

Research Article



Impact of Climate Change Awareness on Climate Change Adaptions and Climate Change Adaptation Issues

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Abstract | This study contributes to the local responses to address the impact of climate change in agriculture sector in the context of Khyber Pakhtunkhwa and Punjab provinces of Pakistan. Pakistan's agriculture is vulnerable to the cataclysmic transformations in the climate system; causing productivity loss, soil degradation, water scarcity, resource depletion etc. Climate change awareness empowers the farming communities to take appropriate measures to mitigate the negative consequences of this phenomenon but the responses are not necessarily identical in scale and forms. In developed countries, climate change awareness is much advanced therefore, their climate change adaptations are also far better than those employed by farmers in the developing countries like Pakistan. The climate change awareness obviously determines the nature, quality and strength of climate change adaptations. The current study measures the impact of climate change awareness on climate change adaptation and climate change adaptation issues (constraints) and their interactions to help in addressing the native agricultural issues emerging from global climate change. The statistical analysis of the field data supports the assumptions about positive association between climate change awareness and climate change adaptations ($R^2=44.6$, $B=.875$ and $P\text{-value}=.000$) and negative interaction between climate change awareness and climate change adaptation issues ($R^2=.318$, $B=-.707$ and $P\text{-value}=.000$). Further, the role of geographic-zones and respondents' educational level has also been found significant. Therefore, more efforts, if directed, to enhance climate change awareness through dissemination of authentic and need based information, would significantly help farmers to undertake more relevant, effective and efficient adaptation measures, thereby, contributing in increasing the agriculture yield and reduce losses. However, imprudent projection of climate change adaptation issues without proper awareness about the associated dynamics, complexities and implications may petrify the farmers thus, yielding negative ramifications with regards to the outcomes.

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Introduction

The climate change is a ubiquitous phenomenon having wide-ranging social, economic, political, geographical, ecological and psychological implications. Pakistan by virtue of its geo-physical, climatological and socio-political locations, is a

unique country on the face of planet. The global climate change is altering our inter-relationship with the environment, transforming comparatively stable climate factors and turning them uncertain, unpredictable and threatening (Ricart et al., 2019). A large number of the developing countries relying on agriculture for the national economy are facing severe

threat of climate change. As per [Gori et al. \(2018\)](#), the climate change has caused changes in the land use besides exerting pressure on water resources thereby, affecting the capacity of ecosystems to sustain food production; ensuring an uninterrupted supply by freshwater resources supply; providing ecosystem services and; promoting the rural multi-functionality. Climate change is a great challenge for the agrarian economies like that of Pakistan ([Mumtaz et al., 2019](#)) as its agriculture sector is highly vulnerable to climate change ([Saleem et al., 2019](#)). Experts believe that owing to large dependence of country's economy on agriculture, Pakistan ranks 12th amongst the most vulnerable countries to climate change, world-over ([Noman and Schmitz, 2011](#); [Ullah, 2017](#)). This sector contributes approximately 25 percent to the national Gross Domestic Product (GDP) and it absorbs about 42 percent of the labor force. The sector contributes in generating more than 75 percent of export revenue. However, agriculture sector in Pakistan is grappling with multidimensional impacts of climate-induced challenges, such as: rising temperatures; decline in rainfalls; floods; droughts; and yield losses ([Noman and Schmitz, 2011](#)). The variation in monsoons and increased temperature most likely is an impending real challenge to the agriculture sector in Pakistan. [Abid et al. \(2016\)](#) believe that evidences substantiate the argument that climate change will perpetually pose threats throughout this century despite international efforts to curtail greenhouse gas emissions. In order to confront the challenges, several climate change policies have been evolved at international; national; subnational; and local levels to address the impacts of climate change. Climate change has emerged as one of the most prominent challenges of the global concern today and consequently two pronged efforts, climate change adaptation, and climate change mitigation, has been launched to manage the cataclysmic repercussions of the phenomenon.

Traditionally, the focus of emphasis of such policies remained on mitigation instead of adaptation measures; despite crucial and immediate need for devising adaptation strategies ([Biesbroek et al., 2009](#)). The most countries vulnerable to climate change regard adaptation as the focus of their strategies to manage the negative consequences of climate change. Several countries including Pakistan are alive to the challenge and cognizant of the need to direct their efforts to address the climate induced challenges through application of effective and efficient

adaptation strategies. The adaptation efforts are the focus of PNCCPP (2015). [Abid et al. \(2016\)](#) posit that Pakistan falls amongst the countries having the least adaptive capacity due to extreme poverty and lack of physical and financial wherewithal. Government of Pakistan, therefore, has launched several initiatives to bolster farmers' capacity to adopt appropriate adaptation measures in agriculture sector. This study therefore, explores the relationship amongst variables: (a) climate change awareness and climate change awareness adaptation; and (b) climate change awareness and climate change adaptation issues.

