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AGRICULTURAL AND NATURAL RESOURCES ADAPTATIONS TO CLIMATE CHANGE

Land Ownership and Catastrophic Risk Management in Agriculture: The Case of Khyber Pakhtunkhwa Province of Pakistan

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The agricultural sector faces numerous threats arising mainly due to adverse weather conditions. These climatic risks are usually beyond the control of farmers and are mostly uncertain. Managing these risks and uncertainties is crucial in an effort to alleviate poverty and ensure food security for the masses who depend on farm sector for their livelihoods. Land tenure agreements along with other socioeconomic factors play an important role in farmers' decisions to adopt risk coping tools. This study is aimed at investigating the effect of tenure agreements on farmers' decisions to adopt three risk coping tools, namely off-farm diversification, precautionary savings and credit reserves, to mitigate climatic risks in Khyber Pakhtunkhwa Province of Pakistan. The results revealed that the adoption of traditional risk coping tools is relatively higher among landless tenants when compared with owner-cum-tenant farmers and owner farmers. However, for formal risk coping tools (credit reserves) tenant farmers have significantly lower access when compared with owner farmers. Owner farmers, on the other hand, can access financial institutions to lessen their burden of risks. The findings of the logit models also indicated the significant role of land ownership status, along with perceptions of risk sources and attitude towards risk, on farmers' decisions of adopting off-farm diversification and credit reserves. Therefore, it is suggested that financial institutions should facilitate tenant farmers' access to credit facilities by simplifying and shortening the credit sanction procedure.

Keywords: Risk Management; Land Ownership; Risk Perceptions; Risk Attitude; Khyber Pakhtunkhwa

1. Introduction

Agriculture is one of the sectors most affected by natural hazards and disasters, which enhance vulnerabilities of resource-poor and landless farmers in particular and often threaten their livelihood security (UN 2014). Agricultural activities are subjected to a wide range of risks and uncertainties because of the variable economic and biophysical environment in which farming operates (Ullah et al. 2015a). Agricultural production is riddled with risks and uncertainties that can adversely affect production levels and leads to sizeable losses (Drollette 2009). Natural hazards determine production in ways that are outside the control of the farmer (Anton 2009). The risks in agriculture arising from uncertain factors such as weather and market conditions can result in variable returns (income) to decisions made in a particular year (Mishra et al. 2004).

The development of the agriculture sector is crucial for poverty reduction and sustainable development for agrarian economies such as Pakistan. Despite steady progress towards industrialization, agriculture still remains the most important sector in Pakistan with 18.9 percent contribution towards the country's Gross Domestic Product (GDP) and an employment rate of 42.5 percent of the total labor force (GoP 2018). However, this important sector is devastated by two successive years of massive floods that caused unprecedented losses to agriculture crops, livestock, fisheries and forestry and primary infrastructure such as tube wells,

water channels, household storages, houses, animal sheds, personal seed stocks, fertilizers and agricultural machinery. One-fifth (17 million acres) of the country's total land area remained inundated. 1.9 million houses were destroyed, and over 2000 people have died (Ullah et al. 2016). The economic impact of the tragedy has been estimated at over US$43 billion (RISE 2010). In 2011, another massive flood struck Pakistan leaving a significant impact on people's lives and resulted in the loss of livelihoods, primarily those related to agricultural activities. The flood destroyed standing crops of cotton, rice, sugar cane, sorghum, vegetables and pulses on about 0.84 million hectares of land. Livestock also suffered heavy losses, approximately 115,500 livestock have perished and about 5 million surviving livestock were directly affected (GoP 2012).

Masses around the globe depends on access to land resource for shelter and livelihoods, and therefore food security (Mitchell and Myers 2013). Land tenure agreements largely affect/influence the efficiency of farm inputs and the adoption of modern technologies, which in turn affect agricultural productivity. Keeping in view the scarcity of land and related resources, the distribution and tenure arrangements are regarded as key issues in the nation's development strategy (Nasrin and Uddin 2011). The term tenure connotes the bundle of rights an individual, household or community may have with respect to land or water or other resources for that matter (ibid). With land tenure, the meaning is restricted to rights related to land, their origin and their operation (Bruce 1993). FAO (1993) defines land tenure as the relationship (whether legally or customarily defined) among people, as individuals or groups, with respect to land. In simple words, land tenure systems determine the ownership (who can use what resource), time (for how long) and conditions of use of the land and related resources (Nasrin and Uddin 2011).

