

FARMERS' PERCEPTION OF CLIMATE CHANGE AND ADAPTATION IN KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract: : Climate change has a devastating effect on yields of major crops and is considered to become a threat to national food security. Therefore, this study was designed to explore farmers' perception of climate change and investigate changes in seasonal temperature and rainfall over the last two decades. Focus Group Discussion (FGD) was employed to analyze the perceptions of farmers about climate change vulnerabilities and their adaptation strategies to cope with the changing climatic conditions. The results revealed that regarding environmental services, water availability was decreased due to low rainfall. In addition, the supply of firewood was also decreased due to ahigh demand on fuel and construction purposes. Furthermore, there was an increase in population density and a decrease in medicinal plants and wildlife due to deforestation. The temperature increased over the last 20 years and the length of the summer period was longer due to less rainfall while the duration of winter turned to be short. It is reported that the spring season is almost merged in the summer season, with the increase of temperature during the spring. Therefore, agriculture research should develop a variety of crops that can adapt to climatic extremes and educate farmers through seminars and campaigns to build their adaptive capacity dealing with the use of cultural practices to mitigate climate change.

Keywords: food security, FGD, extremes climate, climate change mitigation, climate adaptation

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1. Introduction

Similar to other developing countries, Pakistan is a mainly agricultural country with a substantial capacity of crops, livestock, and other agricultural production. Blessed with great natural resources, this country has appropriate climate setting, deep soil conditionality, and suitable topographic conditions along with water resources. If appropriately utilized, it can improve its potential in achieving the sustainability in agriculture (Khan, 2006). Climate change is the most devastating challenge that has a negative impact on the human's health, livelihood, and food security (Mitchell and Van-Aalst, 2008; Romieu *et al.*, 2010). Having been mostly exposed to the vulnerabilities of the climate change, agriculture is considered to be the most affected sector. Climate change negatively affects the production of major crops, vegetables, fruits, livestock, and poultry. The risks of the climate change are increasing with every passing day, and the most prominent change is the rise in temperature which results in droughts (Shukla *et al.*, 2002).

Farmers are using various strategies to overcome the effects of the severe climate conditions. These methods are based on the research and also have consequences on the other aspects of the plant production. The other disadvantage of these local strategies is that it is not sustainable, which means that its effect is only in the particular stage of the plant (Ryan and Spencer, 2001). Since a

large majority of the farmers in Pakistan are illiterate, this laid excessive pressure on the extension personnel regarding the adoption of improved farming practices. Being unable to take information from other sources like Radio and Television, farmers only rely on the extension services. Hence they could be motivated to adopt the sustainable practices to solve their problems that will ultimately facilitate them in achieving higher yields (Belliveau *et al.* 2006).

Several studies about climate change (Gumbo 2006; Mertz *et al.*, 2009) highlighted that there is a report from the farmers that sheds light on the short term approach about climate change like the increase in rain, the onset of earlier summer or winter, high-speed rain compared to long-term changes observed in climatic conditions. The majority of farmers have pointed out the short-term climate change issues like intense temperature and low rainfall. All of these studies conclude that climate change is the unfelt need of the farming community that must be addressed in order to minimize its consequences. Agriculture extension organizations are responsible to create awareness among the farming community to encounter the threats of the climate change and also to train the farmers about the mitigation of climate change. The extension field staffs need to build the capabilities of the farming community in order to adopt the latest innovation to minimize the risks of climate change and also to get maximum

yields (Banerjee *et al.*, 2013). Therefore, this study was designed to investigate the perception of the farmers about the climate change issues and evaluate their adaptation options with the following objectives : 1) To study farmers perception about climate changes and its effect on crops and vegetables yield in district Nowshera, 2) To investigate changes in seasonal temperature and rainfall over the last two decades, 3) To assess water availability for drinking and irrigation over time, and 4) To analyze farmer adaptation and mitigation strategies in response to changes in temperature and rainfall events.

2. Material and Method

A survey was conducted from January to February 2018 in District Nowshera using Focus Group Discussion (FGDs) to record the perceptions of farmers about climate change vulnerabilities and their adaptation strategies. District Nowshera is bordered with Mardan in the north, Charsadda in the northwest, Swabi to the east and Attock to the southeast. The average annual rainfall is 635 mm with the maximum rainfall in late winter and late summer. District Nowshera comprises of warm and sub-humid climate with a mean temperature of about 30°C. The major crops of the district include wheat, maize, sugarcane, and barley. They are grown along with the intensive cultivation of seasonal vegetables and fruits like apricot, plum, pear, peach, and orange.