The awareness building is one of the prominent efforts launched in Pakistan to withstand the negative fallout of the extremities linked with climate change. It is important to consider two dimensions of farmers' perceptions about climate change uncertainties, potential impacts and risks: first, exchanges of local experiences and patterns followed at individual and community level across the society and second, awareness of climate uncertainties, potential risks, and observed impacts of climate change, as the first step towards adaptation ([Lebel et al., 2015](#)). The climate change awareness encompasses their general know-how about the phenomenon, effects generated by change in climate, causes and impacts of climate change. The impact of climate change related events determines the scale and direction of effort aimed at application of adaptation measures to tackle the projected threats. In order to control losses caused by climate change, climate-related perceptions and adaptation strategies of farmers assume greater importance because knowledge regarding impact of climate change will induce employment of relevant adaptation strategies to offset negative impact of climate change ([Schiermeier, 2015](#)). Usually adaptation strategies are categorized into short run (autonomous incremental responses based on local knowledge), and the long run (transformative responses); and both are essential for minimizing risks from weather extremes ([O'Brien, 2013](#)). Adaptation actions are important response to climate change as these actions help to reduce the vulnerabilities in the social and biological system ([Adger et al., 2009](#)). One of the major objectives of adaptation measures is to build the resilient in societies to face climate change ([Mumtaz et al., 2019](#)). The adaptation practices related to farm production could include: diversification of crop and livestock varieties; changes in the intensity of production; changes in land use practices which entail

altering the location of crop and livestock production (land fragmentation); conservation of moisture and nutrients; implementation and intensification of irrigation practices; and changes in timing of farming operations (Ali, 2017).

A large number of researches have been conducted on adaptation at farm level with respect to climate change across different disciplines in several countries exploring adaptive behavior and its determinants. Extensive international research on adaptation in agriculture sector to climate change notwithstanding, a limited research has been done in South Asia (Abid *et al.*, 2015). As of now, researches on climate change and agriculture in Pakistan have been exclusively limited to impact of climate change on a particular crop or sectors, however, very limited studies have been conducted towards capacity building of farming community over awareness to effectively respond to the impact of climate change on agriculture sector. The previous studies conducted by various researchers focused on investigating farmers' attitudes towards climate change risks and adaptation issues (Adimassu and Kessler, 2016) or compared farmers' perception of climate change with meteorological data (Ayanlade *et al.*, 2017), however, a little research has been directed at exploring public perception about climate change (Ricart *et al.*, 2019).

Salman *et al.* (2018) also noted that a series of studies on climate change awareness and adaptation conducted in the past assessed the adaptation behavior of the farmers in different contexts and responses could be pro-active or reactive, depending upon different dynamics like farm production process; insurance; scale and magnitude of the event; the frequency of extreme events and gender of the household head etc. but the investigation of the role of farmers' perception in adaptation to climate change and policy framework in the context of Pakistan is still lacking, despite being very crucial. Although numerous studies on the impact of climate change on agriculture in the past, however, no consensus exists amongst the researcher on the issue. Majority of the studies report the negative impact of temperature on agriculture. For example, Husnain *et al.* (2018) reported the negative impact of temperature on agriculture. Ali *et al.* (2017) found that extreme temperature adversely affects crop production in Pakistan. There is not much known about farmers' perceptions on climate change in empirical literature (Simelton *et al.*, 2013); as the

focus of previous studies has been on the biological and physical impacts of climate change (Pidgeon and Fischhoff, 2011).

The researching on climate awareness has gained momentum in the recent past and remains critical even at present since awareness of the communities in the context of climate change is considered as a means of consolidating their resilience to climate change and climate variability and augmenting systems thereof (Akrofi *et al.*, 2019). Eliška *et al.* (2019) also emphasized on the need for further research to investigate the role of public perception of climate change on climate change adaptation; mitigation; and climate policy and communication.

In the backdrop of this knowledge deficit across the world in general and Pakistan in particular, the current study has been undertaken to measure the impact of climate change awareness on climate change adaptation and climate change adaptation issues (constraints) and their interactions so as to help the farmers in Pakistan by enhancing their capacity to address the native agricultural issues emerging from global climate change. The statistical analysis of the field data supports the assumptions about positive association between climate change awareness and climate change adaptations ($R^2=44.6$, $B=.875$ and $P\text{-value}=.000$) and negative interaction between climate change awareness and climate change adaptation issues ($R^2=.318$, $B=-.707$ and $P\text{-value}=.000$).

The study reveals that more efforts if directed to enhance climate change awareness, through dissemination of authentic and need based information, would significantly help farmers to undertake more relevant, effective and efficient adaptation measures, thereby, contributing to increase the agriculture yield and reduce losses. Whereas, imprudent projection of climate change adaptation issues without proper awareness about the associated dynamics, complexities and implications may petrify the farmers thus, yielding negative ramifications with regards to the outcomes.