Natural disasters impact individuals in many ways and the degree of impact depends on various factors such as land tenure security, extent of loss to property and the capability of the individuals to recover their land and livelihood. The most vulnerable segment of the community to natural disaster comprised of those who depend on land resources for their livelihood with weak and insecure land rights (Charoenkalunyuta 2011). In the wake of disaster this vulnerable segment (comprised of informal settlers, farm laborers, lessees and sharecroppers) may be forced to settle in hazard-prone areas such as near a flood-prone river) as they lack any affordable alternatives (Quan and Dyer 2008). Their rights may or may not be considered in post-disaster decisions. It is these people who may not be adequately considered when post-disaster decisions on compensation are made. In contrast, individuals with privately owned land with secure tenure are less vulnerable to the impacts of natural disasters (Mitchell 2011). Secure land tenure is a key factor in terms of the allocation of assistance and reinstatement of land in response to catastrophe (Mitchell 2009). Therefore, land tenure security can support the resilience of community to cope with the disasters. Improving land tenure is a strategy to increase the resilience and to reduce the vulnerability of communities from natural hazards (Charoenkalunyuta 2011) and provides an incentive for investing in land improvement activities including soil protection measures, pasture improvement, tree plantation, irrigation and sustainable cropping (FAO 2011).

As agriculture is the only source of livelihood for most of the people in rural areas, it is important for the farmers to protect and safeguard their farms from risk and uncertainty to continue earning their livelihood from agriculture (Ullah et al. 2016). In response to the devastating floods in 2010 and 2011, farmers are adopting risk management strategies to reduce the impacts of such kind of risks in future. The land tenure system along with socioeconomic factors of the farmers play an important role in these decisions, and thus, these factors need to be studied and should be key elements while drafting risk management strategies for agriculture sector. This study is therefore, designed to investigate how tenure systems affect farmers' decisions to adopt risk coping tools to manage farm risks.

1.1. Conceptual Framework

Land ownership can impact a farmer's risk management decisions through its indirect effects on his or her risk perceptions, risk attitude and access to publicly provided services. Tenant farmers perceive the catastrophic risks (floods, heavy rains, pest and diseases, and droughts) to be major sources that can alter their farm earnings and lead to significant productivity losses. The higher perceptions of the natural calamities then translate into their risk management decisions as farmers with higher perceptions of catastrophic risk sources tend to adopt more risk management tools to cope with growing instabilities in farm incomes (Ullah et al. 2015b). Land ownership status can also effect a farmer's attitude toward risk. Tenant farmers may avoid risky prospects and choose alternatives with lower risks compared to their owner counterparts (Ullah et al. 2016). The opportunity for farmers to increase farm production and eventually to increase their income from farm enterprise largely depends on their access to the credit market and their ability to compete in it (Moll et al. 2007; Abedullah et al. 2009; Markelova et al. 2009). However, studies

on credit indicated that farmers (especially small holders and landless tenants) have poor access to formal credit due to institutional constraints (Jabbar et al. 2002; WB 2008). Owner farmers are expected to have higher access to publicly provided services particularly to the institutional credit sources, which in turn enable them to adopt risk management tools at farm level (see **Figure 1**).

2. Methodology

2.1. Study Area and Sampling

The study was conducted in four districts, namely, Peshawar, Charsadda, Swat and Shangla, of Khyber Pakhtunkhwa Province, Pakistan (**Figure 2**). A multistage sampling procedure was adopted for the selection of study area. In the first stage Khyber Pakhtunkhwa province was purposively selected. The main reason behind this selection was the fact that this province was severely affected by the flood that struck Pakistan during July 2010. The flood severely affected the agriculture sector of the province and also left heavy impacts on the primary infrastructure including storage facilities, roads, communication,

