Remittances Review
January, 2024
Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received: 10 January 2024, Accepted: 15 February 2024

DOI: https://doi.org/10.33282/rr.vx9il.129

Impact of Risk Perception on Farmers' Adaptation to Climate Change

Muhammad Nawaz Khan[1], Akhtar Ali[2], Bushra Hassan Jan[3], Riaz Ahmad[4] and Muhammad Adnan[5]

1. Assistant Professor Department of Sociology, Shaheed Benazir Bhutto University Sheringal Dir Upper, Khyber Pakhtunkhwa, Pakistan; nawazsocio@sbbu.edu.pk

2. Associate Professor, Department of Rural Sociology, Faculty of Rural Social Sciences, The University of Agriculture Peshawar- Pakistan; akhtar@aup.edu.pk

3. Associate Professor, Department of Rural Sociology, Faculty of Rural Social Sciences, The University of Agriculture Peshawar- Pakistan; bushrahjan@aup.edu.pk

\

4. Assistant Professor, Department of Sociology, Shaheed Benazir Bhutto University Sheringal Dir Upper, Khyber Pakhtunkhwa, Pakistan; nawazsocio@sbbu.edu.pk

5 Lecturer, Department of Sociology, Shaheed Benazir Bhutto University Sheringal Dir Upper, Khyber Pakhtunkhwa, Pakistan; nawazsocio@sbbu.edu.pk

Correspondence author:
Email address: nawazsocio@sbbu.edu.pk

Abstract

This study focused on the association between climate change risk perception and farmers' adaptation to climate change in the rural areas. The study was limited to farmers involved in agricultural crops, namely wheat, maize, rice, and vegetables. The data was collected from 383 farmers in 21 selected union councils of District Upper Dir and District Lower Dir, Khyber Pakhtunkhwa through multistage stratified random sampling. The data was analyzed through bivariate and multivariate analyses. Chi-square and Kendall's T^b tests were applied to test the relationship between climate risk perception and farmers' adaptation. The findings revealed that majority of the farmers were aware about climate change occurrence and the risks associated with it. At the bivariate level, risk perception has significant and positive association with farmers' adaptation to climate change. At multivariate level, family type, marital status, level of education, and farming experiences as control variables explained variations in the association of risk perception with farmers' adaptations. Organized awareness campaign is suggested to be regarded as an important component of climate change policies. This would allow the general public, and particularly farmers, to perceive climate change as a risk, which is critical for climate change mitigation and adaptation actions.

Key Words: Climate change, Adaptation, Risk Perception, Farmers

1 Introduction

Climate change is widely accepted as one of the most significant challenges to human development and security (IPCC, 2007; Mearns & Norton, 2010), and the rural poor, who are primarily dependent on natural resources as their livelihood, are significantly affected by extreme weather conditions (UNFCCC, 2007). Pakistan, like other developing countries, has experienced the worst effects of climate change in all areas of its provinces (Hussain *et al*., 2018; Ali & Erenstein, 2017). The agriculture-dependent rural communities of Pakistan have been most vulnerable to adverse weather conditions, including floods, droughts, storms, and cyclones (Ali & Erenstein, 2017). In Khyber Pakhtunkhwa province, climate change variability has been reported as a serious threat to agriculture and the livelihood of farming communities (Khan *et al*., 2016).

Adaptation to climate change has been increasingly recognized as a way to reduce the adverse impacts of climate change on agriculture (Maddison, 2007; Bryan *et al*., 2013). In the turn of this century, the focus has been prominently shifted from mitigation to adaptation (Mearns & Norton, 2010). The environmental sociologists suggest a more integral approach to adaptation that includes both objective and subjective dimensions. They claim that adaptation to climate change in biophysical conditions will not solve the problem; rather, humans will also have to understand the relationship between society and the environment. In other words, the adaptation capacity of individuals and society will have to be understood in the light of existing social systems, beliefs, values, and worldviews (O' Brien & Hochachka, 2010). This is because adaptation can increase resilience while decreasing vulnerability to climate change. The

January, 2024
Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

adaptation to climate change is affected by a number of structural, cultural, and group factors, including gender, race, class, caste, ethnicity, age, and indignity (Ribot, 1995; Blaikie *et al*., 1994). In other words, a number of social, informational, and economic factors affect the adaptation strategy of the farmers (Brayan *et al*., 2013).

The research in psychology suggested that along with cognition and risk perception, emotions are of great importance when taking decisions regarding climate change (Kahneman, 2011; Stanovich, 2008). Psychological factors such as risk perception and perceived adaptive capacity play a significant role in decision-making about climate change adaptation (Grothmann & Patt, 2005). Social psychology stresses the role of descriptive and prescriptive norms. The descriptive norms simply define the behaviors as similar to others, while the prescriptive norms tell how one should think or behave (Cialdini *et al*., 1991). Moreover, the norms are thought of as how people act, think, or feel in a particular situation (Popenoe, 1983). The relationship between public perception about climate change and their response to address the issue is not very well explored. However, in the last decade, there has been an increasing trend to consider different measures of climate change and individual behavior, as well as consideration for climate change mitigation and adaptation policies (van der Linden, 2017). Despite people having knowledge about climate change, scholars report that an appropriate response is still lacking (Whitmarsh *et al*., 2012; van der Linden, 2015).