Materials and Methods

Climate change awareness (CCA)

Perception transforms the attitude of individuals or societies to take certain actions under particular situations. The knowledge and attitude of individuals

play a central role in improving natural environments (Mumtaz et al., 2019). The new information or situations challenge or change individuals' initial attitudes (Nazir et al., 2019). The intentions of an individual to portray a particular behavior, are the central tenet of the 'theory of planned behavior'. This intention reflects the extent of motivation and effort that an individual will make to project a behavior and is gauged by his attitude toward the behavior; subjective norms; and supposed behavioral control (de Oliveira et al., 2019). This theoretical perspective is also applicable to climate action, hence, the interventions are aimed at behavioral change through environmental awareness campaigns directed at creating new attitudes and perceptions about a new behavior by altering mediating factors such as knowledge; and social norms (Mumtaz et al., 2019). Likewise, social cognitive theory, (Bandura, 2001), also postulates that human factors and environmental influences are all interactive determinants of human behavior. The concept of self-efficacy, involving peoples' self-confidence about their capacity to perform certain tasks or undertake a particular behavior, is the central idea of the social cognitive theory (de Oliveira et al., 2019). Malaysia, Mashud et al. (2015) posited that perception, awareness and knowledge of climate change influence person's attitude towards climate change and, consequently, pro-environmental behavior. The climate change awareness entails knowledge creation, values development and accepting and transformation of attitudes and building skills and abilities amongst individuals and social groups regarding the issues of climate change with a view to attain a better quality environment (Akinubi et al., 2012). The awareness is ability to directly know and perceive, to feel, or to be conscious of events, thoughts, emotions and sensory patterns. Tonn (2007) defines climate change awareness as "the extent that primary producers understand, relate to, and prioritize climate change as a driver of change within bio-agronomic systems". The other objectives of awareness-raising are information sharing, increasing concerns, stimulating self-mobilization and mobilization of local knowledge and resources (O'Connor et al., 1999). Leiserowitz (2007) focused on public perception of climate change and stressed the significance of realizing public perception as it can significantly affect future development and policies regarding environment. Doss and Morris (2001) focused on the perceptions of

ethnic communities, the way they think and behave in relation to climate change, as well as their values and aspirations, which they argued have a significant role to play in addressing climate change. In recent years, numerous research initiatives have described the gap between environmental awareness, knowledge, and real presentation of pro-environmental behavior (Kollmuss and Agyeman, 2002). However, question arises now as how to address the problems with fundamental awareness and knowledge relatively less pronounced (O'Connor et al., 1999; Lorenzoni and Pidgeon, 2006; Whitmarsh and Lorenzoni, 2010). Increased climate change awareness in Pakistan could help in preparing and implementing climate change adaptation strategy (Shahid, 2012). It is anticipated that most of the people are aware of climate change phenomenon, but awareness about the impacts of same and urgency of the matter is low. Lack of awareness ultimately leads toward no or little effort to drive the change. There is lack of access/knowledge of effective platform where their voices can be heard/actions can be generated (UNEP, 2006). The awareness raising campaign results into increased awareness of climate change impacts, support, impact assessment, adaptive policy formation, enhance adaptive capacity, indigenous solution and reduced vulnerability.

There are various forms of media which help disseminating the message i.e. newspapers, internet, and television (Sampei and Usui, 2009; Arlt et al., 2011). Madobi (2012) observed that one of the commitments made by the parties under the UNFCCC in Article 4 that all parties contribute to "promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process". Awareness and knowledge about climate change is an important feature for individuals to make decisions about development and to mount political pressure on government to enact policy decisions to address the issues related to climate change (Dineshkumar and Moghariya, 2012). The climate change awareness has emerged as potentially important factor that influences the capacity of primary producers to adapt to and cope with climate changes (Marshall et al., 2011c; Vignola et al., 2010; Howden et al., 2007; Walker, 2005). Marshall (2011) suggests that climate change awareness might be managed to support adaptation processes. They posit that climate change awareness influences the capacity of primary producers to adapt to climate change risks while

suspecting that ability of primary producers is limited as desired to adapt from the outset; particularly when it comes to adoption of novel climate adaptation strategies (Howden *et al.*, 2007; Jagtap *et al.*, 2002; Patt and Schröter, 2008; McKeon *et al.*, 1993).

