Farmer's Perception and Adaptation Strategies to Mitigate Impacts of Climate Change in District Chitral, Pakistan

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Abstract

The study in the district of Chitral, farmers' perceptions of and adaptation measures to reduce its effects on climate change, the last week of July 2021. It was based to know farmer's perception, adaptation and mitigate the effects of climate change. Questionnaires and Focus group discussion were the methods used for data collection. The steep topography of Chitral restricts the amount of land that can be cultivated, while freezing temperatures in roughly half of the country preclude the production of more than one crop per year. The single-cropping zone encompasses almost half of this area. The rest is in the zone of double-cropping. Perception of farmer's to climate change, adaptation, major constraints to adaptation and their decision-making with regard to climate in Chitral, a total 6 villages were selected, 3 from each cropping zone were studied in which the most severely affected was double cropping zone in context of sowing and harvesting periods. Climate change has positive effects on crops cultivation in Chitral, the cultivation of Wheat (Triticum Aestivum L.) is now possible in village Khot and Rabat where it was not possible 40 years ago and due to severe cold constantly crops failure occurred. The maize (Zea mays L.), Rice (Oryze sativa) and Barley (Hordeum vulgare, L) crops sowing days changes is also quite clear that in both the cropping zones where it become early from that of the past.

Keywords: climate change, Chitral River, sowing, crop failure, crop diseases, temperature

Introduction

Farmers of the Chitral are totally depended upon the weather and climate conditions of the area, so they developed a strong indigenous knowledge about the prediction of weather (Ansari, 2009). Climate change consequences can be greatly minimized by implementing effective adaption methods based on improved weather and climate forecasting accuracy (Fahad et al., 2018). Most rural communities will be able to make

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educated, timely, and indigenous climate forecasting decisions as a result of this (Ali, 1995). Indigenous understanding of environmental hazards allows communities at risk to use this knowledge to defend themselves from natural catastrophes in many situations. Indigenous groups in various parts of Africa and other parts of the world still have this knowledge (Aslam et al., 2013).

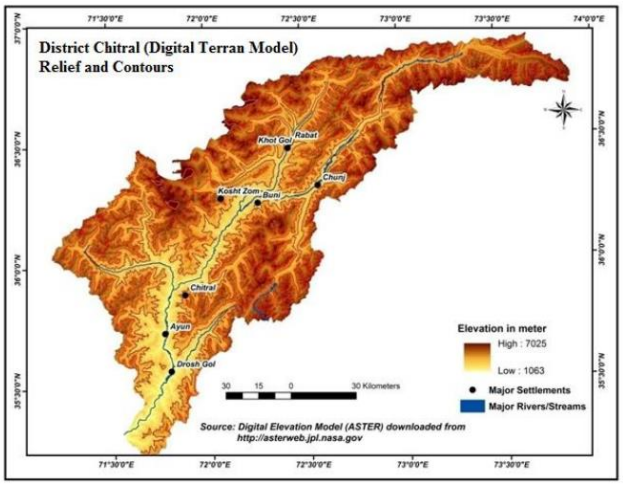
In most developing nations throughout the world, lack of understanding about climate change and its effects on agriculture productivity has slowed long-term agricultural growth (Kemausuar et al., 2011). The Intergovernmental Panel on Climate Change (IPCC) not only supports global climate change, but also outlines its possible agricultural consequences (Murray et al., 2012). At the regional level, noticeable changes in the hydrological cycle have been seen as a result of rising temperatures. Precipitation patterns, water availability, shifting cropping patterns, drought periods, the intensity of heat waves, the frequency of precipitation events, and weather-induced natural catastrophes are all examples of these (Rasul et al., 2012).

The potential of cultivable land, particularly at the old Pleistocene gravel fans in the valley of, is dependent on the availability of irrigation water by channels that originate not from the main rivers but from other side valleys, as it is in other mountainous areas of Pakistan and many sites in the Afghan Hindu Kush. In the Rabi dry region farming area in southern Chitral, the inter-annual fluctuation of precipitation and the potential of a trend of change are of equal importance. As a result, it is important to keep an eye on changing patterns in the dry agricultural region and the potential for long-term usage (Haserodt, 1995).

The river Chitral takes its origin from Chaintar Glacier. This river from its origin till its enters Afghanistan, has various name, while passing from Yarkhun valley, it is called Yarkhun river. At Mastuj, River of Mastuj collects water from Torikhow river and numerous hill torrents and stream and drained area between Torikhow and Mulikhow, during their flow it joined Lotkuh river and onward it become Chitral river. On the way, the Chitral river joined by many streams as Ayun Gol, Shishi Gol, Ginjirat gol, Ashrat Gol etc. (Pastakia, 2004). The main valley, from its source to the border of Afghanistan is about 352 Kilometers long. The average width is not more 1.2 Kilometer, e.g. at Buni, Chitral Town, Drosh

and Baroghil, while at other places Darband, Koragh, Kar Bitari, and many more localities have a defile of fewer than 200 yards. The valleys on the sides are considerably smaller (Khan et al., 2013).