A pre-designed questionnaire was used to collect primary data from the farmers. It contains the information regarding crops, forest, and livestock in the study area; the perception of the community about changes in temperature, perception, drought; and the length of the season during the last 20 years. The information of community observation was collected. It tells about the changes in animal, forest, and livestock species and its relationship with climate changes, compared to current and past seasonal crops, and adaptation to climatic changes. In order to assess the respondents' perceptions about parameters being measured, the questionnaire contained the questions about the increase or decrease in temperature, rainfall, duration of season, crops livestock and water availability. Six Focus Group Discussions were conducted in district Nowshera to ensure the participation of a maximum number of farmers. The respondents were encouraged to participate in discussion and overall perception of the respondents regarding specific parameters were recorded and presented. Being considered to be agriculturally rich, six villages including Shaidu, KhitabKally, Ali Bag, Pushtoon Ghari, Kheshgi Bala and Muhib Banda were selected purposively. The farmers were contacted and gathered with the help of the local extension officer. Having at least 20 years of farming experience, a group of 25 farmers became the participants and constituted one FGD to share their

perception about the mentioned parameters in the latest two decades.

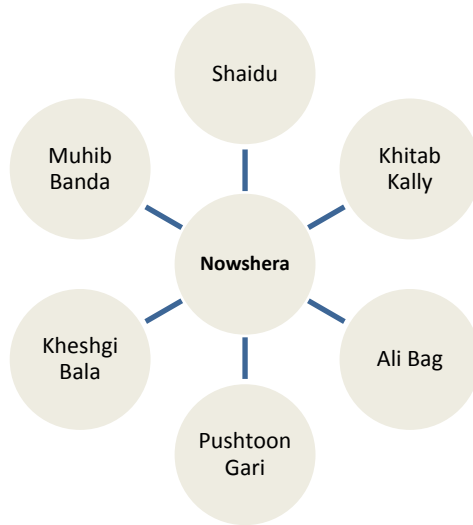


Figure 1. Selected villages for focus group discussion

3. Result and Discussion

3.1 Forest and livestock

The forest and livestock species in district Nowshera reported by the local community during the group discussion is presented as table follows.

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Table1. Perception of farmers about forest and livestock species

Wildlife Species	Livestock	Forest Species	Medicinal Plants	Fruits
Pigs	Cow	<i>Prosopis juliflora</i>	<i>Malvaneglecta</i>	Pear
Jackal	Buffalo	<i>Eucalyptus camaldulensis</i>	<i>Rumexsp</i>	Plum
Pigeon	Goats	<i>Morus alba</i>	<i>Plantagosp</i>	Peach
Porcupines	Sheeps	<i>Acacia nilotica</i>	<i>Caralumasp</i>	Apricot
		<i>Capparisaffila</i>	<i>Calotropis procera</i>	Oranges

3.2 Environmental services

Table 2.Perception of farmers about environmental services

Environmental services	Reason for increasing/decreasing
Firewood	A high demand on fuel, domestic uses, construction purposes and increased population.
Medicinal plants (<i>Malvaneglecta</i> , <i>Rumexsp</i> , <i>Plantagosp</i> , <i>Caralumasp</i> , <i>Calotropis procera</i>)	These plants are found in very little number because people have stopped their use.
Wildlife (jackal, fox, monkey, rabbits, pigeon, porcupines, honey bees, sparrow, pigs)	Deforestation, bad climatic conditions, the use of weapons and an increase in population density.
Tourism	Not attractive sites and mountains for tourists
Minerals	Only coal reservoir available in Shaidu and none other were reported during the survey.

3.3 Perception of community about change in temperature

During the survey, the respondents reported that the temperature in summer, winter, spring, and fall has increased over the last 20 years due to less rainfall. The length of the summer season is prolonged and the duration of winter season turned to be short. The respondents also reported that the spring season is almost merged in the summer season.

3.4 Perception of community about change in annual precipitation

Majority of the respondents reported that Monsoon cycle is delayed from 3 to 5 weeks and the quantity of Monsoon rain has highly decreased. Moreover, the majority of the respondents argued that winter rain delayed for 4 to 6 weeks and its quantity and frequency has highly decreased.

3.5 Perception of the community drought-past and present

During the survey, respondents were investigated regarding the duration of dry spells in all of the four seasons. The respondents reported an overall increase in the dry spells in all the four seasons. It was reported that the maximum of the drought was in the summer season. All of the respondents argued that at present severe dry periods in summer are found in the months of July to October.

