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Climate Change and Agriculture: An overview of constraints in adaptive strategies in Punjab-Pakistan

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Abstract: Climate change is a living threat to the rural economy of the developing countries, without adaptive strategies and removal of constraints, this sector could not make sustainable growth. It is essential to remove structural and behavioral constraints at micro and macro level because 38.5% of labor force is employed in agriculture sector of Pakistan. The main objective of the current study is to examine the constraints in agricultural adaptive strategies to cope with climate change. Data of the research in hand were generated by the interview of 672 respondents, selected randomly from the research area. Descriptive and inferential statistical techniques were applied. According to the descriptive analysis, 64.7% of the respondents had lack of guidance, 61.7% had limited awareness and 60.4% of the respondents had low level of technology to cope with climatic changes. The result of factor analysis showed that three major factors predict constraint in the adaptation which are low level of technology used by the farmers, poverty/lack of resources and property related issues. It is suggested that the provision of information and dissemination of new technology should be made available through innovative ways according to the need of the farmers. The government should take steps in conjunction with the market forces to upgrade the level of awareness regarding climate change.

Key words; Climate change, constraints, adaptive strategies, rural economy

1- Introduction

Climate change has emerged as a global phenomenon and a potential challenge to economic development as well as sustainable rural livelihoods. The agricultural sector of Pakistan is vulnerable due to adverse implications of climate change which are well-acknowledged and well documented in many scientific researches (GoP, 2012: ADB, 2010: Kreft and Eckstein 2013).

The vulnerability in dry-land areas (where a significant shortage of water is existed due to short rainy seasons) is likely to be higher. A decline in overall agriculture production in East and South Asia (for example in Thailand, Bangladesh and Western India) and in most of the African region, while increments are also anticipated in some countries like Taiwan, Malaysia, Indonesia and some areas of China and India. In developing countries, the agricultural sector is unlikely to have adjustment with extra pressure of climatic variations in the absence of proper response strategy, low level of technology and credit issues (Crosson, 1997).

The problem of access to credit facility and information of climatic variations, supply issues of improved seeds, increasing cost of agricultural input(fertilizers, pesticides, mechanization), inefficient weather forecasting, social and economic issues regarding agriculture adaptive strategies are significant constraints in building climate-resilient rural communities (Nhemachena and Hassan, 2007).

Global warming had several effects on rural as well as urban communities and its correlation is highly significant with their exposure to climatic changes, their ability to perceive it as a potential challenge, their vulnerability and their ability to make a necessary adjustment with it (IPCC, 2007).

There should be a resilient agriculture system which can integrate the negative implication of climatic variations with proper adaptive strategies. If proper adaptive strategies cannot be adopted, then it will be difficult to make agriculture a profitable option and to maintain the standards of food security. Crop diversification will be a viable option to improve sustainability and resilience, which will allow farmers to increase resilience and maintaining pecuniary benefits in the scenario of climate change (Lin, 2011).

Crops are highly vulnerable to change in the weather patterns. The phenomenon of changing climate need to be undertaken seriously for development of agricultural related activities in Pakistan. According to a study conducted for exploring the effects of climatic variations in arid agriculture areas, there are adverse implications on production of crops due to increase in temperature. Adoption of proper adaptive strategies i.e. new method of farming, use of high yield varieties, new irrigation methods and change in cropping pattern will prove to be game-changer under the climatic changes. The role of rural sociologist and extension services is very important for the timely dissemination of information to the farmer at the grass-root level to cope with climate change. The agriculture research institutions should introduce new crops with heat resistant and drought tolerant varieties to reduce the potential damages to agriculture. New and innovative policies should be introduced to shift the traditional paradigm into smart farming. The role of Government is very important in the monitoring and evaluation of climate change and in the dissemination of information to farmers and their capacity building regarding the appropriate adaptive strategies (Shakoor*et al.*,2011).

The effective adaptation policy would be helpful in enhancement of the wheat production in Pakistan. There are different crop-specific strategies like change in plating dates, irrigation management, change in the variety of crop and use of inorganic fertilizers. Farmers can utilized the positive implications and significant benefits from the adaptation of appropriate strategies. Farmer's access to credit, source of

information, adaptive capacity and size of farm are important variables in the adaptation process of climate change (Siddiqua*et al.*,2019).

A research has been conducted to explore the adaptive farming practices and potential constraints to cater the implication of climate change in the province of Khyber Pakhtunkhwa-Pakistan. These meditative measures and principle versatile of the farmers consisted of change in the application and timing of manure, change in the planting dates, decision of high yield varieties (HYVs) and decision of seed change. Lack of resources, low awareness, the absence of advanced adjustment and intrigue are the important elements to address to cater the implication of climate change. Due to climate change, there are the issue of land degradation, surges circumstances and other associated problems. This research concludes that climate change has negative implications upon all spears of agricultural activities (Ahmad *et al.*,2017).