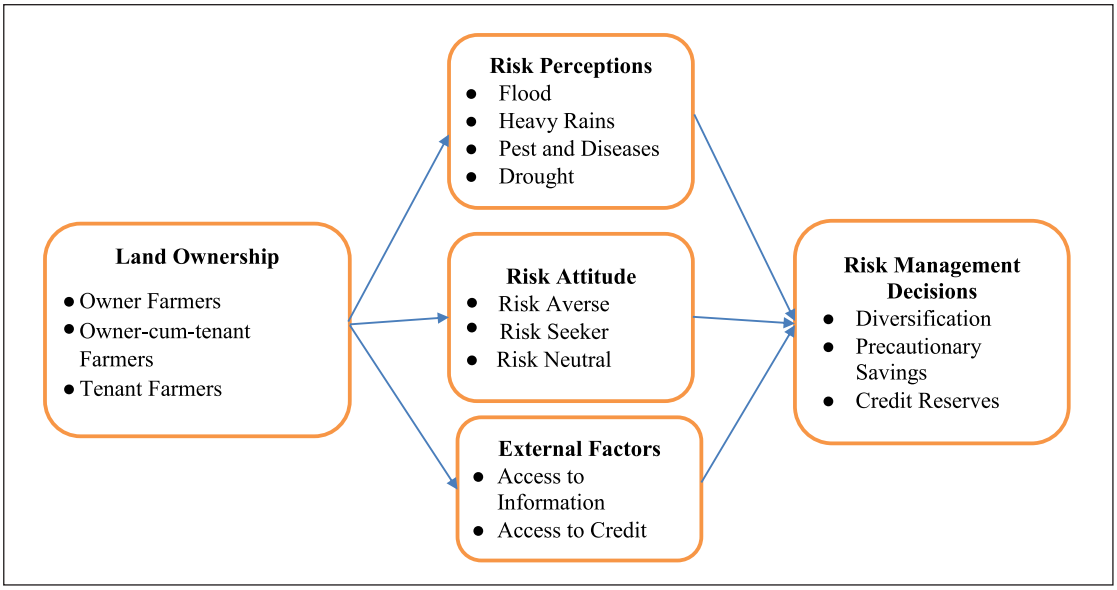

Figure 1: Conceptual Framework.

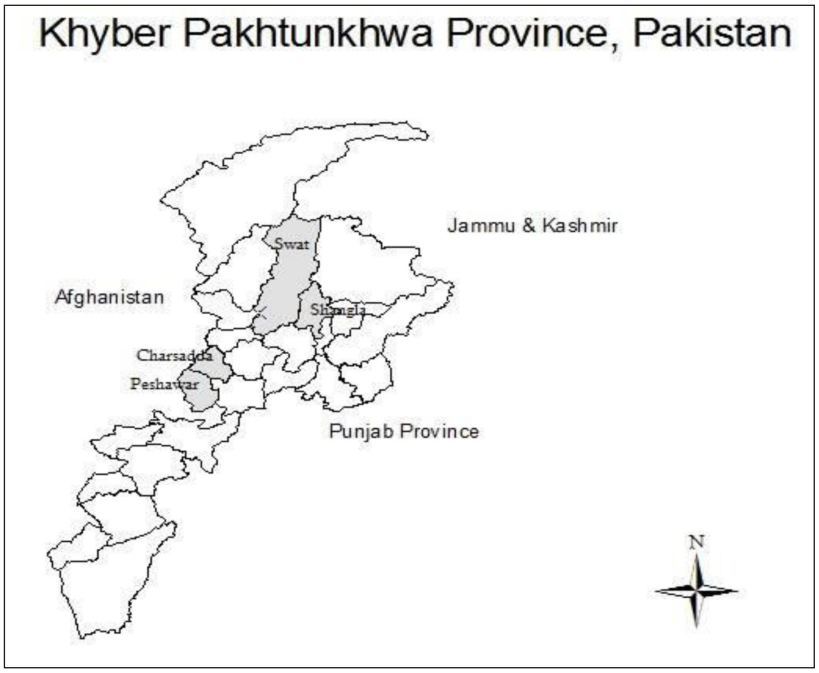

Figure 2: Map of Study Area.

tube wells, etc. in the second stage four districts were selected using stratified random sampling such that two districts viz. Peshawar and Charsadda are selected from Peshawar valley where the farmers have relatively higher access to main markets and other publicly provided services while farmers in the other two districts (Swat and Shangla) have comparatively lower access to these incentives (Ahmad et al. 2007; Shahbaz et al. 2010).