Extensive literature is available that focuses the impact of climate change on agriculture but these studies have mostly covered the biological and physical aspects of climate change (Husnain *et al.*, 2018). There is dearth of studies that try to examine perceptions and adaptation strategies of farmers in response to climate change in Pakistan. Recently Nazir *et al.* (2018) examined farmers' perceptions about climate change and found that farmers are well aware of the changes that are happening because of climate change. Based on their endogenous knowledge they can predict and forecast weather. This study improves this research at least in two ways. First, sample size of this study is at least three times larger than their study. Large sample size is more likely to provide reliable results as compare to small sample. Second, the sample area of this study locates in the region where climate change is going to hit hard through water shortage and droughts. Despite numerous studies on the impact of climate change on agriculture, no consensus exists among the researcher on the issue. Majority of the studies report the negative impact of temperature on agriculture. For example, Husnain *et al.* (2017) reported the negative impact of temperature on agriculture. Ali *et al.* (2017) found that extreme temperature adversely affects crop production in Pakistan. Very little is known about farmers' perceptions on climate change in empirical literature (Simelton *et al.*, 2013) as the focus of previous studies has been on the biological and physical impacts of climate change (Pidgeon and Fischhoff, 2011). The farmers' perceptions to climate change are closely linked with community perceptions of climate variability. Mahmood *et al.* (2010) reiterated that perceptions about climate change help in the formulation of coping strategies. The climate change is going to hit hard small farmers due to their limited adaptive capacity (Archer *et al.*, 2007). The climatic variations reduce resilience in poverty-hit regions (Lal *et al.*, 2011). Traore *et al.* (2015) are of the view that adaptation can reduce the negative impacts of climate change in future and without adaptation the effect of climate change will not be substantial. Likewise, Waha *et al.* (2013) also reported that adaptation to climate change reduces the intensity of its impacts on agriculture. Farmers can maximize their profits

by adapting to climate change (Tilman *et al.*, 2002). However, adaptation alone cannot be as effective as in case of its integration with farmers' understanding of risk. The farmers' perceptions related to climate change provide foundations for adaptation (Simelton *et al.*, 2013). It is obvious from the literature that perceptions of the farmers are prerequisite to adaptation to climate change and negative climatic variations impacts soften because of adaptation. This variable comprises seven items; three for indicators and four for impacts.

Climate change adaption (CCAD)

Adaptation to climate change involves changes in agricultural managing practices in response to changes in climate conditions. Adaptation is a complex, multi-dimensional, and multi-scale process, and has been defined as adjustments to economic structures or behavior in order to reduce vulnerability of society in face of scarcity or threatening environmental change (Adger *et al.*, 2003; Bryan and Behrman, 2013). The intergovernmental panel on climate change (IPCC) survey report revealed that adverse impacts of climate change are likely to impact agricultural sector in Southeast Asia primarily, due to increase in the occurrence of droughts, increase in incidence of intense rains and rise in temperature (Shrestha *et al.*, 2018). Agriculture is exposed to multiple, simultaneous and inter-connected economic, ecological and social pressures (Feola *et al.*, 2015). Fader *et al.*, 2013 reported that increased economic inter-relationship in globalized world leads to creation of unpredictable dynamics and the conditions of price volatility, with potentials to influence agricultural incomes and livelihoods. Climate change is anticipated to have severe impact on our ecosystem, socio-economic matrix and human society.

Despite proliferation of knowledge about climate change and awareness campaigns run by various stakeholders, rural households continue to behave indifferently about adaptation to new climatic conditions (Shahid, 2012). Smit and Skinner (2002) clustered agricultural adaptation strategies to four (4) main categories, but noted that they are not mutually exclusive, namely technological developments, government programs and insurance, farm production practices, and related financial management. This typology is founded on scale at which the stakeholders operate. Adger (2005) observed that adaptations occur in the milieu of cultural, demographic and

economic change and transformation in information technology, social conventions, global governance, and the flows of capital. Akhter and Erenstein (2017) observed in a study conducted in Pakistan's context that climate change adaptation strategies for agriculture comprise: (a) micro-level options, like crop change and adjusting the timing of operations (Deressa et al., 2009); (b) responses from market, just as income diversification and credit schemes; (c) institutional changes, primarily government responses, like introducing subsidies/taxes and improvement in agricultural markets (Mendelsohn, 2001) and finally, (d) technological developments, like promotion and expansion of new crop varieties and advances in water management techniques.

Farm production practices entail changes introduced by producers in their operational practices at farms, which may be encouraged or introduced by government and industry programmes. Adaptations related to farm production include farm-level decisions about farm production, use of land, irrigation, land topography and the timing of operations. Changes in farm production activities bear potential to reduce vulnerability to climate related risks and enhance flexibility of farm production to the changing climatic conditions (Akhter and Erenstein, 2017). Besides, adaptations practices related to farm production could include diversification of crop and livestock varieties, changes in the intensity of production, changes in land use practices which entail altering the location of crop and livestock production (land fragmentation), conservation of moisture and nutrients, implementation and intensification of irrigation practices, and changes in timing of farming operations (Ali et al., 2017). The diversification of crops, modification in input scheme, modification in irrigation practices, change in the land use practices for the production, conservation of moisture and nutrients, changes in timings of farming operations, are few common adaptation strategies/ measures. The tendency and intensity of adaptation of these measures vary from region to region (geo-climatologically). This variable comprises five items related to application of different adaptation measures.