2- Methodology

This study analyzes the constraints in adaptive strategies in response to climate change in Punjab-Pakistan. A cross-sectional research approach (survey) was utilized to collect the primary data. The economy of Punjab is based on the agriculture sector and industry. It shares 68% of total food production in Pakistan.The data analysis primarily divided into two sections, the first one was univariate analysis in which frequency distributions, standard deviation and mean of variables were analysed. In the second section, factor analysis was utilized to precise the findings of research

Multistage sampling technique was used to select the respondents from the universe.At the first step of sampling, three districts were selected (Bahawalnagar, Chakwal, and Faisalabad) from 36 districts in Punjab, at the 2nd step two rural tehsils from each selected district, at the 3rd step six union councils (two from each tehsil) and at the last step two village from all these union councils were selected. Hence, 28 farmers has been taken as sample from everyvillage at the final stage which constitute the overall sample of 672 respondents.Randomness has been maintained at every step of the sampling process. The detail of the sampling procedure is presented in sampling layout.

2.1- Sampling Layout

3- Results and Discussion

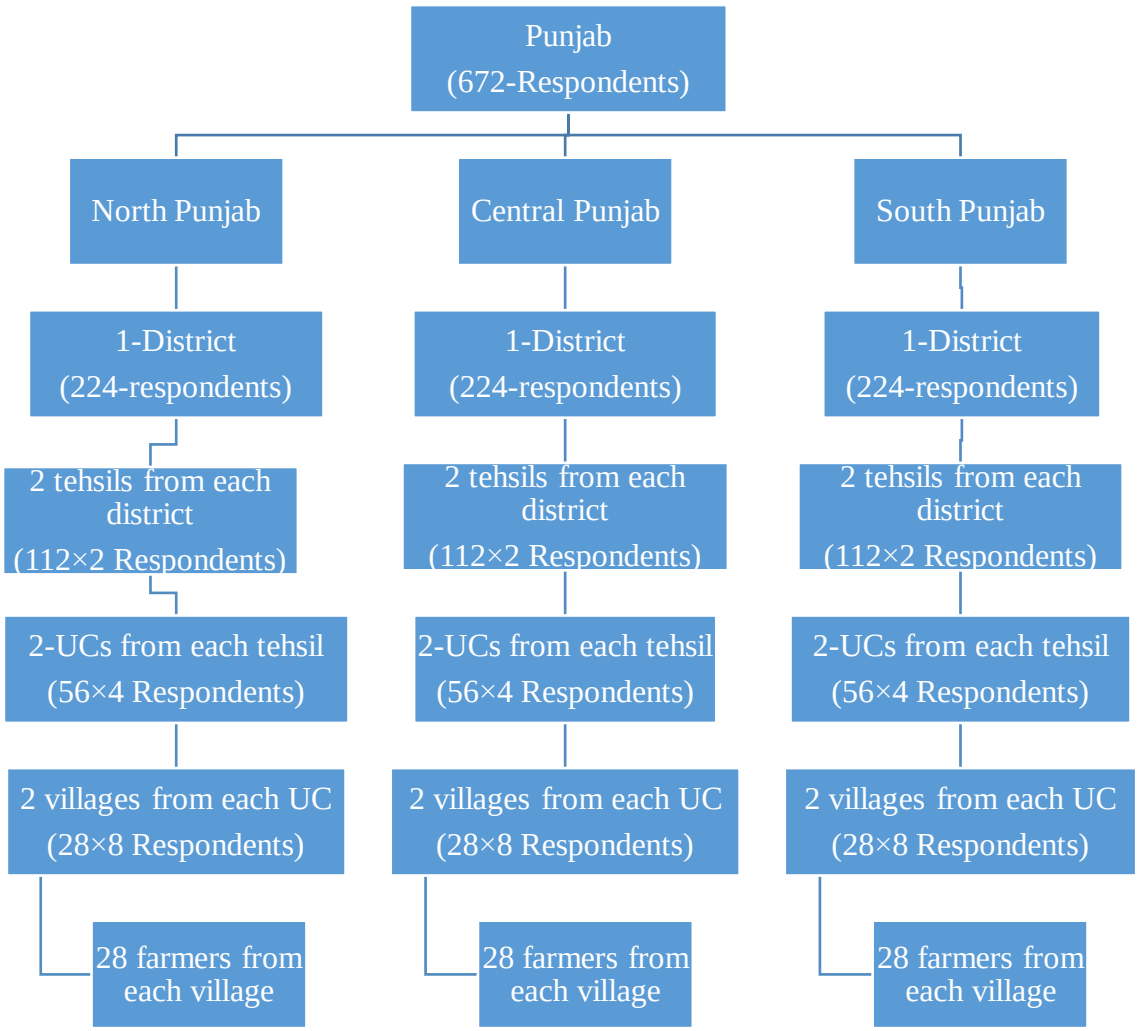

Table 1explains that 61.7% of the respondents agreed that limited awareness was a constraint in adapting climate change, 37.4% of the respondents were neutral and only 0.9% of the respondents were disagreed with assumption. Changing climatic conditions demand for extra vigilance and value information to be provided at the farm level. Archer (2005) endorsed the finding that poor agriculture performances and failure to implement adaptive strategies have been considered due to lack of resources and information by farmers.

