Research Article

The Role of Farm Service Centre (FSC) in Adoption of Improved Wheat Seed Technology in Khyber Pakhtunkhwa: A Logistic Regression Analysis

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Abstract | This research work investigated the role of Farm Service Centre (FSC) program on farmers' adoption of improved wheat seed technology in Khyber Pakhtunkhwa province of Pakistan. A sample of 336 wheat growers, consisted of equal number of FSC registered and non-registered farmers, was selected from Northern, Central and Southern climatic zones of Khyber Pakhtunkhwa. The selected wheat growers were interviewed for data collection. Binary Logistic regression analysis was conducted over the collected data-set to estimate a grower's probability of adopting improved seed technology and quantify the role of FSC in adoption. Result confirms that membership in FSC was the most important determinant of improved wheat seed technology adoption. Head's education level was the other important determinant with a positive significant effect on adoption of improved seed technology. The study recommends awareness program for encouraging farmers to register in FSC. The provision of free public education facility and agricultural extension services over modern agricultural technologies could augment the rate and intensity of adoption by the wheat growers.

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Introduction

Wheat is a main staple food for Pakistani consumers and it accounts for around half of their total daily caloric consumption. Wheat is grown by majority of the farmers in the country and is an important source of their income. In the past 40 years, Pakistan's wheat production has increased significantly. According to Daroash and Malik (2010). Pakistan's wheat production has increased by more than double from early 1970s to late 1990s, and it has risen by a further one-quarter since then. However, it is still significantly lower than that of United Kingdom, Germany and France. This yield gap might be due to using conventional production technology and under utilization of recommended inputs.

Bauru More than a hundred improved wheat seed varieties have been developed and released during the past 40 years (Daroash and Malik, 2010); however, majority of the farmers normally sow their last year's produce instead of purchasing the certified and recommended seeds. The use of improved seed varieties is needed for maximizing wheat yield. Therefore, policy makers give high priority to agricultural research in new seed technology development. However, the dissemination and proper adoption of the new seed technology are also important, thus a strong and effective agricultural extension system is needed. Unfortunately, the agricultural extension program in Pakistan is suffering from various problems and is not performing effectively. The most important of these problems are poorly motivated staff, inadequate

operational funds, lack of relevant technology, top-down planning, centralized management and weak accountability systems (Bajwa, 2004).

The agricultural extension experts are now exploring other models for the sack of effectiveness and vast coverage (Baig et al., 2009). In this direction the government of Khyber Pakhtunkhwa (KP) has started a new program with the name of Farm Service Centre (FSC). The basic concept of the Farm Services Centre program is to provide a platform to the farming community at union council level and develop their linkages with government line agencies to enable them to communicate and resolve their agricultural issues of common interest.

Each FSC consist of a management committee with a general body and elected members, including the president, the vice-president, the general secretary and the finance secretary for running the Centre's affair. Rules for the management committees to regulate their business are framed by a higher regulatory body, the Farm Service Center Board. The Board is headed by the secretary of the Provincial Agriculture and Livestock department. Each Centre has a fund, consisting of donations from provincial allocations, grants, membership fee, and contributions. Similarly, income from their resources also goes to their funds.

The evaluation of the effectiveness of this program in resolving farmers' problems and augmenting their productivity and returns is an area of special interest to the economists. That's why this study is designed to investigate the role of FSC program in adoption of improved wheat seed technology in KP.

Materials and Methods

Sampling and data collection

Based on climatic conditions, KP was divided into Southern, Central and Northern zones (see Figure 1 for details) and one district was randomly selected from each zone. Thus, in total, three districts, namely D. I. Khan, Charsada and Lower Dir, were randomly selected from KP province. From each of the three districts, one tehsil, having maximum number of FSC registered farmers, were selected.

A Stratified Random Sampling design was used to select a sample of 336 farmers (see Table 1 for details). The total sample size was decided using Yamane (1967)'s formula and farmers were proportionally selected from the three tehsils. The selected farmers were interviewed face to face for data collection during Spring, 2017.