Climate change adaptation issues (CCADI)

The issues that constrain climate change adaptation vary from country to country and region to region. These issues are multidimensional. The recent researches have focused on the certain constraints to

climate change adaptation besides perceived climatic and non-climatic stressors of climate vulnerability, particularly in the developing countries (Ozor et al., 2010; Antwi et al., 2014). Literature reveals that lack of information about climate change, lack of sufficient resources (availability of farm inputs, water and irrigation channels, land constraints etc.), and lack of finances (due to inadequate income, credit constraints, complex banking system), shortage of the labour force and inadequate government support or other agriculture extension services. Several authors, thus, posited that in climate change context, exposure is triggered by both climatic factors (rainfall, extreme temperature, drought, etc.) and non-climatic dimensions (income, lack of agricultural equipment, etc.) and it is imperative to understand the combination of these stressors (factors) that exacerbate the vulnerability of farming households to climate change (Antwi et al., 2017).

Experts believe that significant knowledge gaps exist that impede flow of information coercing adaptation, but knowledge by itself is not sufficient to drive adaptive responses (Adger et al., 2007). Even the review of recent literature supports these conclusions. Adaptation stakeholders and practitioners in both developing (Bryan et al., 2009; Deressa et al., 2009; Begum and Pereira, 2013; Pasquini et al., 2013) and developed (Tribbia and Moser, 2008; Gardner et al., 2010; Jantarasami et al., 2010) continue to identify knowledge deficits as adaptation constraint. Also, Tribbia and Moser, (2008), Whitmarsh (2011), Stoutenborough and Vedlitz (2013) highlighted the importance of information as a key enabler. Similarly, physical constraints have significant ramifications for human adaptation as well. Information and communication tools can play highly effective role in creating the enabling environment for Pakistani society to survive tumults created by climate change during all stages. Climate change adaptation is reckoned to be most vital element of strategic responses to counter threats posed by climate change (Moser and Luers, 2008).

Water-dependent entities in the water deficient regions have reduced flexibility to cope with ephemeral or long-term declines in water supply. This, resultantly influences the range of adaptation measures that can be implemented effectively to manage risk to water security and, consequently, energy security (Voinov and Cardwell, 2009; Dale

et al., 2011), agriculture and food security (Hanjra and Qureshi, 2010). Likewise, soil quality and water quality can constrain agricultural activities, thus, the adaptation propensity of agricultural systems with respect to climate change (Delgado et al., 2011; Lobell et al., 2011). The farmers, main decision-makers in farming, have to work in a very complex environment encompassing political, economic, bio-physical and institutional conditions (Hanif et al., 2010). There are also few internal factors like personal characteristics, farming practices and the individual environment which further define farmer's response and his capacity to adapt. Farming communities that are well informed about climate induced developments can take effective decisions and employ the efficient techniques and measures thereby enhancing their ability of the climate change adaptation. However, certain constraints beyond capacity of the farming community that inhibit adaptation are not positively related to the awareness about climate change. Ravi and Patil (2019) have summed up these constraints as: lack of adequate funds available with farmers; lack of market access (Poor transportation networks and market information system); lack of credit or insurance service; low/no subsidies on desired agricultural inputs; lack of belief on current weather forecast system; irregularity in power supply; lack of timely availability of farm inputs; limited access to agricultural extension services; lack of access to timely weather forecast information; lack of knowledge about need based improved agriculture technologies; lack of knowledge and information about climate change and adaptation strategies; and lack of irrigation facility and access to water. Physical and ecological barriers; technological limits; financial barriers; informational and cognitive barriers; and social and cultural barriers are another few constraints to the adaptation. Insofar as the relationship between climate change awareness and climate change adaptation issues (constraints) is concerned, it has projected negative results. It means that awareness alone cannot stimulate farmers to take adaptation measures, given the fact that other constraints are overwhelmingly massive and beyond capacity of a common farmer to address at individual or local level. Moreover, awareness is also limited to just a few dimensions not encompassing the entire range of information required by the farmers. This variable also contains five items (main issues limiting the farmers' propensity to employ adaptation measures).

Research hypothesis

H₁: CAA is significantly associated with CCAD and CCADI

H₂: CCA significantly and positively predicts CCAD (Positive Prediction)

H₃: CCADI is significantly and negatively explained by CCA (Negative Prediction)

Research design

Philosophy and approach: Research philosophy determines the type of research methodology adopted to conduct any research effort in any area of study. This study follows 'positivism' as the set of beliefs about 'knowledge' and the way it is 'captured and communicated.' It suggests that knowledge is what can be 'verified' and it is recorded and communicated through 'standard terminologies or concepts' as language of knowledge. Further, survey approach was used to conduct literature and field surveys.

Tools and techniques: Qualitative data has been gathered from literature through preparing cards/notes of the relevant primary themes. These themes were then rearranged into organizing themes, which were connected together into a theoretical framework for the field study. Data from field survey was statistically manipulated to test (verify) the hypotheses, emerging from theoretical framework, using correlation and regression procedures.

Reliability and aalidity: Cronbach Alpha and Factor analysis were used to compute reliability and validity statistics of all three research variables and the instrument/questionnaire.

The reliability of the instrument was done through Cronbach Alpha. The minimum acceptable value for the Cronbach is (.7) in social sciences while in present case, the Cronbach values for all the research variables are above the required values: climate change awareness (.800); climate change adaptation (.903) and climate change adaptation issues (.697). Thus, the construct has good reliability with regard to the internal consistencies amongst the research variables and their items (questions).