About 60.6% of the respondents perceived the low level of technology/traditional farming as a constraint in response to climate change, 38.4% respondents were neutral and 1% of the respondents were disagreed. Farmers required new and advanced technology to adapt to changing climatic conditions.

About 53.3% of the respondents agreed that poverty/lack of resources was a constraint in response to climate change, 45.4% respondents were neutral and only 1.3% respondents were disagreed. Factually,

the adaptive measures are like an investment which needs extra resources to put in farm management techniques.

Around 47.3% of the respondents were considering the poor quality of soil as a constraint to cope with climate change, 50.0% respondents were neutral and remaining 2.7% respondents were disagreed. Climate is one of the factors that affect the soil composition which is important for its development, management and usage perspective concerning the structure of the soil, nutrient availability, erosion, stability, and capacity of water holding in topsoil. According to different estimates, projected changes in precipitation, temperature and evaporation may bring visible change in the turnover of organic matter and CO^2 dynamics. There are also socio-economic and political forces that stimulate the biophysical process of soil degradation. It is not possible to take more out of the soil than what is put in it without degrading its quality. It is necessary to integrate the local techniques of soil preservation along with modern ways.

About 44.3% of the respondents were considering lack of water as a constraint in response to climate change, 50.1% respondents were found neutral and 5.5% were disagreed. Kundi (2017) also reported that Pakistan is 36 most water-stressed country despite having the largest glaciers in the world. Moreover, it is anticipated by many national and international organizations that the country may run out of the water by 2025 if the government does not take immediate and practical steps.

It is need of the hour that general public, political leadership and civil society jointly coordinate and take up the "water cause" for improving availability of water for agricultural use, proper maintenance and up-gradation of existing water channels, expansion and innovation in the irrigation network of arid and semi-arid areas in order to maximum utilization of arable land, raising community awareness about water conservation, protection of water rights, depoliticizing water management system, improving trans boundary communication with neighboring countries, and involvement of research institutes into the water discourse.

Around 50.4% of the respondents agreed that land shortage was a constraint in adaptation, 37.9% of respondents were neutral and 11.7% were disagreed with the above-mentioned phenomenon.

About 45.2% of the respondents perceived that less interest of farmers as a constraint to climate change, 46.7% respondents were neutral and remaining 8% were disagreed. The interest of the farmers is a very important factor to deal with climate change implications. So, it is important to facilitate as well as stimulate the urge to adopt. Interest and motivation of the farmers can be enhanced through external motivational factors like subsidies, yield competitions, best adaptive farmer award, etc. There is a consensus among the researchers that younger farmers have a high interest in climate change adaptation, so this fact must be addressed through youth-focused policies. Because it is easy to make them understand how climate change may be adapted in a better way.

A proportion of 27.7% of the respondents agreed that ineffective weather forecasting as a constraint in adapting climate change, 47.3% of the respondents were neutral and 25% of the respondents were disagreed with the statement. The results are in line with the UNEP (2006) which stated that there is confusion among the farmers regarding traditional calendar of seasonal change and current patterns of climate change. There is a need to take a bottom-up or decentralized forecast system where weather information should be provided in the local language with local means of communication and its disbursement should be ensured and evaluated by the concerned authorities. It is very important for the farmers that their decision regarding the farm management, may be based on the weather forecasts and

these forecasts should also be reliable and correct. And, the weather forecast system will be effective only if it gives sufficient time to farmers for timely decisions.

Forty two percent of respondents were considering the property-related issue as a constraint to climate change, 32.1% of respondents were neutral and 25.9% respondents were disagreed. The finding agrees with the study of Benhin (2006) that land tenure status and farm size are major factors in the adoption of adaptive measures to cope with climate change. Land tenure, water rights, terms of tenancy and protection are important factors in the determination of productivity because all these factors make farmers able to invest in soil conservation techniques and batter farm management operations.