In the third stage two villages from each district were selected at random and such that one was severely affected by the flood in 2010 while the other was moderately affected by the flood. A sample of 330 respondents were randomly selected using Yamane's formula (Yamane, 1967) as given below;

$$n_i = Ni / (1 + Ne^2) \quad (1)$$

Where,

n_i = Sample size in the i^{th} Village
Ni = Total number of farming households in i^{th} village
e = Precision which is set at 15% (0.15)

2.2. Data Collection

Data were collected from 330 sampled respondents across the selected districts during November 2012 to April 2013 using a structured questionnaire. Farmers were interviewed for relevant information on various farm practices, ownership status, farm size and their risk management strategies through face-to-face meetings at their field/home.

2.3. Data Analysis

The study is aimed at assessing the impacts of land ownership, risk perceptions, risk attitude and access to information and credit sources on farmers' decision of adopting risk management strategies.

2.3.1. Risk Management Tools

During the surveys, the most prevalent and dominant risk management strategies in the study area were found to be off-farm diversification, precautionary savings and credit reserves (among the many possible and available risk management strategies) and hence the analysis are based on the adoption of these three risk coping tools.

Off-Farm Diversification: Diversification is one of the most basic and obvious approaches used since humankind began to engage in agriculture (Tangermann, 2011). Crop diversification and intercropping systems are means to reduce the risk of crop failure due to adverse weather events, crop pest or insect attacks (WB 2005). Apart from altering agricultural production strategies, households also smooth income by diversifying income sources and thus minimizing the effect of a negative shock to any one of them. Diversification as risk management strategy included in the analysis comprised of off-farm diversification. In off-farm diversification the producers diversify the income sources off-farm (off-farm investment and employment).

Precautionary savings: Of crops or liquid assets present obvious means for households to smooth consumption. Currency and crop inventories function as buffers or precautionary savings (WB, 2005). Farmers tend to invest in assets such as livestock, farm and household tools, equipment, fertilizer, perennial crops and the human capital of family members (e.g., education, immunizations, etc.) especially in lower income countries where the choice of investing in financial assets such as saving accounts are generally not available (Collier et al. 2009). Precautionary savings include accumulation of liquid and semi-liquid assets in the form of livestock, cash, crop inventories, farm and household tools, equipment and other productive assets. These assets are widely used as post ante shock absorbing mechanisms mostly by small holder farmers.

Credit Reserves: Agricultural credit plays an important role in the process of modernization of agriculture and commercialization of the rural economy (Abedullah et al. 2009) and the credit reserves are one way farmers manage risk (Skees 1999). Holding a credit reserve can be an efficient way to provide liquidity to guide a business through hard times (Anderson 2001). There are various uses of credit in farm operations/ activities, however, in this study its value depends on the farmer's decision to utilize credit reserves only for the purpose of farm risk management.

The study also analyzes the impact of land ownership status on farmers' risk perceptions, risk attitude and their access to information and credit sources. According to land ownership, farmers are categorized into three groups (owner farmers, owner-cum-tenant farmers and tenant farmers).

2.3.2. Land Ownership Types

There are three categories of farmers in our sample these are i) owner farmers who cultivate their own land, ii) Owner-cum-tenant farmers are basically owner farmers who leased in additional land for cultivation and iii) tenant farmers who cultivate the land of another and pay rent with cash or with a portion of the produce. The tenural agreement found in most parts of the selected districts was share cropping where tenant farmers cultivate the land of land owners and share 50 percent of the produce with the land owners. The land owners shoulder 50 percent of the cost of ploughing, fertility inputs and pesticides/weedicides. In some cases, the tenants leased the land and pay a specific (agreed upon) amount to the owners. Our sample comprised of 107 owner farmers, 72 owner-cum-tenant farmers and 151 tenant farmers.

2.3.3. Risk Perceptions

Risk perceptions of the sampled respondents were quantified using a risk matrix containing incidence and severity of each source of risk (flood, heavy rains, pest and diseases and hail storms). For instance, the respondents were asked to rank the incidence and severity of a risk source on a likert scale from 1 (very low) to 5 (very high). Farmers' responses were combined in a risk matrix (**Figure 3**) and were categorized as low if the score lies between 2 and 5 while high if it ranges from 6 to 10.

The risk score has been transformed into a binary variable by assigning 1 to individuals with risk score between 6 and 10 (high) and 0 otherwise.