The above tables (2nd, 3rd and 4th) present results of Bartlett's tests and Kaiser-Meyer-Olkin (KMO).

Table 1: *The reliability statistics.*

S.No	Variables/Instrument	No. of items	Cronbach's Alpha
1	Climate Change Awareness (CCA)	07	.800
2	Climate Change Adaptation (CCAD)	05	.903
3	Climate Change Adaptation Issues (CCADI)	05	.697

Table 2: *Validity statistics on climate-change awareness.*

KMO and Bartlett's Test			Matrix	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.779	Items	Score
Bartlett's Test of Sphericity	Approx. Chi-Square	1231.796	CCA1	.761
	df	21	CCA2	.682
	Sig.	.000	CCA3	.654
	Required		CCA4	.702
KMO test	= or > .7	Computed	CCA5	.544
Bartlett's test	= or < .05	.779	CCA6	.774
Factor Loadings	= or > .4	.000	CCA7	.593

Table 3: *Validity statistics on climate-change adaptation.*

KMO and Bartlett's Test			Matrix	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.849	Items	Score
Bartlett's Test of Sphericity	Approx. Chi-Square	1877.526	CCAD 1	.812
	df	10	CCAD 2	.837
	Sig.	.000	CCAD 3	.870
	Required		CCAD 4	.850
KMO test	= or > .7	Computed	CCAD 5	.883
Bartlett's test	= or < .05	.849		
Factor Loadings	= or > .4	.000		

Table 4: *Validity statistics on climate-change adaptation issues.*

KMO and Bartlett's Test			Matrix	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.932	Items	Score
Bartlett's Test of Sphericity	Approx. Chi-Square	10508.606	CCADI 1	.989
	df	15	CCADI 2	.991
	Sig.	.000	CCADI 3	.993
	Required	Computed	CCADI 4	.992
KMO test	= or > .7	.932	CCADI 5	.989
Bartlett's test	= or < .05	.000		
Factor Loadings	= or > .4			

The Bartlett's and KMO tests are the approaches used for factor analysis in order to determine the extent of the suitability of data. The KMO test accords with adequacy of sampling for the complete model as well as each variable in model. For KMO, the acceptable value is (.7) whereas in current situation, for measures, computed values for variables (climate change awareness = .779), (climate change adaptation

= .849) and (climate change adaptation issues = .782) which are above the required values. Similarly, Bartlett's test studies the postulation that "correlation matrix is an identity matrix" which designate that how much the variables are unrelated or interrelated and consequently unsuitable or suitable for the structure detection. In this connection, with significance level, the small values (.05) indicate that factor analysis

may be suitable for the current data. In current case, the “Bartlett’s test values for each measure” (climate change awareness = .000), (climate change adaptation = .000) and (climate change adaptation issues = .000) which designate the appropriateness of the present data for the factor analysis. Likewise, the “items with factor loading below (.4) have been excluded from the analysis”.

Findings of the study

This section presented the main results obtained through statistical procedures which comprise the descriptive results; testing of hypotheses; and the test of significance. It provided the data about description of research variables (descriptive) and their relationships (testing of hypotheses).

Table 5: Cross-tabulation across Districts/Education.

		Education			Total
		Illiterate	Under graduate	Post graduate	
Dis-tricts	Swabi	52	42	36	130
	D.I. Khan	95	112	16	223
	Gujrat	46	44	22	112
	Vihari	23	70	37	130
Total		216	268	111	595

Descriptive results

The table above provides the information about respondents concerning the districts of the respondents as well as their level of education. This table is self-explanatory, therefore, there is no need to further interpret the table.

Table 6: Descriptive statistics.

	N	Min.	Max.	Mean	Std. deviation
Climate change awareness	595	1.80	4.80	3.7906	.66690
CC Adaptation	595	1.40	5.00	3.9566	.87375
CCAD Issues	595	1.00	5.00	2.6017	.83679

The table above provides the information about the descriptions of the research variables concerning the total sample size, the minimum and maximum responses rate of the respondents, their mean and standard deviation. This table is also self-explanatory thus, there is no need to further interpret the table.

Testing of hypotheses

H₁: CAA is significantly associated with CCAD and CCADI

Table 7: Correlation analysis.

		Climate change awareness	Climate change adaptation
Climate change adaptation	Pearson correlation	.668**	1
	Sig. (2-tailed)	.000	
	N	595	595
Climate change adaptation Issues	Pearson Correlation	-.564**	-.870**
	Sig. (2-tailed)	.000	.000
	N	595	595

*** Correlation is significant at the 0.01 level (2-tailed).*

The hypothesis # 1 is substantiated with the positive significant statistics linking climate change awareness with climate change adaptation (R=.668 and P-value=.000) and adverse results about the relationship between climate change awareness and climate change adaptation issues. The results show that climate change adaptation issues are negatively and significantly associated with the climate change awareness (R = -.564 and P-values = .000) as also climate change adaptation issues are negatively and significantly associated with the climate change adaptation (R = -.870 and P-values = .000). Therefore, from the results of correlation about the association among the research variables, the first hypothesis is accepted.

