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A SOCIOLOGICAL ANALYSIS OF THE IMPACT OF WILLINGNESS TO ACT ON FARMERS' ADAPTATION TO CLIMATE CHANGE IN RURAL PAKHTUNKHWA PAKISTAN

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ABSTRACT

The purpose of this research study was to assess the impact of farmers' willingness to act on their adaptation actions to climate change risk in two districts (Dir Upper and Lower) of Khyber Pakhtunkhwa Pakistan. The study was focused on farmers of agricultural crops including wheat, maize, rice, and vegetables. Using multistage sampling, the data was collected from 383 farmers in selected UCs of the study area. Chi-square and Kendall's T^b tests were applied to test the association between climate risk perception and farmers' adaptation at bivariate and multivariate level of analysis. It was found that farmers were willing to act against the climate change risks posing threats to their crops production. Similarly, willingness to act has significant and positive association with farmers' adaptation to climate change. In addition, famers' willingness to act influenced their adaptation to climate change more positively in case of married, literate and more experienced farmers. Similarly, joint family system have more positive influence on the association of willingness to act and farmers' adaptation to climate change. The agriculture departments will need to be strengthened and well-equipped in order to keep farmers up to date with climate change information and new knowledge that could help them be more willing to adapt autonomously.

Key words: willingness to act, climate change, farmers, adaptation, family, education, farming experience

INTRODUCTION

The term "willingness to act" in this study refers to farmers' level of interest in learning, organizing, and effectively responding to the impacts of climate change. It plays a crucial role in both mitigation and adaption to climate change and is closely linked to risk perception. Various Studies has shown that increased risk perception leads to a greater willingness to take measures for mitigation and adaptation (O'Connor et al., 1999; Spence et al., 2011; Van de Linden, 2015). While international programs and policies have been implemented at the national and local levels to address climate change risks, their success depends not only on organizational and governmental measures but also on individuals who take personal action. Consequently, new climate change policies recognize the roles and commitments of individuals (Kno et al., 2017). The World Development Report (2010) emphasizes the importance of understanding the drivers of human behavior for effective climate change policies. This involves making decisions and taking adaptive measures under conditions of uncertainty (Grothmann & Patt, 2005). While the role of psychological factors in climate change adaptation has been less recognized, it is crucial to acknowledge that a significant portion of adaptation involves individual actions within local environments. Psychological literature on climate change adaptation highlights the significance of cognitive factors, such as perceived abilities and motivation, alongside socio-economic factors, in accurately predicting future actions (Sberghaus et al., 2010).

Kroemker and Mossler (2002) stated that motivation and competence levels impact individuals' protective capacity. Their study reveals that successful adaptive responses occur when both factors are high. Wolf et al. (2010) conducted a study on the adaptive capacity of elderly individuals to heatwaves and found that social capital, including strong bonds and support networks, plays a significant role in effective adaptation measures. Drawing on the evaluation of Protection Motivation Theory (PTM), Sberghaus et al. (2010) demonstrate a strong relationship between perceived risk and motivation. The original PTM theory consists of two independent appraisal processes known as threat appraisal and coping appraisal (Norman et al., 2005). Threat appraisal involves assessing the severity of a potential threat and personal vulnerability to that specific threat. If individuals perceive themselves as vulnerable and the threat as severe, their fear increases, motivating them to take protective measures. Coping appraisal refers to individuals' evaluation of potential coping behaviors in response to the perceived threat, based on their beliefs and abilities (Sberghaus et al., 2010). Research has indicated that lack of understanding, unawareness, and perception gaps between the general public and scientific community pose obstacles to climate change adaptive behavior (Etkin & Ho, 2007; Kellstedt et al., 2008). Accurate, relevant, and detailed information about climate change has been found to contribute to more effective adaptation measures (Klein et al., 1999). The Word Development Report (2010) suggests that organized dissemination of climate change information to empower individuals can effectively promote adaptive actions. Adger et al. (2009) highlight the importance of programs that enable individuals to predict the impacts of their behavior on the environment and create a supportive decision-making environment for adaptive actions at both individual and community levels. The assessment of farmer behavior is crucial for enhancing adaptive capacity and ensuring sustainable agriculture. Farmer behavior directly influences the success of adaptation efforts and policies related to sustainability (Home et al., 2014). To identify favorable conditions for successful intervention, it is important to understand farmers' actions within their social and ecological context. This understanding provides opportunities to effectively promote socio-technical change, innovation, and design and implement measures such as regulations, incentives, and institutional reforms (Home et al., 2014; Bartel & Barclay, 2011)

METHODOLOGY

A cross-sectional research study was carried out in Districts Dir Upper and Lower Khyber Pakhtunkhwa Pakistan. A sample size of 383 household heads (farmers) was determined using the following formula of (Chaudhry & Kamal, 2008).