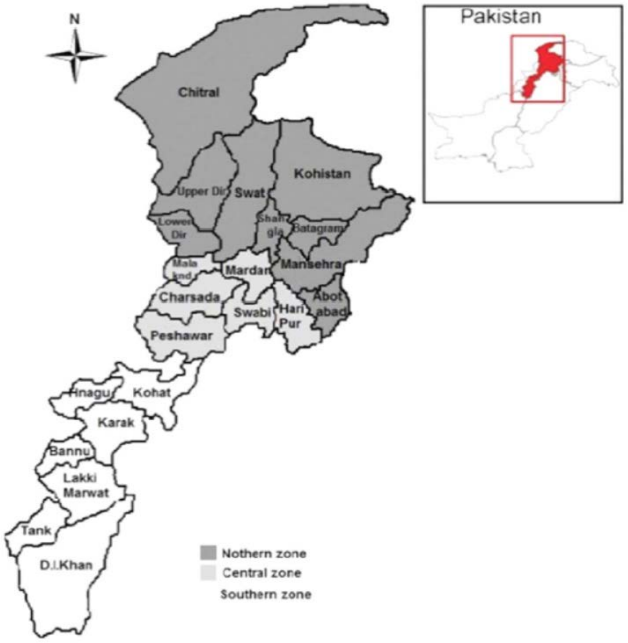

Figure 1: *Climatic zones of Khyber Pakhtunkhwa province of Pakistan.*

Analytical framework

Data on socioeconomic characteristics of the selected farmers were analysed thorough descriptive statistics. Farmers' choice of adopting improved seed technology and the resulting outcome (increase in yield) was separately analyzed. An independent sample t-test was used for testing the effect of improved seed technology adoption on wheat crop yield per acre. Binary logistic regression model was estimated to predict a farmer's choice of adopting improved seed technology and link it with registration in FSC.

Different functional forms for logistic regression model are given below.

$$P_i = P_i(Y_i = 1|X_i) = \frac{1}{1+e^{-z_i}} \quad \ldots(1)$$

$$1 - P_i = P_i(Y_i = 0|X_i) = \frac{1}{1+e^{z_i}} \quad \ldots(2)$$

$$L_i = ln\left(\frac{P_i}{1-P_i}\right) = z_i = \beta_0 + \sum_{n=j}^{n} \beta_j x_{ji} + \epsilon_i \quad \ldots(3)$$

Where;

Pi is the probability of the adopting the improved wheat seed technology; 1- *Pi* probability of not adopting the improved wheat seed technology; *Pi/1-Pi* is the odds ratio in favor of adopting the improved

Table 1: *Distribution of sampled registered and non-registered farmers.*

District	Tehsil	Registered farmers	Total farmers	Sampled farmers		
				Registered	Non-registered	Total farmers
Dir	Tazagram	100	2700	40	40	80
Charsadda	Toragzai	70	3104	28	28	56
D.I. Khan	Kulachi	250	4412	100	100	200
Total		420	10216	168	168	336

wheat seed technology; *Yi* is the apparent choice of the farmer (1 if adopted improved wheat seed technology, 0 otherwise); X is the vector of explanatory variables (list is given below).
L is called logit and is an index z ranging from -∞ to ∞; β_s are coefficients or weights on X variables; The marginal effect of an explanatory variable Xj is estimated as;

$$\frac{\partial P_1}{\partial X_j} = \frac{\partial P_1}{\partial L} \cdot \frac{\partial L}{\partial X_j} = f(L).\beta_j = \frac{e^{-z}}{(1+e^{-z})^2} \cdot \beta_j$$

The $f(L)=e^{-z}/(1+e^{-z})^2$ is derived at the mean of the explanatory variables (both continuous and dummy).

Explanatory variables were selected based on literature review and discussion with farmers during interview. Details on their nature and their coefficients signs are provided in Table 2.

Table 2: *Explanatory variables used in logit model.*

Variables	Description and measurement	Variable type	Sign
FSC registered	1 if yes, otherwise 0	Dummy	+
Irrigation facility	1 if yes, otherwise 0	Dummy	+
Tenure status	1 if owner, otherwise 0	Dummy	+
Farm size	Acres	Continuous	+
Head's age	Years	Continuous	-
Head's education	1 if literate, otherwise 0	Continuous	+
Monthly income	Pak. Rupees (000)	Continuous	+

Results and Discussion

Socioeconomic characteristics of the farm households

Table 3 presents summary statistics for data set on socioeconomic characteristics of the sampled farmers. Head's characteristics reveal that they were on average above 40 years and their agricultural experience was more 25 years. Half of them were literate had their average education level was 6 years of schooling. The average farm household size in selected districts of KP (9 individuals) was slightly above the national average (8 individuals).

Agriculture was the main source of income for 59 percent of the households. The average household income was Rs. 33616 per month, and average per capita income was Rs. 155 per day. This amount is somewhat greater than the absolute poverty line of Rs. 130 ($1.25) per day, and it point outs the existence of considerable poverty in the farming community of the selected districts.

Table 3 also present the same characteristics across FSC registered and non-registered farmers. They were significantly different in head's education level, primary source of income, daily per capita income level, access to irrigation water facility and farmland ownership.

Adoption of improved wheat seed technology

Survey data shows that 172 farmers (51.1 percent) reported the use of improved Wheat seeds out of which 77 percent were registered in FSC while only 23 percent were non-registered. The most frequently reported improved seeds were *Pirsabaq, Sahar, Uqab* and *Fakhre Sarhad* in irrigated areas and *Hashim, Seirn* and *Tatara* in rain-fed areas of the selected districts.

Yield comparison of the adopters and non-adopters of improved seeds exposes significant differences. Table 4 shows that average wheat yield for adopters of improved wheat seed technology was significantly greater than non-adopters' yield. This result implies that adoption of improved seed could significantly improve wheat production in KP province.