A number of studies report that there are strong linkages between public concerns about climate change and adaptation and mitigation measures (van der Linden, 2017). A study reveals that public worry about climate change is one of the influential sources in the formulation of climate change policies, treaties, and regulations (Smith & Leiserowitz, 2014).. Similarly, another study shows that climate change concerns significantly influence the behaviors necessary to reduce energy use (Spence *et al*., 2011). In fact, numerous research studies identify a strong relationship between risk perceptions, efforts to address climate change threats, and support for policies about climate change (Ding *et al*., 2011; McCright *et al*., 2013). Due to their greater personal relevance, individuals can show more willingness to initiate adaptation measures, but there is research evidence that shows that climate change risk perception and certain behavior actions are not always consistent (Helgeson *et al*., 2012). There is a moderate level of association between climate change beliefs, support for climate change policies, and behavioral actions towards them (Hornsey *et al*., 2016). One of the reasons for this discrepancy is the gap between stated concerns and actual behavior (Sheeran, 2002). Another fact is that there is a lack of studies that could explore the role of climate change risk perception in climate change adaptation, mitigation, and behavioral action on climate change (van der Linden, 2017).

2. Methodology

To fulfill the study's objectives, the following procedure was implemented.

2.1 Universe of the study

The study was conducted in north-western districts (Upper Dir and District Lower Dir) of Khyber Pakhtunkhwa Pakistan. Upper Dir District has an area of 3699 square kilometers and consists of 120,000 households. The number of households in District Lower Dir is 151669 having area of 1583 square Kilometers. Apart from small areas in the south-west, the districts are mostly mountainous terrain (GOP, 2017). The major crops in the area include wheat, maize, rice, potato, and onion. Major fruits grown in the district are peas, persimmon, apple, plum, and mulberry (PPAF, 2014). The populations of these two districts are vulnerable to climate change conditions, especially in terms of their agricultural productivity.

2.2 Research Design

In this study a cross-sectional research design has been focused to collect the desired data at one time point and creates a kind of "snapshot" of human behavior (Neuman, 2014). The purpose of the study was to analyze the possible relationship between climate risk perception and farmers' adaption to climate change.

2.4 Operationalization of the variables

'Risk perception' in this study means the judgment of the individual farmers about the characteristics and severity of the risks associated with climate change. It represents the perception of climate change patterns, weather patterns, temperature patterns, and the perception of climate change impacts. "Farmers' Adaptation to Climate Change" refers to the various methods and techniques adopted by farmers to cope with climate change risks.

2.4.2 Instrumentation of the Study Variables

In this study, a fixed response interview schedule was used to measure the association between study variables. The variables include one independent variable (risk perception), one dependent variable (farmers' adaptation) and four background variables (family type, marital status, educational level, and farming experience etc. A 9 items scale was developed to measure farmers' adaptation techniques. A positive response on six or more items was considered a high level of adaptation to climate change. The 'Risk perception' was measured on 9-item scale showing different dimensions of risk perception. A positive response on five or more items was considered evidence that the respondent has a risk perception of climate change.

2.4.3 Method and Tool of Data collection

The information was gathered through a carefully constructed interview schedule aligned with the study's goals. Prior to data collection, a pre-test was conducted to address any inconsistencies or ambiguities. The data collection involved interviews conducted with households led by farmers, employing skilled enumerators who, under the researcher's guidance, visited farmers in their homes and agricultural fields.

2.4.4 Reliability Analysis

To assess the instrument's reliability, the Cronbach Alpha (α) test, as proposed by Cronbach (1951), was employed to measure its internal consistency. In the field of social sciences, Cronbach's alpha reliability test is considered acceptable within the range of 0.60. The following formula was applied to determine the reliability.

$$\alpha = \frac{N * \bar{c}}{\bar{v} + (N-1) * \bar{c}} \quad \text{............................... eq. (1)}$$

The results of Cronbach Alpha (α) test have been given in the following table

Table 1 The results of Cronbach's alpha (α)

Variable	Cronbach's Alpha (α)
Farmers' Adaptation	0.786
Risk Perception	0.810

Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

2.4.5 Indexation of the variables

The dependent and independent variables of this study were indexed to measure their association both at the bivariate and multivariate levels.

2.4.6 Sample Size

As previously stated, the total number of households in the 21 designated union councils of the study area amounted to 93,620. The sample size, consisting of 383 household heads who are farmers, was calculated using the formula provided by Chaudhry and Kamal (2008).

$$n = \frac{N\hat{p}\hat{q}Z^2}{N\hat{p}\hat{q}Z^2 + Ne^2 - e^2} \quad \text{.................................. eq. (2)}$$

2.5 Analytical Framework

The collected data was analyzed at bivariate and multivariate levels.

2.5.1 Bivariate Analysis

At the bivariate analysis level, the independent variables were cross-tabulated to explore their associations. The dependent variable was indexed (computed) and subsequently cross-tabulated with the independent variables in the study. To gauge the strength and direction of association between variables, Chi-square and Tau-b tests were employed.

Measurement of Chi-Square values were worked out using formula of McHugh (2009)

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} \quad \text{.. eq. (3)}$$

Kendall' Tau-b is expressed through the formula given by (Nachmias and Nachimas, 1992)

$$\tau_B = \frac{n_c - n_d}{\sqrt{(n_0 - n_1)(n_0 - n_2)}} \quad \text{...eq. (5)}$$

2.5.2 Multi-variate Analysis

Multivariate analysis was employed to investigate whether variations in the dependent variable (Farmers' adaptation) attributed to the independent variable (risk perception) can be explained by the control variables (marital status, family type, educational level, and farming experience). The Chi-square test was used to assess the association between variables, and the tau-b test was applied to determine if the variations in the study variables are influenced by the

January, 2024
Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

control variables or not. This approach aims to understand the interplay of these factors in the context of the research.