2.3.4. Risk Attitude

An Equally Likely Certainty Equivalent (ELCE) model is used in this study to elicit respondents risk attitude. Following Binici et al. (2003) a series of certainty equivalent points over the income distribution were derived and matched with utility values. For instance, the respondent was asked to specify the monetary value of a sure outcome that make him indifferent between the two risky outcomes of PKR (Total Annual Household Income, say PKR[1] 50,000) and PKR 0 with equal probability. Suppose the response was PKR 26,000, the respondent was again asked to specify the monetary value of a sure outcome that made him indifferent between the two risky outcomes of PKR 26,000 and PKR 0 with equal probability supposing the response was PKR 12,000. This process continues until sufficient data points were obtained. For the other half of the income distribution, the farmer was asked to specify the monetary value of a sure outcome that makes him indifferent between PKR 26,000 and PKR 50,000 each with 0.5 probabilities. In this way, several CE equivalent points were obtained and matched with their respective utility values. Utility value attached with the lower outcome (PKR 0) is 0 and with the higher outcome (PKR 50,000) is 1. The farmer's response of PKR 26,000 is his CE for uncertain payouts of PKR 50,000 and PKR 0 with equal probabilities (0.5 each) and the utility value for this CE is calculated as

$$U(26{,}000) = 0.5u(0) + 0.5u(50{,}000) = 0.5(0) + 0.5(1) = .50 \quad (2)$$

Similarly utility values for all the CE points are calculated and are presented in **Table 1** (for this example).

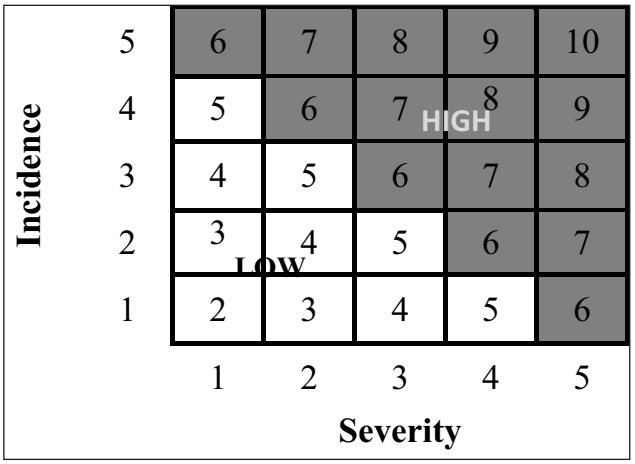

Figure 3: Risk Matrix.

[1] PKR is abbreviation for Pakistani currency (1 PKR is approximately equal to 0.01 USD).

Table 1: Example of Elicitation of Certainty Equivalents and Computation of Utility Values.

Step	Elicited CE	Utility Calculation
	Scale	U(0) = 0 and U(50,000) = 1
1	(26,000; 1.0) ~ (0, 50,000; 0.5, 0.5)	U(26,000) = 0.5u(0) + 0.5u(50,000) = 0.5
2	(12,000; 1.0) ~ (0, 26,000; 0.5, 0.5)	U(12,000) = 0.5u(0) + 0.5u(26,000) = 0.25
3	(5,000; 1.0) ~ (0, 12,000; 0.5, 0.5)	U(5,000) = 0.5u(0) + 0.5u(12,000) = 0.125
4	(2,000; 1.0) ~ (0, 5,000; 0.5, 0.5)	U(2,000) = 0.5u(0) + 0.5u(5,000) = 0.0625
5	(36,000; 1.0) ~ (50,000, 26,000; 0.5, 0.5)	U(36,000) = 0.5u(50,000) + 0.5u(26,000) = 0.75
6	(42,000; 1.0) ~ (50,000, 36,000; 0.5, 0.5)	U(42,000) = 0.5u(50,000) + 0.5u(36,000) = 0.875
7	(45,000; 1.0) ~ (50,000, 42,000; 0.5, 0.5)	U(45,000) = 0.5u(50,000) + 0.5u(42,000) = 0.937

Author's Calculations.

After deriving several certainty equivalents and matching them with utility values, a cubic utility function of the following form was then used to estimate the utility of each individual respondent. Following Binici et al. (2003) and Olarinde et al. (2007) household income was used in the utility function to represent wealth.

$$u(w) = \alpha_1 + \alpha_2 w + \alpha_3 w^2 + \alpha_4 w^3 \tag{3}$$

The above equation was estimated using Ordinary Least Squares (OLS) estimation procedure. The estimated coefficients were used to transform the shape of utility function from ordinal scale to a more quantitative measure, Arrow-Prat absolute risk aversion coefficients using the following mathematical equation:

$$r_a(W) = -\frac{U'(W)}{U''(W)} \tag{4}$$

$r_a(W)$ is coefficient of absolute risk aversion, U' and U" are first and second order derivatives of wealth (income in our case), respectively. The coefficient of absolute risk aversion is positive if individual is risk averse, negative if individual prefers risk and zero if individual is indifferent to risk. The risk attitude of the farmers was included in the analysis as 1, if individual reflect risk averse nature and 0, otherwise.