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

In this study, a fixed response interview schedule was used to measure the association between study variables. The variables include one independent variable (willingness to act), one dependent variable (farmers' adaptation) and four background variables (family type, marital status, educational level, and farming experience etc. A nine 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 measurement of "willingness to act" utilized an eleven-item scale. A respondent with a positive response to six or more items demonstrated a willingness to take action for adaptation. To correct the inconsistencies and ambiguities it was pre-tested before data collection process. The data was collected form the target households headed by farmers using interview method by engaging well-trained enumerators led by the researcher to visit the farmers in their homes and agricultural fields.

In order to measure the reliability of the instrument, Cronbach Alpha (α) test (Cronbach, 1951) was used to estimate its internal consistency. Cronbach's alpha reliability test has an acceptable range of 0.60 in social sciences. Following formula was used to measure the reliability.

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

…………………………… 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	0.714
Willingness to Act	0.779

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

The data were analyzed through Uni-variate, Bi-variate and Multi variate analyses. At univariate level relevant statistical tools including frequency and percentage distribution of background and independent variables were analyzed by using formula recommended by Chaudhry and Kamal (1996).

Percentage of each data class= f / N × 100 ………………………………………….….. eq. (2)

At the bivariate analysis level, the dependent variable was indexed (computed) and then cross tabulated with the independent variables of the study to find their association. In order to measure the strength and direction of association between variables, Chi-square and Tau-b tests were applied.

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

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

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

$$\tau_B = \frac{n_c - n_d}{\sqrt{(n_0 - n_1)(n_0 - n_2)}}$$

……………………………………….eq. (4)

Multi-variate analysis was used to assess whether the variation in the dependent variable (Farmer's adaptation) caused by independent variable (willingness to act) is explained by the control variables (marital status, family type, educational level and farming experience) or not. To measure the association between variables, the Chi-square test was applied, and the tau-b test was used to find out whether their variation in study variables is affected by the control variables or not.

RESULTS

Farmers' Willingness to Act (Univariate)

The study's findings indicated that the majority of the farmers (75.2%) were interested to discuss climate change issues with their fellow farmers. Similarly, a significant majority (70.2%) of farmers told that they help other farmers in relation to climate change risks while a substantial majority (87.7%) of the respondents showed their willingness to take proper measures to cope climate change. Additionally, 63.4% of respondents reported that they actively motivate other farmers to take actions against potential climate change risks while a majority (64.8%) of the farmers expressed a lack of coordination with institutions despite their motivation towards adaptation measures. Moreover, the study's findings revealed that a huge majority (82.8%) of the respondents were likely to change their seeds in response to climate change risks, while a significant majority (88.8%) of farmers expressed their willingness to use new types of fertilizers when necessary. Also, 71.3% of the farmers expressed their willingness to improve their irrigation system during droughts. The findings also revealed that farmers were interested in using insecticides and pesticides to combat potential plant diseases resulting from climate change, as confirmed by 83.8% of the farmers. The findings of the study further show that majority (84.3%) of the farmers were interested in participating in trainings to learn new adaptations and farming skills. Along with this, a huge majority (87.5%) of the respondents expressed their interest in using new farming technology.