The fan deposits that occur at the mouths of hill torrents or streams make up the open regions. The formation of this alluvial fan may be traced back to the Chitral climate's fluctuations in warmth and humidity, which cause boulders and stones to explode (Khan et al., 2013). Avalanches flowing downhill slopes in the spring and winter, as well as hill torrents and melt-water streams, have all contributed to the creation of alluvial fans. These alluvial fans are home to the majority of the settlements and agricultural regions. Chitral River valley and numerous other valleys, like the mountains, can be divided into three classes, according to their size and form;



1. The main river valley, more than 60 Kilometers long.
2. The tributary valleys, 16-24 Kilometers long.
3. The side short valleys, 5-16 Kilometers long.

Material and Methods

The goal of this research is to see how well farmers can identify climate change and how they have responded to whatever changes they feel have happened. Farmers can foresee and forecast shifting weather and climate using their indigenous knowledge of the area's environment. Knowing such historic knowledge allows you to better understand how farmers are responding to changing weather patterns. Climate change has

a significant impact on agriculture. How farmers see climate change and adapt to changing weather conditions in order to reduce its effects.

An extensive questionnaire was created to quantify the trends described in the focus group discussions. The questionnaire asked questions about all of the above-mentioned variables. Respondents were chosen at random, although elderly and those who own property and work in agriculture were given preference. A total of 300 farmers were questioned, with 50 farmers from each of the six communities chosen. The data were analyzed in MS Excel and the map was created on Arc GIS software.

Result and Discussion

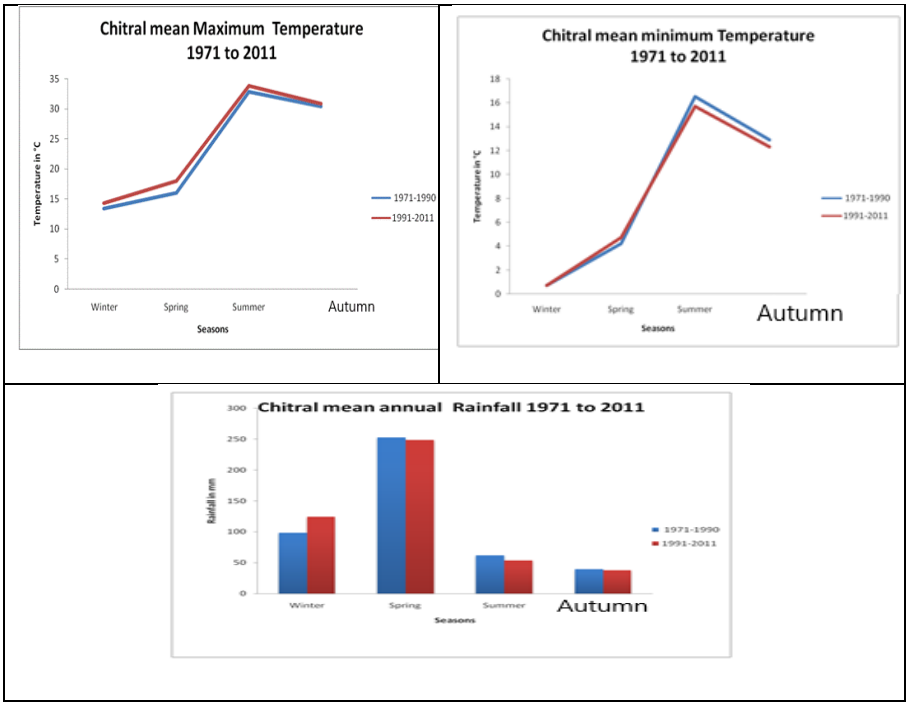


Figure 1.1

The climate of Chitral in distinctly continental from above figure 1.1 shows the results that in all seasons the annual mean maximum temperature in Chitral are increase and annual mean minimum temperature

are decrease in last forty years (1971 to 2011). The temperature data shows that days get hotter while nights get cooler. Average increase in mean annually, temperature in Chitral is 1.2 °C per two decades. The pattern of increasing annual mean maximum temperature (hotter day) and decreasing mean minimum temperature (cooler night) has been observed for all seasons except that of Spring season both the annual mean maximum and minimum temperature are increase. The temperature increase is more in spring and winter seasons as compared to the other seasons. In winter season annual mean minimum (cooler nights) temperature is increase at the 0.9 °C per two decades while annual mean maximum (hotter days) temperature is increase 2 °C per two decades. Spring annual mean temperature increase with the rate of 1.4 °C per two decades, it indicating that spring is getting warm. In summer mean annual temperature increase

Table 1.1

Average Change in Sowing Days of Wheat

Cropping zone	Double Cropping Zone				Single Cropping Zone			
Name of Village	Ayun	Barenis	Shamisad	Kosht	Khot	Rabat		
Types	Fakhr-i-Sarhad	Fakhr-i-Sarhad	Fakhr-i-sarhad	Fakhr-i-sarhad	Local	Fakhr-i-sarhad	Local	Fakhr-i-sarhad
Average days	14.6	10.82	10.34	8.98	2.64	8-April	2.44	5-Apr

is low compared to other seasons of the year. In Chitral mean annual rainfall is increase (figure 1.1). The following figure showing that winter rainfall is increase and in other season rainfall is decrease. Chitral also receives snowfall in winter season which is also increased.