3. Results

3.1 Association between Risk Perception and Farmers' Adaptation (Bivariate)

At the bivariate level, the association between 'farmers' adaptation to climate change' and 'climate risk perception' was examined. The findings revealed that the association of 'farmers' adaptation to climate change' was highly significant and positive with their "perception of climate change risks happening" (P=0.000, T^b =0.235), "increase in climate change risks than before" (P=0.000, T^b=0.201), "increase in the dry season than before" (P = 0.000, T^b=0.181), and "increase in the length of the hot period (P=0.000, T^b=0.180). Similarly, farmers' adaptation was significantly and positively associated with perception of "increase in rainfall intensity" (P = 0.000, T^b = 0.251). However, the association between farmers' adaptation to climate change and their perception of "flood is a risk for the crops production in area" was insignificant and weakly positive (P = 0.034, T^b = 0.108). Moreover, "farmers' adaptation to climate change" had a highly significant and positive association with their perception of "drought as a risk for the crops" (P = 0.000, T^b =0.181), "soil fertility being threatened by extreme weather conditions" (P = 0.000, T^b = 0.214), and "their production being affected b

Table 3 Association between risk perception and farmers' adaptation to climate change

3.3 Multivariate

Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

3.3.1 Association between Risk Perception and Farmers' Adaptation while Controlling

Independent Variable	**Responses**	**Dependent Variable**		**Total**	**Statistics**
		Farmer's Adaptation			
Risk Perception		**Yes**	**No**		
Climate change risks are happening and you know about it	**Yes**	266 (83.4)	53(16.4)	319(100)	X^2= 21.096 P= 0.000 Tau-b= 0.235
	No	37(57.8)	27(42.2)	64(100)	
Climate change risks have increased than before.	**Yes**	274(82.3)	59(17.7)	333(100)	X^2= 15.512 P= 0.000 Tau-b= 0.201
	No	29(58.0)	21(42.0)	50(100)	
Dry season has increased than before.	**Yes**	231(83.7)	45(83.3)	276(100)	X^2= 12.559 P= 0.000 Tau-b= 0.181
	No	72(67.3)	35(32.7)	107(100)	
Length of hot period has increased.	**Yes**	257(82.6)	54(17.4)	311(100)	X^2= 12.435 P= 0.000 Tau-b= 0.180
	No	46(63.9)	26(36.1)	72(100)	
	No	173(70.9)	71(29.1)	244(100)	
There is intensity of rainfall which is a risk for crops production	**Yes**	257(84.3)	48(15.7)	305(100)	X^2= 24.037 P= 0.000 Tau-b= 0.251
	No	46(59.0)	32(41.0)	78(100)	
Flood is a risk for the crops in this area	**Yes**	154(83.7)	30(16.3)	184(100)	X^2= 4.502 P= 0.034 Tau-b= 0.108
	No	149(74.9)	50(25.1)	199(100)	
Drought is a risk for the crops in this area.	**Yes**	246(83.1)	50(16.9)	296(100)	X^2= 12.91 P= 0.000 Tau-b= 0.181
	No	57(65.5)	30(34.5)	87(100)	
Soil fertility has been threatened by extreme weather conditions.	**Yes**	237(84.3)	44(15.7)	281(100)	X^2= 17.461 P= 0.000 Tau-b= 0.214
	No	66(64.7)	36(35.3)	102(100)	
Your production been affected by climate change hazards.	**Yes**	260(84.4)	48(15.6)	308(100)	X^2= 26.770 P= 0.000 Tau-b= 0.264
	No	43(57.3)	32(42.7)	75(100)	

Family Type

According to ***Table 4***, the influence of perceived climate risk on farmers' adaptation in the context of respondents' family types was found to be highly significant (P = 0.000) and positive (T^b=0.292) for nuclear families. Similarly, the association between climate risk perception and farmers' adaptation was also highly significant (P=0.000) and positive (T^b =0.359) for farmers who come from joint families. It can also be observed from Table 4.30 that the values of level of significance and Tau-b for the entire table were highly significant

(P=0.000) and positive (T^b = 0.311) between climate risk perception and farmers' adaptation for both nuclear and joint families. The significant value of the chi-square and the positive values of Kendal T^b showed a spurious relationship between climate risk perception and farmers' adaptation while controlling family type. The results obtained depicted that climate risk perception influenced farmers' adaptation more positively if they belonged to joint families than if they belonged to nuclear families.

Table 4 Association between risk perception and farmers' adaptation while controlling family type

Background Variable Family type	Independent Variable	Dependent variable	Statistic X^2 P (Value) T^b	Level of significance for entire table
Nuclear	Climate Risk Perception	Farmers' adaptation	χ^2 = 13.406 P= 0.000 T^b= 0.292	χ^2 = 37.086 P= 0.000 T^b= 0.311
Joint	Climate Risk Perception	Farmers' adaptation	χ^2 = 23.768 P= 0.000 T^b= 0.359	

3.3.2 Association between Risk Perception and Farmers' Adaptation while Controlling Marital status

The results given in ***Table 5*** highlight that, in the context of respondents' marital status, the influence of risk perception on farmers' adaptation showed a significant (P = 0.000) and positive (T^b = 0.402) association for married farmers. Similarly, the association between the aforementioned variables (risk perception and farmers' adaptation) was highly significant (P = 0.000) and positive (T^b = 0.296) for unmarried farmers. Moreover, the level of significance for the chi-square and the value of Tau-b for the entire table showed a highly significant (P = 0.000) and positive (T^b = 0.311) association between risk perception and farmers' adaptation for both married and unmarried farmers. The significant value of the chi-square and the positive values of Kendal T^b showed a spurious relationship between risk perception and farmers' adaptation while controlling marital status. These results highlighted that risk perception influences farmers' adaptation more positively in the case of married farmers than unmarried farmers.