Table 2
Frequency distribution and proportion of the respondents showing their willingness to act

Statement	Yes	No	Total
You are interested to discuss climate change issues with fellow farmers.	288(75.2)	95(24.8)	383(100)
You seek help from other farmers in relation to risks.	269(70.2)	114(29.8)	383(100)
You are willing to take measures to minimize climate risks	336(87.7)	47(12.3)	383(100)
You are interested to motivate other farmers to take action against risks	243(63.4)	140(36.6)	383(100)
You coordinate with other institution with respect to climate change.	135(35.2)	248(64.8)	383(100)
You are willing to change the seed with respect to possible risks.	317(82.8)	66(17.2)	383(100)
You like to make use of new type of chemical fertilizers	340(88.8)	43(11.2)	383(100)
You are ready to improve your irrigation system during droughts	273(71.3)	110(28.7)	383(100)
You like to use pesticides against possible plant diseases	321(83.8)	62(16.2)	383(100)
You are interested to take participation in trainings to learn new skills	323(84.3)	60(15.7)	383(100)
You are interested to make use of new technology of farming	335(87.5)	48(12.5)	383(100)

Association between Risk Perception and Farmers' Adaptation (Bivariate)

The association between farmers' adaptation to climate change and their willingness to act portrayed that "farmers' adaptation to climate change" was significant and positive in association with their willingness to "discuss climate change information with fellow farmers" (P=0.000, T^b = 0.181), "seeking help from other farmers in relation to risk" (P=0.000, T^b=0.157), "taking measures against climate risks" (P=0.000, T^b =0.180), and "motivating other farmers to take action against possible risks" (P=0.000, T^b =0.237). In addition, farmers' adaptation to climate change was found to be significantly and positively associated with "their coordination with other institutions" (P=0.001, T^b = 0.164), "their interest in changing the seeds" (P=0.002, T^b=0.157), and "their willingness to use new types of fertilizers when necessary" (P=0.000, T^b = 0.204). Moreover, a non-significant and weakly positive association was found between "farmers' adaptation to climate change" and their interest in improving irrigation systems during drought (P=0.264, T^b = 0.057) and with their willingness to use insecticides and pesticides (P=0.484, T^b = 0.036). Similarly, the association of farmers' adaptation to climate change was highly significant and positive with their interest in participating in training to learn new skills (P=0.000, T^b = 0.203) and willingness to make use of new farming technology (P=0.000, T^b =0.232).

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

Independent Variable	Responses	Dependent Variable: Farmer's Adaptation		Total	Statistics
Willingness to Act		Yes	No		
You are willing to discuss climate change issues with fellow farmers.	Yes	240(83.3)	48(16.7)	288(100)	X^2= 12.519
	No	63(66.3)	32(33.7)	95(100)	P= 0.000 Tau-b= 0.181
You seek help from other farmers in relation to risks	Yes	224(83.3)	45(16.7)	269(100)	X^2= 9.460
	No	79(69.3)	35(30.7)	114(100)	P= 0.002 Tau-b= 0.157

You are willing to take measures to minimize climate risks	**Yes**	275 (81.8)	61(18.2)	336(100)	X^2= 12.376 P= 0.000 Tau-b= 0.180
	No	28(59.6)	19(40.4)	47(100)	
You are ready to motivate other farmers to take action against possible risks.	**Yes**	210(86.4)	33(13.6)	243(100)	X^2= 21.482 P= 0.000 Tau-b= 0.237
	No	93(66.4)	47(33.6)	140(100)	
You coordinate with other institutions with respect to climate change.	**Yes**	119(88.1)	16(11.9)	135(100)	X^2= 10.301 P= 0.001 Tau-b= 0.164
	No	184(74.2)	64(25.8)	248(100)	
You are willing to change the seeds with respect to possible risks.	**Yes**	260(82.0)	57(18.0)	317(100)	X^2= 9.405 P= 0.002 Tau-b= 0.157
	No	43(65.2)	23(34.8)	66(100)	
You like to make use of new type of fertilizers when necessary.	**Yes**	279(82.1)	61(17.9)	340(100)	X^2= 15.911 P= 0.000 Tau-b= 0.204
	No	24(55.8)	19(44.2)	43(100)	
You are ready to improve your irrigation system during droughts.	**Yes**	220(80.6)	53(19.4)	273(100)	X^2= 1.249 P= 0.264 Tau-b= 0.057
	No	83(75.5)	27(24.5)	110(100)	
You are willing to use insecticide and pesticides against possible plant diseases.	**Yes**	256(79.8)	65(20.2)	321(100)	X^2= 0 .489 P= 0.484 Tau-b= 0.036
	No	47(75.8)	15(24.2)	62(100)	
You are interested to take participation in trainings to learn new skills.	**Yes**	267(82.7)	56(17.3)	323(100)	X^2= 15.727 P= 0.000 Tau-b= 0.203
	No	36(60.0)	24(40.0)	60(100)	
You are interested to make use of new technology of farming.	**Yes**	277(82.7)	58(17.3)	335(100)	X^2= 20.666 P= 0.000 Tau-b= 0.232
	No	26(54.2)	22(45.8)	48(100)	