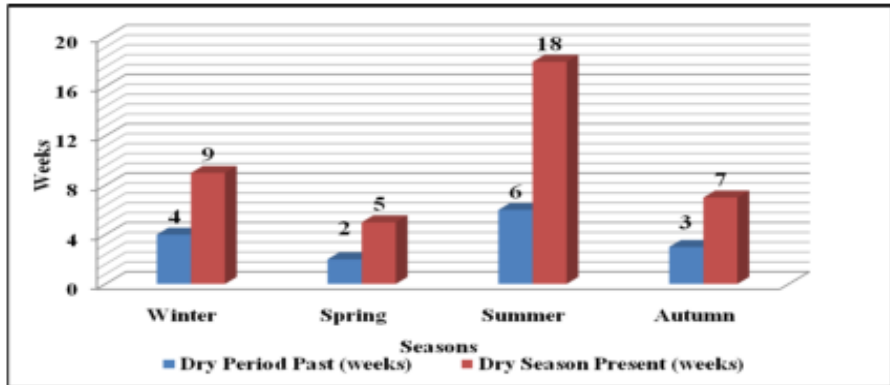


Figure 2. Perception of community about drought-past and present

3.6 Perception of the Community about Length of Seasons-past and present

Figure 3 showed the perception of the respondents regarding the length of the seasons.

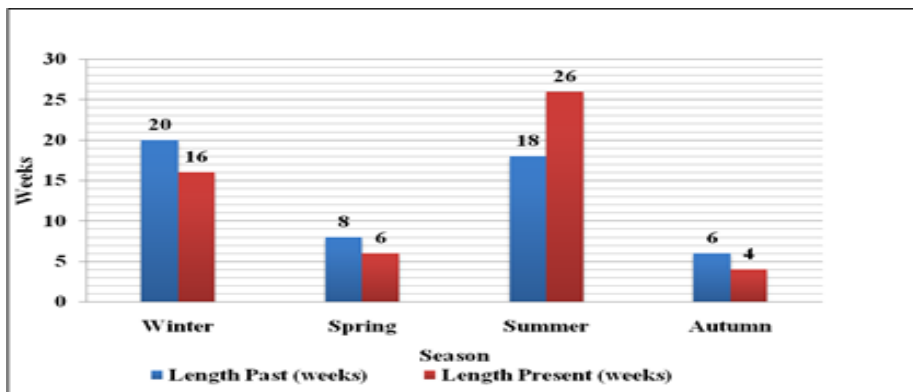


Figure 3. Perception of the community about length of seasons

The Respondents reported prolonged summer by 6 to 8 weeks due to the early setting of summer and delayed autumn. They also reported a decrease in the winter season by 3 to 4 weeks due to the merging of autumn into the winter season. The duration of spring was reported to have shortened by about two weeks due to the starting of early summer. This change of seasons, either be prolonged or shortened, has created known and unknown problems for the farmers in the region. The change in the duration of the seasons has disrupted the sowing time and harvesting time of the crops. These are the known factors that have been reported by the farmers. Meanwhile, the factors of the change in the duration of the seasons including effects on wildlife, animals, wild plants, birds, crop growth and development, animal breeding and migration etc. are still unknown.

3.7 Animal keeping and its productivity

Table 3. Perception of farmers about percent change in animal productivity

Animal productivity Increase(%)	Reason for increase/decrease
Milk production (10% Increase)	Introduction of improved (new) cow breeds, availability of fodders and better nutritional food for livestock such as artificial wanda, kal, vaccination and veterinary services (all private). However, with the increase in temperature during summer, milk production decreases. In addition, the increase in temperature causes many diseases in the livestock, such as foot and mouth diseases.
Buffalo and cow number (10-20% Decrease)	Most people have less or no place for keeping them due to the increase of population density. Heat-stress results in a significant financial burden to livestock producers through a decrease in milk component and milk production, meat production, reproductive efficiency, and animal health.
Goats and sheep (40-50% Decrease)	Unavailability of grazing land and availability of better cow breeds. Farmers are not interested in labor-intensive sheep, goat, and buffalo rearing.
Donkey and horses (90% Decrease)	The availability of faster transport facilities.