Determinants of adoption of improved wheat seed technology

Estimated results for binary logistic regression model are given in Table 5. The log likelihood value (-157.58) is statistically significant, as confirmed by theChi^2 statistic (150.44) with a P-value of 0.000.

Table 3: *Characteristics of FSC registered and non-registered farmers.*

Characteristics	All	FSC Registered	Non-registered
Head's Age (years)	46.47	46.72	46.20
Head's Experience (years)	26.40	27.10	25.64
Head's Education (years)	53%	83%	20%
Farm household's size (individuals)	8.99	8.58	9.43
Agriculture as primary source of income	59%	83%	33%
Daily per capita income (Pakistani rupees)	154.56	179.69	127.56
Farms having Irrigation Water facility	42%	56%	27%
Owners of the farmland	62%	88%	35%

Source: *Field survey (2017).*

Table 4: *Result for Yield Comparison Independent Sample t-test.*

Variable	Adopter	Non-adopters	Difference	T-stat	P-vale
Yield	13.72	7.73	5.99	8.20	0.00

Table 5: *Coefficient estimates for the logistic model.*

Seed Technology adoption	Logit coefficient (β)	Z-stat	P-value	Marginal effect [a, b, c]
FSC registered (1 if yes, 0 otherwise)	2.813	7.590	0.000	0.417
Irrigation facility (1 if yes, otherwise 0)	0.037	0.120	0.905	0.006
Tenure status (1 if owner, otherwise 0)	-0.140	-0.400	0.692	-0.021
Farm size(acres)	-0.005	-2.920	0.004	-0.001
Head's age(years)	-0.016	-1.610	0.107	-0.002
Head's Edu. (1 if literate, otherwise 0)	0.672	1.960	0.049	0.100
Monthly income (Pakistani rupees)	0.000	0.750	0.451	0.000
Constant	-0.792	-1.440	0.150	-1.869
Log likelihood	-157.58			
LR chi2 (7)	150.44			
Pseudo R2	0.3231			
Probability of adoption = 0.51 or 51percent, S.D.= 0.319				

It indicates that the combined effect of all the explanatory variables in the model is significant on a farmer's choice of adopting an improved Wheat seed technology. The estimated logit coefficients, marginal effects and associated z-statistics and p-values are presented in Table 5.

Farmer's status of membership in FSC is the most important determinant of adoption of improved seed technology. The positive logit coefficient indicates direct association with technology adoption. The estimated marginal effect of 0.417 suggests that FSC registered farmers are more likely to adopt improved technologies as compared to a non-registered farmer. This result is consistent with our prior expectation and also with the findings of Tesfaye et al. (2001), Abebaw and Haile (2013), Ahmed (2015) and Kebede et al. (2017).

Head's education level is the second import determinant of farmer's adoption of improved Wheat seeds. The estimated marginal effect of 0.100 demonstrates that a farm household's probability to adopt improved Wheat seed technology is high if headed by an educated individual. Educated farmers are usually more progressive and they mostly prefer contacts with agricultural extension agents for new technologies and training programs. This result is in line with the findings of Nzomoi et al. (2007) and Salasya et al. 1996. Studies by Uematsu and Mishra (2010) and Tesfaye et al. (2001) reported a negative influence of formal education towards adopting genetically modified crops.

Head's age and farm size have negative effects on adoption of improved wheat seeds; however, their

marginal effect values are negligible (close to zero). These results are in line with the findings of Tesfaye et al. (2001), Bingxin et al. (2011), Asfaw et al. (2011), Hailu et al. (2014), Shiferaw et al. (2014) and Kebede et al. (2017).

Canal irrigation infrastructure, tenancy status and farm household's monthly income have no significant effects on adoption of improved wheat seed technology. Though their logit coefficients have the expected signs but statistically insignificant.

Conclusions and Recommendations

Adoption of improved Wheat seed technology can significantly increase farmers' yield. However, the adoption rate of improved seed technology is not satisfactory. The unavailability and high cost of these seeds are major problems our farming community is facing, and to cope with these and alike problems, the provincial government is encouraging farmers to register in Farm Service Centre program. Findings from logistic regression analysis reveal that farmers registered in FSC are more likely to adopt improved Wheat seed technology as compared to non-registered farmers. In addition, head's age, education level and farm size are other determinant having significant effects on farmer's adoption of improved Wheat seed technology.

For adoption of improved wheat seed technology and increase in wheat yield this study recommends;

1. Farmers' registration in FSC program. Hurdles in this direction may be investigated and resolved through Government intervention.
2. Provision of free formal education and easily accessible agricultural extension services to farming community.
3. Government subsidy on important inputs and interest free credit facility for small farmers, as they are more likely to adopt improved production technology.

Novelty Statement

The study investigated the role of Farm Service Centre (FSC) program for adoption of improved wheat technology. The research further emphasized provision of modern and free agricultural technologies to the farmers for production of high wheat crop in Khyber Pakhtunkhwa province of Pakistan.

Author's Contribution

This research work is the part of Muhammad Israr's Ph.D. desertation. Noor P. Khan supervised the research work.

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