MULTIVARIATE

Association between Willingness to Act and Farmers' Adaptation while Controlling Family Type

Table 4 showed that in the context of respondents' family type, the influence of willingness to act on farmers' adaptation to climate change was found to be highly significant (P=0.000) and positive

(T^b =0.246) for the nuclear family. Similarly, the association between the aforementioned variables was positive (T^b=0.368) and highly significant (P=0.000) for farmers who belonged to a joint family. Also, it was discovered that the values of the level of significance and Tau-b for the entire table were highly significant (P=0.000) and positive (T^b=0.314) between farmers' adaptation to climate change and their willingness to act for both nuclear and joint families. The results of Kendal T^b and chi-square significance values revealed a spurious relationship between willingness to act and farmers' adaptation to climate change while controlling family type. The given results highlighted that farmers' willingness to act influenced their adaptation more positively if they belong to joint families than if they belong to nuclear families.

Table 4

Association between willingness to act 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	Willingness to act	Farmers' adaptation to climate change	χ^2 = 14.072 P= 0.000 T^b= 0.246	χ^2 = 37.729 P= 0.000 T^b= 0.314
Joint	Willingness to act	Farmers' adaptation to climate change	χ^2 = 24.489 P= 0.000 T^b= 0.368	

Association between Willingness to Act and Farmers' Adaptation to Climate Change while Controlling Marital Status

According to Table 5, the influence of willingness to act on farmers' adaptation to climate change, in the context of their marital status, showed a significant (P=0.000) and positive (T^b=0.337) association for married farmers. Similarly, the association between the aforementioned variables was highly significant (P=0.018) and positive (T^b =0.243) for unmarried farmers. Moreover, the level of significance of the chi-square and the value of Tau-b for the entire table showed a highly significant (P=0.000) and positive (T^b=0.314) association between farmers' willingness to act and their 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 willingness to act and farmers' adaptation to climate change while controlling marital status. These results depicted that willingness to act influences farmers' adaptation more positively in the case of married farmers than unmarried farmers.

Table 5

Association between willingness to act and farmers' adaptation to climate change 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	Willingness to act	Farmers 'adaptation to climate change	χ^2 = 31.947 P = 0.000 T^b= 0.337	χ^2 = 37.729 P= 0.000 T^b= 0.314
Unmarried	Willingness to act	Farmers 'adaptation to climate change	χ^2 = 5.586 P=0.018 T^b= 0.243	

Association between Willingness to act and Farmers' Adaptation to Climate Change while Controlling Level of Education

Table 6 depicts that the influence of willingness to act on farmers' adaptation to climate change in the context of their level of education showed a significant (P=0.000) and positive (T^b=0.273) association for illiterate farmers. Similarly, the association between the aforementioned variables was highly significant (P=0.000) and positive (T^b=0.387) for literate farmers. Likewise, the level of significance of chi-square and Tau-b for the entire table revealed a highly significant (P=0.000) and positive (T^b=0.314) association between farmers' willingness to act and their adaptation for both illiterate and literate farmers. The significant value of the chi-square and positive values of Kendal T^b showed a spurious relationship between willingness to act and farmers' adaptation while controlling level of education. These results highlighted that farmers' willingness to act influences their adaptation 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	Willingness to act	farmers' adaptation to climate change	χ^2 = 15.748 P= 0.000 T^b= 0.273	χ^2 = 37.729 P= 0.000 T^b= 0.314
Literate	Willingness to act	Farmers' adaptation to climate change	χ^2 = 20.648 P= 0.000 T^b= 0.387	

Association between Willingness to Act and Farmers' Adaptation while Controlling Farming Experience