Table 5 Association between risk perception and farmers' adaptation while controlling marital status

Background Variable / Marital Status	Independent Variable	Dependent variable	Statistic X^2 P (Value) T^b	Level of significance for entire table
Married	Climate Risk Perception	Farmers' adaptation	χ^2 = 27.794 P= 0.000 T^b= 0.402	χ^2 = 37.086 P= 0.000 T^b= 0.311
Unmarried	Climate Risk Perception	Farmers' adaptation	χ^2 = 10.508 P= 0.000 T^b= 0.296	

3.3.3 Association between Risk Perception and Farmers' Adaptation to Climate Change while Controlling Level of Education

The given ***Table 6*** Indicates that in the context of farmers' level of education, the influence of risk perception on farmers' adaptation to climate change depicted a significant (P = 0.000) and positive (T^b=0.298) association for illiterate farmers. Similarly, the association between the aforementioned variables was highly significant (P=0.000) and positive (T^b=0.376) for literate farmers. Moreover, the level of significance of chi-square and Tau-b for the entire table showed a highly significant (P=0.000) and positive (T^b = 0.311) association between risk perception and farmers' adaptation for both illiterate and literate farmers. The value of chi-square and the positive and Kendal T^b showed a spurious relationship between risk perception and farmers' adaptation while controlling level of education. These results highlighted that risk perception influences farmers' adaptation to climate change more positively if they are literate than illiterate.

Table 6 Association between risk perception and farmers' adaptation while controlling level of education

Background Variable / Level of education	Independent Variable	Dependent variable	Statistic X^2 P (Value) T^b	Level of significance for entire table
Illiterate	Climate Risk Perception	Farmers 'adaptation to climate change	χ^2 = 14.851 P= 0.000 T^b= 0.298	χ^2 = 37.086 P= 0.000 T^b= 0.311

Literate	Climate Risk Perception	Farmers 'adaptation to climate change	χ^2 = 24.702 P= 0.000 T^b= 0.376	

3.3.4 Association between Risk Perception and Farmers' Adaptation while Controlling Farming Experience

The given ***Table 7*** revealed that the influence of climate risk perception on farmers' adaptation in the context of farming experience depicted a significant (P=0.005) and positive (T^b=0.206) association for less experienced farmers. Similarly, the association between the aforementioned variables was highly significant (P=0.000) and positive (T^b = 0.312) for farmers with high farming experience. Moreover, the values of chi-square and Tau-b for the entire table showed a highly significant (P=0.000) and positive (T^b=0.296) association between risk perception and farmers' adaptation for low and high farming experience. The significant value of the chi-square and positive values of Kendal T^b showed a spurious relationship between climate risk perception and farmers' adaptation while controlling level of education. These results highlighted that climate risk perception influenced farmers' adaptation more positively in the case of high farming experience than low farming experience.

Table 7 Association between risk perception and farmers' adaptation while controlling farming experience

Background Variable Farming Experience	Independent Variable	Dependent variable	Statistic X^2 P (Value) T^b	Level of significance for entire table
Low (below 10 years)	Climate Risk Perception	Farmers' adaptation	χ^2 = 7.953 P= 0.005 T^b= 0.206	χ^2 = 37.086 P= 0.000 T^b= 0.296
High (above 10 years)	Climate Risk Perception	Farmers' adaptation	χ^2 = 29.089 P= 0.000 T^b= 0.312	

4. Discussion

The association between risk perception (independent variable) and farmers' adaptation to climate change (dependent variable) was found to be significant and positive. The results show that farmers were aware of climate change risks and observed an increased in climate risks than before. With awareness like this, the opportunities for farmers' adaptation to climate change risks are likely to increase. There is a rich literature on the relationship between risk perception and climate change adaptation. For example, Mase *et al*. (2017) reported that there is a significant role of risk perception in climate change adaptation attitudes and behaviors among farmers. Grothmann & Patt (2005) analyzed the relationship between various psychological determinants and adaptation decisions and found that risk perception and climate change adaptation were significantly associated with each other. Higginbotham *et al*. (2013) found that experiencing the effects of climate can provide the basis for adaptive actions. Mase *et al*. (2017) found that those farmers who believed that climate change was occurring and recognized the role of human actions in it, were likely to be more conscious about responding to climate change risks.

Farmers' perception regarding changes in the pattern of temperature and precipitation were also found to be positively and significantly associated with their adaptation to climate change. In other words, farmers' adaptive decisions are expected to occur more frequently if they perceive changes in the pattern of temperature, precipitation including increase in rainfall intensity. Such experiences can be witnessed from previous research studies showing a significant and positive relationship between adaptation and perception of temperature variability including. For example, Fadina & Barjolle (2018) showed that farmers developed a perception of climate change, including an increase in temperature, drought, and the length of the long dry season, and then adopted adaptation strategies in response to the risks associated with it. Similar findings of other studies based on such perceptions have been reported from Kenya (Gebreeyesus, 2017), Nigeria (Mustapha *et al*., 2012), and Niger (Assoumana *et al*., 2016) as well. In the Midwestern U.S., farmers face the issues of drought, longer dry periods, and increased temperature stress on crops that are considered the most important factors of climate risk perception in adaptation strategies (Mase *et al*., 2017). As per the findings of this study, a decrease in precipitation will likely increase the dry season and decrease the cold season. Farmers, who perceive an increase in temperature and dry seasons while a decrease in the amount of rainfall and duration of rainy days, took adaptive measures, including dry-season vegetable farming (Limantol *et al*., 2016). Similarly, in the Khyber Pakhtunkhwa province of Pakistan, climate change variability poses serious threats to agricultural communities (Khan *et al*., 2016). Abid *et al*. (2019) carried out research in three ecological zones in Punjab, Pakistan,

Remittances Review
January, 2024
Volume: 9, No: 1, pp. 2988-3010
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

and observed that accurate perception of changes in temperature patterns led the farmers to practice proper adaptation strategies. Mahmood *et al*. (2021) reported a highly significant association between perception of climate change risks and implementation of adaptation methods. Another study conducted by Ali *et al*. (2020) in Khyber Pakhtunkhwa, Pakistan, illustrated that the awareness of farmers about the rise in temperature and the decline in rain-fall pattern encourages them to shape their farming adaptation strategies.