H₂: CCA significantly and positively predicts CCAD (Positive Prediction)

The hypothesis # 2 stands true with R square of (.446) and Beta-weight of .875 showing the positive prediction of climate change adaptation by climate change awareness. Meaning that there is 45% variance in the climate change adaptation is due to the climate change awareness. Moreover, the coefficient of regression table shows the significant impact of climate change awareness on the climate change adaptation (Beta = .875 and P-value = .000). Therefore, from the results, the hypothesis # is also accepted.

H₃: CCADI is significantly and negatively explained by CCA (Negative Prediction).

In hypothesis # 3, negative relation between the climate change awareness and climate change adaptation issues were tested, which is powerfully substantiated by R square of .318 and Beta-weight of -.707. It means that 32% variance in the climate

Table 8: Regression analysis.

Model Summary						
Model	R	R Square	Adjusted R square	Std. error of the estimate	F	Sig.
1	.668a	.446	.445	.65070	478.011	.000b
Coefficients						
Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. error	Beta			
1 (Constant)	.639	.154			4.146	.000
Climate Change Awareness	.875	.040	.668		21.863	.000

a. Predictors: Climate change awareness; b. Dependent: Climate change adaptation.

Table 9: Regression analysis.

Model summary						
Model	R	R Square	Adjusted R square	Std. Error of the Estimate	F	Sig.
1	.564a	.318	.317	.69181	276.068	.000b
Coefficients						
Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 (Constant)	5.282	.164			32.247	.000
Climate Change Awareness	-.707	.043	-.564		-16.615	.000

a. Predictors: climate change awareness; b. Dependent: climate change adaptation issues.

change adaptation issues is due to the climate change awareness. Similarly, coefficient of regression provides significant information in deciding the negative prediction (Beta = -.707 and P-value = .000). Therefore, hypothesis # 3 is also verified.

The next section entails discussions, conclusions and implications of the study.

Conclusions and Recommendations

The climate change awareness helps in providing the dynamic knowledge about the values development; transformation and acceptance; and involves knowledge creation thereby assisting the individuals in building and shaping their abilities, knowledge, skills and attitudes (Kollmuss and Agyeman, 2002). It further helps the individuals in social groups about the climate change issues with an aim to manage better quality environment concerning climate change (Lorenzoni and Pidgeon, 2006). In this connection, various researchers provide theoretical and statistical evidences, in defining existing gap between actual staging of pro-environmental behavior and environmental knowledge and awareness (Patt and Schröter, 2008). Similarly, adaptation to climate change includes variations in managing agricultural practices in reaction to variations in climate situations

(Bryan and Behrman, 2013). However, adaptation is multi-dimensional, complex and multi-scale process and is defined as changes to behavior and economic structures so as to condense susceptibility of societies in face of threatening and scarcity concerning environmental change.

Moreover, adaptations practices associated to farm production might contain livestock varieties and diversification of crops, changes in land use practices, changes in strength of production which ultimately involve changing the land fragmentation (livestock production) and the crop location, preservation of nutrients and moisture, intensification and application of irrigation practices and changes in the technique of farming processes (Ali, 2017). However, there are certain issues which coerce the climate change awareness and adaptation vary from region to region and country to country (Agwu and Egbule, 2013). The issues about the awareness and adaptation are multidimensional and recent researches have focused on certain limitations to the climate change awareness and the adaptation besides apparent non-climatic and climatic stressors of climate susceptibility, mainly in the developing countries like Pakistan. Numerous researchers suggested that in context of climate change, experience is caused by both climatic (drought, risky temperature, rainfall) and non-climatic factors

(lack of agricultural equipment, income) and thus it becomes highly difficult to comprehend the blend of these factors that worsen the vulnerability of farming households to climate change (Antwi et al., 2014).

The results of the study found positive and strong association between climate change awareness and climate change adaptation with R-value (.668) and P-value (.000). The results are in conformity with the findings of a study conducted by Matsalabi et al. (2018) in the context of Niger. Shahid (2012) conducted a study in the context of Lahore, Pakistan and also noted strong association between climate change awareness and climate change adaptation. (Abid et al., 2017) also found that climate change awareness is significantly correlated with adaptation in agriculture sector in Pakistan, as enhanced knowledge about climate change builds the capacity of farmers for undertaking more effective, efficient and relevant interventions. Chakraborty (2017) in a study conducted in the perspective of the use of Information and communication technology (ICT) as an enabler, also found a strong association between public awareness and climate change adaptation. These findings are also in consonance with the conclusions of a similar study undertaken in the context of India, by Raghuvanshi and Ansari (2017). In another research, the climate change awareness emerged as a significant contributor affecting the ability of main creators to adopt the effective climate change adaptation measures (Whitmarsh and Lorenzoni, 2010). It therefore, validates the concept that higher the awareness level, higher would be the propensity of farmers of employing appropriate adaptation measures to address the climate induced challenges. The results indicate that 45% variance in climate change adaptation occurs due to climate change awareness ($R^2 = .446$, B-value = .875 and P-value = .000). Therefore, in order to promote climate change adaptation, more effort needs to be directed at awareness factor by the concerned stakeholders.