According to Table 7, the influence of farmers' willingness to act on their adaptation in the context of farming experience showed a significant (P=0.000) and positive (T^b =0.258) association for less experienced farmers. Similarly, the association between the aforementioned variables was highly significant (P=0.000) and positive (T^b =0.497) for farmers with high experience. Moreover, the values of chi-square and Tau-b for the entire table revealed a highly significant (P=0.000) and positive (T^b=0.314) association between willingness to act and farmers' adaptation for farmers with low and high experience. The significant value of the chi-square and positive values of Kendal T^b showed a spurious relationship between willingness to act and farmers' adaptation while controlling level of education. These results highlighted that willingness to act influences farmers' adaptation to climate change more positively in the case of farmers with high experience than in the case of farmers with low 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)	Willingness to act	Farmers' adaptation to climate change	χ^2 = 19.891 P= 0.000 T^b= 0.258	χ^2 = 37.729 P= 0.000 T^b= 0.314
High (above 10 years)	Willingness to act	Farmers' adaptation to climate change	χ^2 = 21.001 P= 0.000 T^b= 0.497	

DISCUSSION

According to our findings, farmers were willing to discuss climate change issues with their fellow farmers. The showed interest in seeking help from other farmers in relation to possible climate change risk that threaten their production. They were found motivated to take proper measures by themselves and to guide other farmers to take action against the potential climate change risks. These finding can be justified in the light of pervious research studies as Sberghaus et al. (2010) emphasize that psychological factors, along with socio-economic factors, play a significant role in accurately predicting future actions related to climate change adaptation. Grothmann & Patt (2005) indicated that psychological factors have a greater impact on adaptive capacity than purely socio-economic factors. Strengthening individuals' willingness to act on climate change is a key approach in environmental awareness, which aims to bring about positive attitudinal changes and facilitate adaptation (Banstola et al., 2013).

In relation to seeds and fertilizers, majority of the target farmers were found willing to use improved seeds and new fertilizers in response to the negative effects of climate change on soil fertility. Similarly, farmers were found interested to increase the use of pesticides and improve irrigation system as adaptation strategies. Farmers in Nepal increased the use of improved seeds and chemical fertilizers to minimize climate change risks to their crop production (Dhungana, 2020). Combining improved maize varieties with nitrogen fertilizer results in more desirable productivity benefits (Hurley et al., 2018). Shikuku et al. (2017) identified that farmers were more likely to change crops, land, and planting dates. Similarly, Shee et al. (2020) found that farmers were willingness to pay for improved agricultural technologies in Tanzania including hybrid seeds and chemical fertilizer. In the Sahiwal district of Pakistan farmers used pesticides to control weeds or pests to prevent possible plant diseases (Mubushir et al., 2019). Similarly, farmers in South Binn employed various adaptive strategies, including pesticides, chemical fertilizers, and improved seed varieties (Fadina et al., 2018). Natasapurta et al. (2011) in their research conducted in Jakarta, Indonesia, where farmers showed positive attitudes towards the operation and maintenance of irrigation systems. Farmers' willingness to improve their irrigation channels can also be observed in the study conducted by Kalra et al. (2014), which focused on farmers' perceptions of irrigation management and land degradation in the Western Yamuna Canal.

The farmers in the study area had a positive attitude towards agriculture trainings as well as new technology that could help them increase resilience against the negative impact of climate change. Noor and Dola (2011) investigated the impact of extension training on farmers' perception and performance, revealing that the farmers held positive attitudes towards extension training. Attitudes can be reflected as significant predictors of human behavior and the acceptance of ideas (Arbuckle, 2013; Dietz et al., 2005) that have been recognized as workable in farmers' adjustment to agriculture policy reforms (Gorton et al., 2008). Kazeem et al. (2017) carried out research on farmers' attitudes and adoption of improved technologies in Nigeria and found that the farmers had positive attitudes towards extension trainings, while 64.25% of them had lower levels of adoption of improved technologies. These findings are in contrast with the findings of our study.