2.3.5. Access to Credit and Information Sources

A composite index was used to measure the access of sampled households to information sources. The main information sources identified during surveys include extension workers, television, radio and newspapers private consultant, fellow farmers, friends/relatives and input dealers. Farmers were asked to report the number of contacts they made with each information source in one month period. The values for each information source were first transformed using the following equation.

$$\text{Transformed Value}(\text{TV}) = \frac{\text{Xi} - \text{Min}}{\text{Max} - \text{Min}} \tag{5}$$

The composite index for each sampled household was calculated by taking the sum of TV's for all sources of information.

Credit access of the sampled households was measured using credit access ratio (Amjad and Hasnu, 2007).

$$AC_i = \frac{c_i / C}{I_i / L} \tag{6}$$

Where:

AC_i = Access to credit of i^{th} household
c_i = Amount of credit received by the i^{th} household
C = Total amount of credit received by all sampled households in the study area
l_i = land holding belonging to i^{th} household
L = Total landholding belonging to all sampled households in the study area

The composite index and credit access ratio have been used as independent variables in the binary logistic regression analysis.

2.3.6. Regional Dummy

To capture the effect of regional variation in the adoption of the three risk management tools, a regional dummy variables has been included in the model with a value of 1 if the respondent is from region 1 (Districts Peshawar and Charsadda) and 0 otherwise.

2.4. Data Analysis

A logit model was used to assess the impacts of land ownership status, farmers' perceptions of the risk sources, their risk attitude and access to information and credit sources on their decisions to adopt the three risk management tools. A general description of logit model is as follow;

$$\text{Logit}Y\left[P/1-P\right] = ß0 + ßiXi + ei \quad (7)$$

Y is a dichotomous variable taking a value of 1 if the respondent has adopted a specific risk management strategy and 0 otherwise. ß0 is constant and ßi represents the coefficient vector (to be estimated) while Xi represents independent variables. The logit models are estimated using Maximum Likelihood Estimation (MLE) procedure in Stata version 12.

3. Results and Discussion

3.1. Adoption of Risk Management Tools by Land Ownership Type

The adoption of the three risk management tools by land ownership type is presented in **Table 2** below. The table depicts that off-farm diversification is the major risk coping tool adopted by 53.63 percent of the sampled respondents to offset the adverse effects of climatic risks. Off-farm diversification enables farmers to smooth their consumption and guide their farm enterprise after the farm is struck by a negative shock arising mainly due to climatic risks. Similarly, 40 percent of the sampled respondents adopted precautionary savings as a strategy to cope with climate extremes. During the surveys it was revealed that most of the respondents rear cattle which can be sold in case the farm income is altered by adverse weather conditions. Credit reserves as an ex-post risk coping tool is adopted by 39.69 percent of the sampled respondents in the study area, which indicate the importance of credit reserves as a means of reducing the impact of climatic risks.

Table 2 also depicts that majority of the owner respondents (56.075 percent) used credit reserves to mitigate the adverse impacts of climatic risks at farm level followed by the use of assets accumulation (43.925 percent) and off-farm diversification (42.991 percent). Major proportion among owner-cum-tenant farmers and tenant farmers (56.944 percent and 59.602 percent respectively) adopted off-farm diversification to manage climatic risks. Only 26 percent of the tenant farmers in our sample used credit reserves as an ex-post risk management tool to manage catastrophic risks. The lower adoption of credit reserves among tenant farmers can be associated with the lack of collateral necessary to obtain loan from financial institutions.

3.2. Risk Perceptions and Risk Attitude

Farmers' risk perceptions and their attitude towards risk by land ownership status are presented in the following **Table 3**.

Table 2: Adoption of Risk Management Tools by Land Ownership Type.