3.8 Changes in crops yield

Table 4. Perception of farmers about percent change in crops yield

Name of Crops	Increase/Decrease	Reasons for Increase/Decrease
Wheat	20-25% Increase	Availability of high yielding varieties
Maize	5-10% Decrease	Pigs attack
Sugarcane	40-50% Decrease	Attack of diseases and unawareness on improved varieties
Barley	No Prominent Change in Yield	
Sorghum	No Prominent Change in Yield	
Tomato	20-30% Increase	Availability of improved seeds and pesticides
Onion		
Garlic		
Lady Finger		
Cucumber		

3.9 Comparing current and past seasonal crops (20 years)

Table 5. Perception of farmers about crops

Crops	Seasons	20 years ago	Current
Cereals	Winter	Wheat, Sugarcane Sugar beet, Barley	Wheat, Sugarcane Barley
	Summer	Maize, Sugarcane Millets, Sorghum	Maize, Sugarcane Millet, Sorghum
Vegetables	Winter	Spinach, Garlic Coriander, Potato	Spinach, Tanda Bitter gourd, Pumpkin, Garlic, Potato
	Summer	Lady Finger, Tomato, Spinach Cauliflower	Lady Finger, Spinach Brinjal, Cucumber Chillies, Tomato

3.10 Reasons for the change in cropping patterns

The majority of the farmers do not cultivate sugarcane crop because it requires a huge amount of water, low production, low price of the product in the market, and the unawareness of the high yield varieties. Farmers also left the cultivation of sugar beet due to more labor intensive and also marketing problems. Vegetables were introduced at a larger scale in the cropping system due to improved varieties, short growing duration, and higher market returns.

3.11 Adaptation to climate changes

Introduction of new varieties. Drought resistant and early maturing varieties of wheat and maize were preferred. Wheat varieties like Faisalabad-2008 and Pirsabak 2013 are in use there. Pre-soaking of seeds in case of drought were carried out in order to facilitate early seed germination.

Change in sowing timings. No changes in the sowing timing were reported by the farmers.

Changes in weeding practices. Weedicides are used for the eradication of weeds as a substitute for mechanical control and the use of insecticides spray on fruit and vegetables for their better production.

Changes in irrigation practices. Majority of the farmers did not introduce any changes in the irrigation practices whereas only maize growers reported that they cultivate maize on ridges that requires less irrigation water.

Changes in application of fertilizers. No significant changes were observed in the application of fertilizers in the entire district Nowshera. They were familiar with the importance of fertilizers and apply major nutrients (N & P) fertilizers in split dosage and recommended amounts. Nitrophs fertilizer is not applied due to the unawareness of farmers.

3.12 Changes in Land Holding

From the last 20 years, a significant decrease has been observed in landholding due to land fragmentation, houses building, and roads.

3.13 Water Availability

Table 6. Perception of farmers about irrigation and drinking water availability

Season	Irrigation water availability (Increased/Decreased)	Drinking Water (Increased/Decreased)
Summer	20-35% decrease	10-20% decrease
Winter	10-20% decrease	5-10% decrease

3.14 Reasons for the Decrease in Irrigation and Drinking Water Availability

Irrigation water has decreased due to less number of rainfalls in both winter and summer season. It has also negatively affected the availability of drinking water in District Nowshera. Water resources have been badly contaminated as a result of the flood in 2010. The tube well water on account of its deep depth has been saved from the flood whereas the rest of the resources such as hand pumps, dug well, and bore well have been badly polluted due to flood water. The color, odor, and the taste of the dug well, hand pump, and borewell water is somewhat objectionable whereas the tube well water is colorless, tasteless, and odorless. Non-governmental Organization has installed filtration plants for the drinking water but the respondents argued that it cannot fulfill the requirements of the whole village people. The irrigation water of majority canals has been deteriorated with the domestic sewage and industrial effluents.

4. Conclusion

On the basis of the results obtained during the survey, the following conclusions. Wheat and Maize are the major crops grown on a large scale in District Nowshera. Maize productivity is highly affected by the attack of pests. Sugarcane cultivation is negatively affected over the time because of the diseases.

Temperature over the last 20 years has significantly increased during the entire year. Vegetable cultivation is increased over the time due to the availability of improved seeds and other agricultural inputs. Monsoon and winter rains are delayed by 3 to 5 weeks and 4 to 6 weeks respectively with a significant decrease in frequency. Drought resistant and early maturity wheat varieties like Faisalabad-2008 and Pirsabak 2013 were used in the study area. Pre-soaking of seeds in case of drought was carried out in order to facilitate early seed germination. Maize crop was cultivated on ridges that requires less irrigation water.

5. Recommendations

Agriculture Research department should develop varieties of the crops for the local area that can tolerate climatic extremes, heat stress, and drought conditions. An effort should be made to educate the farmers through seminars, workshops, and campaigns about the harmful effect of climate change on crops yield and also to build the adaptive capacity of the farmers regarding the use of cultural practices to mitigate climate change. Adaptation to climate change should be incorporated into the planning process for the long term sustainable development. There should be a strong monitoring and surveillance system that can provide information about the losses due to climate change. Tunnel farming should be encouraged in the area and the extension department should

initiate steps towards the provision of training and incentives for farmers regarding this technology.

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