The study also reflects negative association between climate change awareness and climate change adaptation issues with R-value (-.564) and P-value (.000). The results indicate conflicting trends when it comes to the inter-relationship between climate change awareness and climate change adaptation issues. It means that climate change awareness alone (without addressing other grave capacity related constraints) cannot overcome the serious issues related to climate change adaptation. These challenges could be in the

form of lack of institutional and human capacity, scarcity of financial resources, lack of research and innovation, and integration of adaptation policy with other related policies (Mumtaz et al., 2019) and unless these challenges are addressed awareness alone cannot make a difference. Without governmental, departmental and institutional support to address the constraints, enhanced focus on the awareness would (instead) further frustrate the farmers and instigate them to launch movement or campaign resulting into crisis. Similarly, dissemination of relevant and authentic information related to climate change in local language while using appropriate media channel is crucial to influence the farmers to overcome the constraints, effectively and efficiently. The farmers had differing views of efficacy of awareness campaign with regards to medium, language and contents of information related to climate change and particularly with respect to constraints and this variance fluctuates from region to region (Hope, 2016). Cooper et al. (2018) also noted negative association between climate change awareness and adaptation issues (constraints). The regression analysis informs that climate change awareness contributes to the tune of 32% with $R^2 = .318$, B-value = -.870 and P-value = .000. It shows that climate change awareness at current format and procedure is not yielding positive impact particularly in scenarios where the constraints other than the awareness are more pronounced and dogged and merit institutional or governmental intervention for amicable and timely remedial measures.

Research implications for study

Numerous studies have been conducted in the past to explore relations between climate change awareness and adaptations, however, have been limited to either certain geographic zones or specific to particular agriculture environment. Likewise, studies focusing interaction between climate change awareness and adaptation issues are also just a few in the context of Pakistan. This research based on field study has been conducted in the perspective of Pakistan, in an area protracted over two provinces unraveling many facts peculiar to the study area while comparing the findings with those furnished in the previous similar researches. Insofar as future research, the researchers may conduct longitudinal researches, carry out comparative studies, incorporate other variables like climate mitigation measures, use of advanced technical tools as means of dissemination of information etc. and include other geographical and ecological zones.

Research implications for farmers

We need to provide location-specific and need-based information to farmers which will help in decision making at grassroots level. The need of the hour is to empower the farming community so that they evolve suitable mechanism for short term and long term adaptation strategies to take care of climate change related risks and uncertainties. We need to provide location-specific and need-based information to farmers which will help in decision making at grassroots level. The need of the hour is to empower the farming community so that they evolve suitable mechanism for short term and long term adaptation strategies to take care of climate change related risks and uncertainties. Farmers in general, still follow traditional measures to manage climate induced challenges. The organization of awareness campaigns, formulation of policies or institutionalization of mechanisms without visualizing the ground realities, scientific, academic and research support, can hardly create a meaningful impact. This study finds the need for provision of need-based and location-specific information to farmers, thereby, empowering them to take prudent and timely decisions with regard to adaptation measures. It will help them to institute suitable mechanisms for short term and long term adaptation strategies to mitigate the impact of climate change. Farmers must also educate themselves to use the advanced ICTs as means of dissemination of information and demonstrate dexterity and flexibility to adopt advanced and scientifically validated measures.

Suggestions for policy institutions and government

We need to provide location-specific and need-based information to farmers which will help in decision making at grassroots level. The need of the hour is to empower the farming community so that they evolve suitable mechanism for short term and long term adaptation strategies to take care of climate change related risks and uncertainties. We need to provide location-specific and need-based information to farmers which will help in decision making at grassroots level. The need of the hour is to empower the farming community so that they evolve suitable mechanism for short term and long term adaptation strategies to take care of climate change related risks and uncertainties. Climate change must be regarded as one of the principal media themes and be incorporated as a subject of regular deliberation and discussion in media. Farmers must be provided credible, relevant

(situation and location specific) and timely information through application of advanced ICT tools by the government institutions in collaboration with concerned departments and stakeholders. Moreover, awareness campaigns, workshops, seminars, talk shows, declaration of special days and incorporation of climate change in formal education curriculum are a few measures meriting government's attention. Interdepartmental coordination is imperative to expedite implementation mechanism, knowledge-based decision-making, promote climate research culture and establish climate policies with sound scientific backing.

Author's Contribution

Zakeer Ahmad Khan: Conception of work; data collection; data analysis and interpretation; drafting the article; critical revision of the article.

Allah Nawaz: Design of work; critical revision of the article; data analysis and interpretation; Final approval of the revision to be published.

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