The findings of our study indicate that farmers' willingness to act have significant and positive association with their adaptation to climate change. Farmers' interest to discuss climate change information with fellow farmers, seek help from each other about these risks, and to take measures in order to minimize the risks are the various indicators of willingness to act that positively and significantly contribute to adaptation to climate change. These finding are in line with previous research studies. Farmers who discuss climate change issues with each other are more likely to improve their agricultural practices (Esham & Garforth, 2013). In Tanzania, the sharing of knowledge from farmer to farmer has been reported as the main method to improve their adaptation capacity (URT, 2008). In Ghana, the willingness and ability of smallholder farmers to share knowledge ensured irrigation and vegetable production techniques as adaptive measures (Laube et al., 2012). Within interpersonal networks, farmers share information with each that affect their learning and decision-making (Skaalsveen et al., 2020). In rural Sindh Pakistan, farmers trusted the information they receive from each other (Shaikh et al., 2020). Such information and social capital based on mutual help have positive impacts on behavioral intentions towards climate change adaptation (Zamasiya et al., 2017). In South Asia, farmers' membership in cooperatives or other relevant organizations was positive and significant for climate change adaptation. Such membership among farmers shows their inclination towards taking help from each other in relation to risk management (Abid et al., 2015; Shikuku et al., 2017).

Farmers' coordination with other institutions in relation to climate change risk yields positive impact on their adaptation measures. Willingness to change the seed, use new type fertilizers and use pesticides and insecticide can also improve farmers' adaptation to climate change. Similarly, farmers' interest in agriculture trainings and use of new farming technologies enhance climate change adaptation actions. The mentioned significant and positive association between various factors of willingness to act and farmers' adaptation to climate change can be justified by previous research studies. Institutional coordination also supports collective action and decisions about climate change adaptation (Grothmann et al., 2013). The role of public institutions, equipped with new knowledge and the latest technologies, is crucial in enhancing farmers' adaptive capacity or resilience (Abid et al., 2017). Without the support of government and institutions, adaptation tends to be limited or restricted (Mumtaz et al., 2018). Farmers' willingness to change the seed indicates that climate change will have adverse effects both on soil fertility and on the quality of seed. Tan et al. (2013) claimed that climate change has been reported to have negative consequences on the biochemical composition of seed and its quality. According to the research findings of Maity and Pramanik (2013), high-quality seed is a basic and pivotal input for agriculture along with other required inputs to provide rapid and uniform germination and healthy crop establishment. In order to increase crop productivity, efforts are made to have improved seed. Toledano (2017) conducted research to identify the attitudes and opinions of farmers towards improved seeds of maize crops in Mexico and found that the farmers were likely to adopt improved seeds having higher yields, resistance to diseases, and large sizes. Abid et al. (2015) examined how farmers in the Punjab province of Pakistan adapted their agriculture to climate change by choosing various adaptation methods, including changing crop varieties, changing planting dates, and changing fertilizer. Similarly, the findings of Daze (2007) revealed that in Ghana, farmers used various adaptation methods such as mix farming, the use of drought-tolerant crops, soil erosion control, the use of chemical fertilizers, etc.

Farmers' willingness to improve their irrigation and to use pesticide will have no impact on their adaptation to climate change risks in the study area, which is in contrast to the results of most of the previous research studies. For example, Wang et al. (2017) concluded that upgrading irrigation infrastructure in villages enhances farmers' ability to adapt to the risks of drought. Similarly, Finger et al. (2011) expressed that maintaining and improving irrigation is believed to be an effective adaptation method to climate change risks. The use of Pesticides is another important adaptation technique along with the use of chemical fertilizers and improved seed varieties (Fadina et al., 2018). Pesticides are constantly used to reduce pest risk and improve crop production and quality (Delcour et al., 2015). Beside this, Farmers' participation in agriculture trainings had a significant and positive relationship with climate change adaptation practices (Haque et al., 2019). Karim (2011) has also observed a significant positive relationship between farmers' taking part in training and their adaptation practices. Farmers who receive trainings are more likely to consider adaptation practices (Haque et al., 2019). According to Mahmood et al. (2020), climate-related extension services, including farmers' participation in trainings, had highly significant and positive impacts on their decisions and choices of adaptation actions in the rain-fed agricultural zone of Pakistan. Moreover, technology has brought a transformation to the agriculture sector, enabling farmers to increase productivity and profitability (Himesh et al., 2018). In Bangladesh, various research programs are designed to support farmers through extension services by providing agricultural technologies to cope with climate risks (Baas & Ramasamy, 2008). However, various socio-economic, institutional, and environmental factors make the farmers unable and unwilling to adopt improved technologies (Dhehibi et al., 2020).