The significant and positive association between farmers' adaptation and their perception of the impacts of climate change (drought, low soil fertility, and other hazards that affect their crop production) shows that these farmers were expected to be more inclined towards adaptation actions. It is important to mention that farmers in the target area were at low risk due to flooding. Therefore, the association between farmers' adaptation and their perception of flooding as a crop risk is insignificant and weakly positive. The above-mentioned findings of this study are in line with the research findings of Fadina & Barjolle (2018), who showed that farmers in South Benin perceived a number of climate changes, including variation in temperature, rainfall, and other extreme events such as floods, violent winds, and drought. They further observed that these events had negative effects on their agriculture activities and livelihood, which led them to develop adaptation strategies for changing cropping systems. Cochet *et al*. (2017) have reported a similar relationship between farmers' perception of climate change effects and their adaptation strategies taken as a response in Tanzania and Senegal. Pakistan is also experiencing the severe impacts of drought, heatwaves, and floods, which affect the production of various crops (Arshad *et al*., 2018; Ahmad & Afzal, 2020). In order to minimize the harmful effects of climate change on agriculture, several adaptation methods have been identified (Fahad and Wang, 2020; Khan *et al*., 2020). In order to elaborate on the association between farmers' perceptions of climate change effects and risks, Mahmmod *et al*. (2020) explained that climate change risks mainly refer to the risks associated with drought, heat waves, heat stress, irregular rain patterns, and floods, and the accurate perception of farmers about these risks may lead them to plan and implement adaptation methods.

At multivariate level it was found that farmers from joint families are perceived to be more responsible than farmers from nuclear families. The number of dependent family members in a joint family is greater and they also provide more labor than the number of members in nuclear families. Thus, they are expected to be more inclined towards adaptation as compared to farmers who belong to nuclear families. Previous research studies have found that joint families are positively associated with adaptation practices (Deressa *et al*., 2009; Abid *et al*., 2015). Ali and Erenstein (2017) found that farmers who come from joint families are more positively associated with adaptation practices. Another study conducted by Faisal *et al*. (2021) revealed that the likelihood of zero adaptations to climate change is higher for farmers who belong to nuclear families and have low risk perception. The study findings of Regmi *et al*. (2017) revealed that adaptation decisions were positively and significantly affected by family type. They further said that in joint families, the likelihood of adaptation practices would increase as compared to nuclear families. Such findings have also been given by Belay *et al*. (2017) who found out that larger families have the advantage of providing more labor while introducing new farming technologies.

Using marital status as controlled variable the study found that the perceived climate risk of the target farmers affected their adaptation measures more positively for married farmers than the unmarried farmers. While comparing married and unmarried farmers in terms of owing responsibility, empirical evidence suggests that married farmers are more responsible than unmarried. For example, Rudel *et al*. (2016) showed that married farmers adopt new technology more than unmarried farmers. Moraine *et al*. (2017) have also presented similar results. Similarly, Marandure *et al*. (2021) reported that married farmers have a more positive perception of the selection of various farming practises compared to unmarried farmers. Yakubu *et al*. (2021) analysed married farmers had a higher risk that led them to adopt more effective climate change adaption practices. The study findings of Mabe *et al*. (2014) in relation to mulching as an adaptation strategy revealed that married farmers had a higher probability of applying the mulching as an adaptation technique. Marie *et al*. (2020) reported that in Ethiopia, marital status positively affected the adaptation measures related to early and late planting to adjust to climate change.

The findings of the study revealed that, in the case of farmer literacy, climate risk perception is found to be more positively associated with farmers' adaptation to climate change. This implies that literate farmers could have more knowledge, awareness, and understanding of environmental issues and adaptation practices. Ahmed *et al*. (2021) reported that farmers' education can effectively enhance their resilience to adopt different adaptation strategies to cope with the risks of climate change. As de Sousa *et al*. (2018) conducted research on the influence of farmers' climate awareness on adaptation decisions and found that the introduction of new crops and soil management were preferred by literate farmers. This implies that education helps develop farmers' awareness and perception of climate change, which enable them to take more effective adaptive measures. A number of other studies have also demonstrated the correlation between farmers' awareness and perception of climate variability and their adoption of sustainable agriculture practices as climate change adaptation (Singh *et al.*, 2017; Schattman *et al.*, 2016; Elum *et al*., 2017). The findings of de Sousa *et al*. (2018) revealed a strong relationship between farmers' perceptions of climate change and their decision to adopt climate-smart agriculture practices.