About 64.7% of the respondent's perceived lack of guidance as a constraint in adoption to climate change, 32.2% respondents were the neutral and remaining proportion of 3.1% respondents was disagreed with the statement. As earlier discussed in this research that the interventions of the extension workers in research areas were not commendable. So, it is necessary to strengthen the network of extension workers and rural sociologist to raise awareness and a smart interconnection between farmers and scientist.

Table 1: Distribution of respondents regarding as a constraint in adapting climate change

Constraints in Adaptation	Agree		Neutral		Disagree	
	f	%	*f*	%	*f*	%
limited awareness/information as a constraint	415	61.7	251	37.4	6	0.9
Low level of technology as a constraint	407	60.4	258	38.4	7	1.0
Poverty/lack of resources as a constraint	358	53.3	305	45.4	9	1.3
Poor quality of the soil as a constraint	318	47.3	336	50.0	18	2.7
Lack of water as a constraint	298	44.3	337	50.1	37	5.5
Shortage of land as a constraint	339	50.4	255	37.9	78	11.7
The interest of the farmers as a constraint	304	45.2	314	46.7	54	8.0
Ineffective weather forecasting as a constraint	186	27.7	318	47.3	168	25.0
Property related issue as a constraint	282	42.0	216	32.1	174	25.9
lack of guidance as a constraint	435	64.7	216	32.2	21	3.1

The results as presented in Table2 shows that three components were extracted from the variables with Eigen values of <=1. These variables are the low level of technology and lack of resources to harness the implications of climate change and property related issues with variance of 18.569%, 14.246% and 14.088% respectively. These variables extracted alone explain 46.903% of the variance of the constraints faced by the farmers in the study area.

Table 2: Total Variance Explained as generated by SPSS package

Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.900	18.998	18.998	1.857	18.569	18.569
2	1.489	14.888	33.886	1.425	14.246	32.815
3	1.302	13.017	46.903	1.409	14.088	46.903
4	.971	9.705	56.609			
5	.930	9.304	65.913			
6	.861	8.613	74.526			
7	.756	7.562	82.088			
8	.660	6.596	88.684			
9	.618	6.181	94.865			
10	.513	5.135	100.000			

Low level of technology

Table 3 depicts that low level of technology or non-utilization of modern techniques is also important factor in determining the potential constraints of adaptation by 62.9 percent loading. Ishaya and Abaje (2008) also reported the same findings that supply of hybrid or improved seeds, lack of investment and credit issues, low awareness and lack of modern knowledge on adaptive measures were among the constraining factors in the process of adaptation.

Poverty/lack of resources

Factor analysis further revealed that poverty or lack of resources among the farming community has also potential to influence the ability of the adaptation. Table3 shows that the component has a loading of 70.9 percent, which is the highest of all other explaining variables. Bhushal (2009) also suggested in his research that the government should ensure the access of farmers to provision of credit at soft conditions which will help them to purchase agricultural inputs (fertilizers, chemicals, HYVs and irrigation facilities).

Property related issue

Table 3 shows the component matrix with the variable "property related issues" carrying the highest percentage loading of 76.6. Bryan et al. (2009) also reported that small farm size and shortage of labor, ineffective irrigation system, lack of credit or fiscal issues, and insufficient information regarding adaptive measure were major constraints in climate change adaptation. In Pakistan, due to large family size and inherited land laws, the size of land holding is decreasing day by day and there are countless property related issue which hinder the adoption to climate change.

Table 3: Component Matrix

Component (Constraints)	Component		
	1	2	3
limited awareness/information	-.049	.189	.691
Low level of technology	-.031	.033	.709
Poverty/lack of resources	-.224	.629	.124
Poor quality of the soil	.411	-.223	.448
Lack of water	.189	.602	.171
Shortage of land	.186	.595	-.321
The interest of the farmers	.326	-.405	-.068
Ineffective weather forecasting	.604	.158	-.150
Property related issue	.766	.067	.219
lack of guidance	.712	-.178	-.070

Conclusion

The climate change sensitization is pertinent in conjunction with all the remediation measures to avert the potential risks associated it. Climate change has the potential to affect the rural economy, agriculture adaptive strategies and patterns of livelihood in the developing countries. Pakistan has been ranked as one of the most affected countries by the implications of changing climate and its topography is also vulnerable as huge population resides in climate-sensitive areas. Thus, a survey was carried out to explore the constraints faced by the farmers to cope with climate change. There were many structural as well as behavioral constraints constrains faced by the respondents. Descriptive analysis showed that lack of guidance, limited awareness, low level of technology, lack of resources and land related issues were the major constraints. Moreover, the findings of factor analysis also revealed three major constraints in the adaptation of clime change. These are low level of technology, poverty/lack of resources and property related issues due to which farmers are unable to put enough input to cater the adverse effects of climate change. The government should consider these issues in policy-making, so that effective mitigation in response to climate change could be developed.

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