Land Ownership Types	Off-farm Diversification		Assets Accumulation		Credit Reserves		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Owner farmers	46	42.991	47	43.925	60	56.075	107	32.424
Owner-cum-tenant farmers	41	56.944	33	45.833	32	44.444	72	21.818
Tenant farmers	90	59.602	52	34.437	39	25.828	151	45.757
Overall	177	53.636	132	40	131	39.697		

Source: Derived from survey data.

Table 3: Farmers' Risk Perceptions and Risk Attitude by Land Ownership Status.

Land Ownership Types	Risk Perceptions								Risk Attitude	
	Risk of Floods		Risk of Heavy Rains		Risk of Pest and Diseases		Risk of Hail Storms		Risk aversion	
	Freq.	%age	Freq.	%age	Freq.	%age	Freq.	%age	Freq.	%age
Owner Farmers	69	64.49	65	60.75	83	77.57	24	22.43	81	75.70
Owner-cum-tenant Farmers	57	79.17	49	68.06	52	72.22	22	30.56	58	80.56
Tenant Farmers	104	68.87	115	76.16	110	72.85	40	26.49	124	82.12
Total	230	69.70	229	69.39	245	74.24	86	26.06	263	79.70

Source: Derived from survey data.

The table depicts that among the majority of the owner respondents (77.57 percent) perceived risk of pest and diseases to be the major threat to their farm enterprise followed by risk of floods (64.49 percent) and risk of heavy rains (60.75 percent). Similarly, a major proportion among the owner-cum-tenants (79.17 percent) considered the risk of floods to be the main threat that can affect their farm activities and incomes followed by risk of pest and diseases (72.22 percent) and risk of heavy rains (68.06 percent). Among the tenants, majority of the sampled respondents (76.16 percent) considered risk of heavy rains to be the main source of catastrophic risk that can alter their farm earnings while 72.85 percent and 68.87 percent believed risk of pest and diseases and risk of floods respectively to be the major risk sources that can affect their farm incomes. Only 26.49 percent respondents among the tenants perceived that hail storms could be a major source of climatic risks that can cause production losses on the field. A general observation from the table reveals that the risk perceptions are higher among tenant farmers compared to owner and owner-cum-tenant farmers. Secondly, the risk of pest and diseases was recognized as a major threat by the sample respondents in the study area. The table also presents the distribution of sampled respondents in risk attitude. The results presented in the table clearly reveals that tenant farmers are mostly risk averse in nature and will tend to avoid activities with higher degree of risk involved. The higher perceptions and risk averse nature may induce farmers' adoption of the available risk management tools.

3.3. Access to Credit and Information Sources

Farmers' access to credit and information are greatly influenced by their land ownership status. It is hypothesized that owner farmers have higher access to the publically provided services including information and credit sources. The access to information and credit sources by land ownership status in our sample is provided in **Table 4**.

The access to information sources is limited in case of tenant farmers compared to owner and owner-cum-tenant farmers. Owner farmers enjoy higher access to information sources followed by owner-cum-tenant farmers. Similarly, tenant farmers remains at the tail end in case of their access to credit sources. This is mainly because tenant farmers lack collateral to obtain institutional credit. Owner farmers have comparatively higher access to credit sources followed by tenant farmers.

3.4. Adoption of Risk Coping Tools

Farmers' decisions of adopting the available risk management tools are affected by various factors. We employed three separate logit models to assess the impact of land ownership status along with farmers' perceptions of the risk sources, their attitude towards risk and their access to information and credit sources on their decisions to adopt the three risk management tools. **Table 5** presents the parameter estimates of the three individual logit models.

The findings highlighted the significance of land ownership status in farmers' decisions of adopting the three risk management tools to mitigate the adverse impacts of climatic risks at farm level. The results indicate that the adoption of off-farm diversification as an ex-ante risk coping tools is significantly higher among tenant farmers and owner-cum-tenant farmers compared to owner farmers. The lower adoption of off-farm diversification among the owner farmers may be attributed to their land tenure security. Larger proportion of owned land is related to greater wealth, greater stability of land control and a larger asset base (Velandia et al. 2009) and therefore reduces the probability of adopting odiversification as a risk coping tool. Owner farmers and owner-cum-tenant farmers also adopt assets accumulation as a risk management strategy however, this relationship between land ownership and the adoption of assets accumulation is

Table 4: Access to Information and Credit by Land Ownership Status.

Land Ownership Types	Access to Information	Access to Credit
	Composite Index Score	Credit Access Ratio
Owner Farmers	0.369	0.894
Owner-cum-Tenant Farmers	0.299	0.595
Tenant Farmers	0.250	0.429

Source: Derived from survey data.