Similarly, the impact of farming experience (as a controlled variable) was assessed on the association between farmers' risk perception and their adaptation to climate change. In the case of farmers with more than 10 years of experience high experience, a more positive impact of climate risk perception was observed on farmers' adaptation as compared to farmers who had experience less than 10 years. This shows that farmers with high experience tend to have a more positive perception of climate risk and are more likely to be adapted to those risks than their peers with low farming experience. While associating climate change risk perception with farming experience, Deressa *et al*. (2009) reported that farmers' perceptions of risk were positively associated with their farming experience and education. Similarly, the study by Sarkar and Padaria (2016) indicated that farmers with more farming experience were more likely to observe variations in climate. They also found that the farming experience was one of the most important contributors to climate change adaptation. Abid *et al*. (2015) showed that farmers with higher experience (more than 20 years) were more likely to perceive a change in climatic conditions than farmers with lower experience (10 to 20 years or below 10 years). They also discovered that farmers with higher levels of experience had higher levels of adaptive intention and were more likely to participate in adaptation actions than farmers with lower levels of experience. Similar findings have also been given by Maddison (2007), showing a positive relationship between farming experience and climate change. Another study conducted by Abid *et al*. (2016a) found that most of the adapters to climate change were more educated and experienced than the non-adapters. These findings show that farmers with more experience are expected to have better risk perception and are more inclined towards the adoption of adaptation practices.

Conclusion

Farmers of the target area had risk perception of the climate change and were fully aware of the various aspect of climate change including, weather pattern, temperature pattern, pattern of precipitation and the impacts of climate change. Farmers' risk perception had a significant and positive association was climate risk perception. The various indicators of risk perception were found to influence farmers' adaptation towards climate change positively and significantly. This indicates that farmers with higher risk perception were more likely to adapt to climate change adaptation. At multivariate level the impacts of family type, marital status, educational level and farming experience explained variations in the association between risk perception and farmers' adaptation. The association between risk perception and farmers' adaptation to climate change was more positively influenced by farmers who were married, literate, lived in joint families and had higher experience than the farmers who were unmarried, illiterate, lived in nuclear families and had less farming experience. This show that married and literate farmers were more interested in adaptation to climate change than the unmarried and illiterate farmers. Similarly, farmers who lived in joint families and had higher experience were more likely to take adaptation actions than the farmer who lived in nuclear families and had less farming experience. Given that global climate change is one of the most significant and complex challenges confronting the international community in terms of its negative consequences, an organized awareness campaign should be regarded as an important component of climate change mitigation and adaptation policies. This would allow the general public, and particularly farmers, to perceive climate change as a risk, which is critical for climate change mitigation and adaptation actions.

References

Abid, M., Scheffran, J., Schneider, U.A., & Ashfaq. (2015). Farmers' perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan. *Earth System Dynamics*, *6*, 225-243. https://doi.org/10.5194/esd-6-225-2015.

Abid, M., Scheffran, J., Schneider, U.A. & Elahi, E. (2019). Farmer Perceptions of Climate Change, Observed Trends and Adaptation of Agriculture in Pakistan. *Environmental*

Abid, M., Schneider, U. A., & Scheffran, J. (2016a). Adaptation to climate change and its impacts on food productivity and crop income: perspectives of farmers in rural Pakistan. *Journal of Rural Studies*, *47*, 254–266.

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson D. R., Naess, L. O. Wolf, J., & Wreford, A. (2009). Are There Social Limits to Adaptation to Climate Change? *Climatic Change*, *93*, 335-354.

Ahmad, D., & Afzal, M. (2020). Climate change adaptation impact on cash crop productivity and income in Punjab province of Pakistan. *Environmental Science and Pollution Research*, *27*(24): 30767-30777.

Ali, A., & Erenstein, O. (2017). Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan. *Climate Risk Management*, *16*, 183-194.

Ali, A., Issa, A. B. & Rahut, D, B. (2020). Adoption and Impact of the Maize Hybrid on the Livelihood of the Maize Growers: Some Policy Insights from Pakistan. *Scientifica*. https://doi.org/10.1155/2020/5959868.

Arshad, M., Amjath-Babu T. S., Aravindakshan, S., Krupnik T. J., Toussaint, V., Kächele, H., & Müller, K. (2018). Climatic variability and thermal stress in Pakistan's rice and wheat systems: a stochastic frontier and quantile regression analysis of economic efficiency. *Ecological indicators, 89*: 496–506. https://doi.org/10.1016/j.ecolind.2017.12.014.

Assoumana, B. T., Ndiaye, M., Puje, G., Diourte, M., & Graiser, T. (2016). Comparative Assessment of Local Farmers' Perceptions of Meteorological Events and Adaptations Strategies: Two Case Studies in Niger Republic. *Journal of Sustainable Development, 9*(3), 118–135. http://dx.doi.org/10.5539/jsd.v9n3p118

Babbie, E. R. (2010). *The practice of social research*. Belmont, Calif: Wadsworth Cengage.

Belay, A., Recha J. W, Woldeamanuel, T., & Morton, J. F. (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. *Agriculture and Food Security*, *6*(24). https://doi.org/10.1186/s40066-017-0100-1

Blaikie, P., Terry, C., Ian, D., & Ben, W. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. London: Routledge.

Bryan, E., Ringler, C., Okoba, B., Roncoli, C., Silvestri, S., & Herrero, M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. *Journal of Environmental Management, 114*, 26-35.

Chaudhry, S.M., & Kamal, S. (2008). Introduction to Statistical. Theory Parts I & II (8th ed.). Ilmi Kitab Khana: Lahore, Pakistan.

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct. *Advances in Experimental Psychology*, *24*, 201–234.

Cochet, H., Ducourtieux, O., & Garambois, N. (2017). *Systèmes agraires et Changement climatique: Les chemins de l'adaptation*. Working Paper.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297–334.

de Sousa, K., Casanoves, F., Sellare, J., Ospina, A., Suchini, J.G., Aguilar, A., & Mercado, L., (2018). How climate awareness influences farmers' adaptation decisions in Central America? *Journal of Rural Studies, 64*, 11-19. https://doi.org/10.1016/j.jrurstud.2018.09.018

Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yosuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change*, *19* (2), 248-255.

Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change, 1*(9), 462–466.