According to our findings, variations in the respondents' family type cause variations in the association between willingness to act and farmers' adaptation to climate change. In joint families, farmers' willingness to act influences their adaptation more positively as compared to nuclear families. Because of more dependent family members in joint families, farmers feel pressure to feed more people, making them more conscious of climate change hazards and are more likely to take adaptation measure. Large families can practice multiple cropping, whereas small families are more likely to practice mono-cropping (Nhemachena & Hassan, 2007). The multiple cropping systems are more labor intensive, need more members, and hence positively influence the adaptation measures based on more intensive labor (Nyangena, 2008). Matasci et al. (2014) showed that stakeholder willingness to act is a central component of social acceptability, which facilitates adaptation to the impacts of climate change. The larger family size also affects the willingness to act positively. In this regard, Saptutyningsih et al. (2020) conducted research on the role of social capital in climate change adaptation and found that farmers who belong to large families are more willing to participate in the process of climate change adaptation.

As per multivariate analysis in this, willingness to act influenced adaptation to climate change risk more positively for married farmers as compared to their unmarried counterparts. Individuals' willingness to act depends on their perception of the risk they experience (Harries, 2008), and a highly significant correlation has been found between risk perception and willingness to act (Matasci et al., 2014). Therefore, the martial status of the farmers is expected to influence the association between their willingness to act and adapt in the same way it affected the association between risk perception and farmer' adaptation. Being more responsible, conscious, and organized than unmarried farmers, married farmers are more likely to be willing to take measures to adapt to climate change risks. Married farmers may have positive risk perception, and their production could be higher as compared to unmarried farmers (Maonga et al., 2013). Therefore, they are more likely to be willing to act or pay for the adoption of new technology than their counterparts (Chuma et al., 2020).

According to the findings, farmers' adaptation to climate change was influenced by their willingness to act more positively in the case of being literate as compared to their illiterate counterparts. This implies that the farmers with higher levels of literacy were more willing to act against the climate risks that could have affected their crops or productions. Lebel et al. (2021) found that farmers with greater experience and higher education were more willing to use risk management practices. Spicka (2020) found a significant relationship between farmers' level of education and their willingness to act against climate change risks. Similarly, Hassan and Nhemachena (2008) highlighted farmers' education as one of the important factors influencing their decisions to adopt adaptation strategies. He further explained that better education would improve the awareness level of the farmers and their willingness to participate in soil conservation and natural resource management.

We could observe from the given findings that the willingness to act of farmers influenced their adaptation action more positively when they had high farming experience than when they had low farming experience. In other words, farmers with more farming experience are expected to better perceive the risks resulting from changes in climatic conditions. Therefore, these farmers will be more willing or motivated to act against possible climate risks. Thus, they will be more likely to adopt adaptation practices as compared to farmers with less farming experience. Lebel et al. (2021) found that farmers with more experience were more willing to use risk management practices. Similarly, Jense et al. (2007) showed that farming experience positively affected farmers' willingness to adopt bioenergy crops. Another study conducted by Embaye et al. (2018) highlighted that a number of factors, including farming experience, significantly influenced farmers' willingness to grow oilseed crops. They further explained that farmers who had prior experience with oilseed production were more willing to grow oilseed crops than farmers who had no prior experience in it.

CONCLUSION

Farmers of the target area were willing to act against the possible climate change risks. They were interested to discuss climate change with issue with fellow farmers and make use of various adaptation strategies. The various indicators of Farmers' willingness to act had a positive association was climate risk perception. Various variable including family type, marital status, educational level and farming experience explained variations in the association between willingness to act and farmers' adaptation to climate change. In case of farmers lived in joint families, farmers' adaptation to climate change was more positively influence by willingness to act. Similar results were obtained in case of farmers being married, literate, and had high farming experience. This show that married and literate farmers were more willing to take adaptation measures than the unmarried and illiterate farmers. Similarly, farmers who lived in joint families and had higher experience were more willing to take adaptation actions than the farmer who lived in nuclear families and had less farming experience. Farmers' willingness to act or adapt is a critical component of their adaptation to climate change risk, but it is hampered by a lack of access to climate change information and knowledge of new farming techniques. As a result, the agriculture department will need to be strengthened and well-equipped in order to keep farmers up to date with such information and new knowledge that could help them be more willing to adapt autonomously.

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