information and awareness through extension services, liquidity constraint, Complicated and costly certification process, lack of access to organic market and small land holdings are the major limiting factors for the adoption of organic farming in Pakistan. Government and policy makers should focus to overcome the constraints of organic farming. Awareness and motivation of farmers should be done through education, training and effective role of extension services. Easy, timely and adequate credit should be the top priority of policy makers to improve the productivity of agriculture.

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