Elum, Z.A., Modise, D.M. & Marr, A. (2017). Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa. Climate Risk Management, 16: 246-257. https://doi.org/10.1016/j.crm.2016.11.001

Fadina, A.M.R. & Barjolle, D. (2018). Farmer's Adaptation Strategies to Climate Change and Their Implication in The Zou Department of South Benin. *Environments, 5*(15), 2-17: https://doi.org/10.3390/environments5010015.

Fahad, S. & Wang, J. (2020). Climate change, vulnerability, and its impacts in rural Pakistan: a review. *Environmental Science and Pollution Research, 27*, 1334-1338. https://doi.org/10.1007/s11356-019-06878-1

Faisal, M., Chunping, X., Abbas, A., Raza, M. H., Akhtar, S., Ajmal, M. A., & Ali, A. (2021). Do risk perceptions and constraints influence the adoption of climate change practices among small livestock herders in Punjab, Pakistan? *Environmental Science and Pollution Research, 28*, 43777–43791. https://doi.org/10.1007/s11356-021-13771-3

Gebreeyesus, K. A. (2017). *Impact of climate change on the agroecological innovation of coffee agroforestry systems in Central Kenya* (Doctoral dissertation, Montpellier SupAgro).

Government of Pakistan (GOP). (2017). *Pakistan Climate Change Act. 2017. Senate Secretariat:* Islamabad, Pakistan, 2017.

Helgeson, J., van der Linden, S., & Chabay, I. (2012). The role of knowledge, learning and mental models in public perceptions of climate change related risks. *Learning for sustainability in times of accelerating change*, 329-346.

Higginbotham, N., Connor, L. H., & Baker, F. 2013. Subregional differences in Australian climate risk perceptions: coastal versus agricultural areas of the Hunter Valley, NSW. *Regional Environmental Change, 14*(2), 699-712.

Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. 2016. Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change, 6*, 622–626.

Hussain, M., Liu, G., Yousaf, B., Ahmed, R., Uzma, F., Ali, M.U., Ullah, H., & Butt, A.R. (2018). Regional and sectoral assessment on climate-change in Pakistan: social norms and indigenous perceptions on climate-change adaptation and mitigation in relation to global context. *Journal of Cleaner Production, 200* 791-808. https://doi.org/10.1016/j.jclepro.2018.07.272

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, *15*, 199-213.

Higginbotham, N., Connor, L. H., & Baker, F. (2013). Subregional differences in Australian climate risk perceptions: coastal versus agricultural areas of the Hunter Valley, NSW. *Regional Environmental Change*, *14*(2) 699-712.

Intergovernmental Panel on Climate Change (IPCC). (2007). Climate Change 2007: Climate Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Geneva. Inter-governmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf

Kahneman, D. (2011). *Thinking, Fast and Slow*. Allen Lane, London.

Khan, A. A., Ijaz, M., Muhammad, J., Goheer, A.R., Akbar, G., & Adnan, M. (2016).Climate change implication for wheat crop in DeraImail Khan District of Khyber Pakhtunkhwa. *Pakistan Journal of Meteorology*, *13* (25), 17-27.

Khan, I., Lei, H., Shah, I.A., Ali, I., Khan, I., Muhammad, I., Huo, X., & Javed, T. (2020b). Farm households' risk perception, attitude and adaptation strategies in dealing with climate change: Promise and perils from rural Pakistan. *Land use policy, 91*, 104395. https://doi.org/10.1016/j.landusepol.2019.104395

Limantol, A. M., Keith, B. E., Azabre, B. A., & Lennartz, B. (2016). Farmers' perception and adaptation practice to climate variability and change: a case study of the Vea catchment in Ghana. SpringerPlus, 5(830): https://doi.org/10.1186/s40064-016-2433-9

Mabe, F. N., Sienso, G., & Donkoh, S. (2014). Determinants of Choice of Climate Change Adaptation Strategies in Northern Ghana, *Research in Applied Economics*, *6*(4) 75-94. https://doi.org/10.5296/rae.v6i4.6121

Maddison, D. (2007). The Perception of and Adaptation to Climate Change in Africa; World Bank: Washington, DC, USA; Volume 4308.

Mahmood, N., Arshad, M., Kaechele, H., Shahzad, M. F., Ullah A., & Mueller, K. (2020). Fatalism, Climate Resiliency Training and Farmers' Adaptation Responses: Implications for Sustainable Rainfed-Wheat Production in Pakistan. *Sustainability*, *12*(4), 1650. https://doi.org/10.3390/su12041650

Mahmood, N., Arshad, M., Mehmood, Y., Shahzad, M. F., & Kächele, H. (2021). Farmers' perceptions and role of institutional arrangements in climate change adaptation: Insights from rainfed Pakistan. *Climate Risk Management*, *32*. https://doi.org/10.1016/j.crm.2021.100288

Marandure, T., Bennett, J., Dzama, K., Makombe, G., & Mapiye, C. (2021). Drivers of low-input farmers' perceptions of sustainable ruminant farming practices in the Eastern Cape Province, South Africa. *Environment, Development and Sustainability*, *23*(6), 8405-8432. https://doi.org/10.1007/s10668-020-00973-x

Marie, M., Yirga, F., Haile, M., & Tquabo, F. (2020). Farmers' choices and factors affecting adoption of climate change adaptation strategies: evidence from northwestern Ethiopia. *Heliyon*, *6*(4): p.e03867. https://doi.org/ 10.1016/j.heliyon.2020.e03867.

Mase, A. S., Graming, B. M., & Prokopy, L. S. (2017). Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern U.S. crop farmers. *Climate Change Risk Management*, *15*, 8-17. https://doi.org/10.1016/j.crm.2016.11.004

McCright, A. M., Dunlap, R. E., & Xiao, C. (2013). Perceived scientific agreement and support for government action on climate change in the USA. *Climatic Change*, *119*(2), 511–518.