Table 5: Parameter Estimates of the Logit Models.

Variables	Off-farm Diversification	Assets Accumulation	Credit Reserves
	Coefficients (std. err)	Coefficients (std. err)	Coefficients (std. err)
Land Owner	−1.378*** (0.295)	0.329 (0.294)	1.183*** (0.345)
Owner-cum-tenants	1.184*** (0.336)	0.128 (0.349)	0.932** (0.412)
Perceptions of Floods	−0.462* (0.278)	0.851*** (0.301)	0.002 (0.319)
Perceptions of Heavy Rains	0.467* (0.279)	0.701** (0.297)	0.961*** (0.346)
Perceptions of Pest and Diseases	0.410 (0.291)	0.580* (0.306)	0.252 (0.342)
Perceptions of Hail Storms	1.372*** (0.329)	1.662*** (0.313)	2.393*** (0.353)
Risk Attitude	0.827*** (0.317)	0.517 (0.337)	0.567 (0.383)
Access to information	0.273 (0.361)	0.153 (0.365)	2.119*** (0.475)
Access to Credit	−0.004 (0.034)	0.008 (0.034)	−0.001 (0.037)
Regional Dummy	0.454 (0.278)	1.104*** (0.299)	0.219 (0.318)
Log likelihood	−194.332	−185.724	−155.47
LR Chi Square	67.07***	72.74***	132.41***
Pseudo R Square	0.147	0.164	0.299

Note: Figures in parenthesis are standard errors. ***, **, and * represents significance at 1 percent, 5 percent and 10 percent respectively.

statistically insignificant in both cases. In case of credit reserves, the results indicate that tenant farmers are at the tail end when it comes to the use of credit reserves as a risk management tool. Tenant farmers are unable to provide the collateral required by financial institutions to obtain loans and meet their financial needs. Their access is further hindered by their low level of knowledge and high markup rates. The owner farmers and owner-cum-tenant farmers enjoy a healthy access to credit sources to meet their financial needs and to cope with adverse consequences of harsh weather conditions.

Farmers' perceptions of the risk sources also play important role in shaping farmers' decisions of adopting the three risk management tools at farm level. The positive and significant coefficients associated with most of the risk sources (expect for perceptions of flood in case of credit reserves and perceptions of pest and diseases in case of off-farm diversification and credit reserves) indicate that higher perceptions of these risk sources lead to higher adoption of the three risk management tools. Farmers' risk averse nature also induce them to adopt the three risk management tools. Risk aversion has a positive and significant relationship with adoption decisions of off-farm diversification. The relationships of risk aversion and the adoption decisions of precautionary savings and credit reserves are also positive however insignificant.

Access to information and credit sources encourage the adoption of the three risk management tools. However, the impacts of access to information and credit sources on farmer' decision adoption are statistically insignificant except for the impact of access to information sources in case of adoption of credit reserves to mitigate climatic risks which is statistically significant. The coefficients associate with regional dummy indicate that the adoption of precautionary savings are significantly higher in region 1 (Districts Peshawar and Charsadda). The adoption of the other two risk management strategies (off-farm diversification and credit reserves) are also higher in region 1 however, the relationship is statistically insignificant.

4. Conclusion

The main conclusion drawn from this study is that the nature of land ownership effects farmers' choices in adopting risk management tools. The adoption of traditional risk management tools (off-farm diversification) is relatively higher for tenant farmers compared to the owner-cum-tenant farmers and owner farmers. Tenant farmers adopted traditionally available risk coping tools (mainly due to their limited access to institutional sources) to mitigate farm risks while owner farmers accessed financial institutions to lessen the burden of climatic risk by using credit reserves. Lower access to intuitional credit sources affects tenant farmers in a number of ways. Lower access to institutional credit sources translate into lower capability to provide essential inputs in time, which leads to significant reduction in the crop yields and revenues. Lower credit access can also affect their risk-taking behavior and force them to forego opportunities of higher profits that bring a degree of risk. Financial institutions can facilitate tenant farmers' access to credit sources by shortening/simplifying the credit sanctioning procedure. The extension workers and agricultural departments can also play a significant role in training the farmers on the ways to obtain institutional credit.

Competing Interests

The authors have no competing interests to declare.

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