McHugh, M. L. (2009). The odds ratio: calculation, usage, and interpretation. *Biochemia medica*, *19*(2), 120-126.

Mearns, R., & Norton, A. (2010). Social Dimensions of Climate Change: Equity and Vulnerability in a warming world. Washington DC: The World Bank.

Moraine, M., Duru, M., & Therond, O. (2017). A social-ecological framework for analysing and designing integrated crop: Livestock systems from farm to territory levels. *Renewable Agriculture and Food Systems*, *32*, 43–56. https://doi.org/10.1017/S1742170515000526

Mugenda, O.M., & Mugenda, A.G. (2003). Research methods. Nairobi. Accelerated Actors.

Mustapha, S. B., Sanda, A. H., & Shehu, H. 2012. Farmers' Perception of Climate Change in Central Agricultural Zone of Borno State, Nigeria. J. Environ. Earth Sci., 2, 21–28.

Nachmias, D., & Nachmias, C. 1992. *Research Method in the Social Sciences (3rd ed.).* St. Martin's press. Inc.: New York, NY, USA.

Neuman, W. L. 2014. Social Researh Methods: Qualitative and Quantitative Approaches (Eds.7th). Pearson, USA

Niles, M. T., & Muller, N. D. (2016). Farmer perceptions of climate change: Associations with observed temperature and precipitation trends, irrigation, and climate beliefs. *Global Environmental Change*, *39*, 133- 142.

O'Brien, K. L., & Hochachk, G. (2010). Integral Adaptation to Climate Change. Journal of Integral *Theory and Practice*, *5*(1), 89–102.

Sarkar, S., & Padaria, R.N. (2016). Farmers' awareness and risk perception about climate change in coastal ecosystem of West Bengal. *Indian research journal of extension education*, *10*(2), 32-38.

Popenoe, D. (1983). *Sociology.* Englewood Cliffs, NJ: Prentice-Hall.

PPAF. (2014). Developing Profile of Upper Dir District: Situation Analysis and Baseline surveys for poverty reduction through rural development in KPK, FATA, and Balochistan. http://ppr.org.pk/PDF/District%20Profile%20Upper%20Dir.pdf

Regmi, N., Dhakal, D., & Ghimire, B. (2017). Determinants of Farmers Adaptation to Climate Change: A Case from Syangja District of Nepal. *Journal of Agricultural Economics, Extension and Rural Development*, *5*(7), 658-663.

Ribot, J. (1995). "The Causal Structure of Vulnerability: Its Application to Climate Impact Analysis." *GeoJournal*, *35* (2): 119–22.

Rudel, T.K., Kwon, O.J., Paul, B.K., Boval, M., Rao, I.M., Burbano, D., McGroddy, M., Lerner, A.M., White, D., Cuchillo, M., & Luna, M. (2016). Do smallholder, mixed crop-livestock livelihoods encourage sustainable agricultural practices? A meta-analysis. *Land*, *5*(1), 6, https://doi.org/ 10.3390/land5010006.

Schattman, R.E., Conner, D., & Méndez, V. E. (2016). Farmer perceptions of climate change risk and associated on-farm management strategies in Vermont, northeastern United StatesFarmer perceptions of climate change risk in Vermont. Elementa. *Science of the Anthropocene*, *4*. 000131: https://doi.org/10.12952/journal.elementa.000131

Sheeran, P. (2002). Intention—behavior relations: A conceptual and empirical review. European *Review of Social Psychology*, *12*(1), 1–36.

Singh, R.K., Zander, K.K., Kumar, S., Singh, A., Sheoran, P., Kumar, A., Hussain, S.M., Riba, T., Rallen, O., Lego, Y.J., & Padung, E. (2017). Perceptions of climate variability and livelihood adaptations relating to gender and wealth among the Adi community of the Eastern Indian Himalayas. *Applied Geography*, *86*, 41-52. https://doi.org/10.1016/j.apgeog.2017.06.018

Slovic, P., Finucane, M.L., Peters, E., & MacGregor, D.G. (2013). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality. In The feeling of risk (pp. 21-36). Routledge.

Smith, N., & Leiserowitz, A. (2014).The role of emotion in global warming policy support and opposition. *Risk Analysis*, *34*(5), 937–948.

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change*, *1*(1), 46–49. https://doi.org/10.1038/nclimate1059

Stanovich, K.E., & West, R. F. (2008). On the relative independence of thinking biases and cognitive ability. *Journal of Personality Psychology*, *94*(4). 672–695. http://dx.doi.org/10.1037/0022-3514.94.4.672.

Van der Linden, S. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41*, 112–124. https://doi.org/10.1016/j.jenvp.2014.11.012

Van der Linden, S. (2017).The nature of viral altruism and how to make it stick. *Nature Human Behaviour*, *1*, 0041. https://doi.org/10.1038/s41562-016-0041

Weber, E.U., & Stern, P.C. (2011). Public understanding of climate change in the United States. *American Psychologist*, *66*(4), 315–328. https://doi.org/10.1037/ a0023253.

Whitmarsh, L., Lorenzoni, I., & O'Neill, S. (2012). *Engaging the public with climate change: Behaviour change and communication*. Routledge.

Yakubu, D.H., Akpoko, J.G., Akinola, M.O., & Abdulsalam, Z. (2021). Assessment of perceived effects of climate change on rice production among farmers in North-west zone, Nigeria. *Ghana Journal of Agricultural Science*, *56*(1), 48-64. https://doi.org/10.4314/gjas.v56i1