Impact of climate change on sowing of wheat *(Tiriticum aestivum L.):*

The climate change have a postive impact on wheat cultvation in Chitral and now wheat cultvation is also posibal even in village Khot where crops failers was ferquant 40 years ago. Now a days in Chitral 60% rainfall occurred in wheat growing season October to April and the arrivail time of rainfall come early.

Impact of climate change on sowing of Maize (*Zea mays L.)*

In Chitral in major area of maize crop cultivation is double cropping zone, in this zone on average the farmers cultivate maize 8.97 sowing days earlier than the past, in village Ayun the farmers are 12.2 days earlier, in Barenis 7.3 days and in Shamisabad 7.3 days but in single cropping zone of studied area only one village Kosht the farmers cultivate maize and have been changed by 13.5 days.

Table 1.2

Average Change in Maize Sowing Days

Cropping zone	Double Cropping Zone			Single Cropping Zone		
Name of Village	Ayun	Barenis	Shamisabad	Kosht	Khot	Rabat
Average days	12.24	7.34	7.34	13.56		

Impact of climate change on sowing of Rice (*Oryze sativa*)

In Chitral the rice is cultivating in double cropping zone only, here the sowing day are become earlier on average by 8.9 days as compared to 40 years ago

Table 1.3

Average Change in Rice Planting Days

Cropping zone	Double Cropping Zone			Single Cropping Zone		
Name of Village	Ayun	Barenis	Shamisabad	Kosht	Khot	Rabat

Average days	10.04	7.82

Impact of climate change on sowing of Barley (*Hordeum vulgare, L*)

In Chitral the sowing dates is erlier more in Barenis 15.26 days and least advanced in village Khot 5.54 days.

Table 1.4

Average Change in Barely Sowing Days

Cropping zone	Double Cropping Zone			Single Cropping Zone		
Name of Village	Ayun	Barenis	Shamisabad	Kosht	Khot	Rabat
Average days	9.75	15.26	13.84	11.83	5.54	5.56

Emergence of diseases in Wheat Crop (*Tiriticum aestivum L.*) with climate change

In Chitral the wheat crop diseases are increasing. The most common disease recorded from almost all the villages of the study area is *Powdery Mildew*. According to flied survey 46% respondent in Ayun pointed the incidents of *Powdery Mildew*. The favorable condition for *Powdery Mildew* disease is cool temperature 18 °C to 25 °C and when dry condition prevailed for long time. The 2nd most common disease of wheat recorded in study area is *Jumps Red Sea* locally known *Alipha*.

Table 1.5
Wheat Crop Diseases

Croppin g Zone	Double Cropping Zone			Single Cropping Zone		
Village	Ayun	Barenis	Shamisabad	Kosht	Khot	Rabat

Diseases	YL	JRS	PM	YL	JRS	PM	YL	JRS	PM	YR	YL	JRS	PM	YL	JRS	PM	YL	JRS	PM
Percent of Respondent	16	38	46	18	38	44	32	24	16	28	20	44	36	52	26	22	34	16	50

YL: Yallow Leaves JRS: Jumps Red Sea PM: Powdery Mildew YR:Yellow or Stripe Rus

Emergence of diseases in Maize crop (*Zea mays L.*) with climate change:

From below table it is clear that highest number of respondents reported the occurrence *smut* disease in Barenis as compared to the rest of the study area. In single cropping zone maize is grown in Koshat village. In Koshat 30% respondents reported incidents of *Smut* disease. Beside *Smut* other diseases of maize found in the study area *Maize Stalk Rot*, *Helminthosporium leaf Spots* and *Stem Bore* but the incident of occurrence is relatively low as compared to *Smut* disease.

Table 1.6
Maize Crop Diseases

CZ	Double Cropping Zone												Single Cropping Zone					
Village	Ayun				Barenis				Shamisabad				Kosht				Khot	Rabat
Diseases	M	S	H	Sb	M	S	H	Sb	M	S	Sb	M	S	H	Sb			
Percent of Respondent	12	66	12	10	4	86	4	6	16	34	50	16	50	30	20			

M: Maize Stalk Rot **S**: Smut **H**: Helminthosporium leaf Spots **Sb**: Stem Borer

Emergence of diseases in Barely crop (*Hordeum vulgare, L*) with climate change:

In Chitral valley disease in Barley crop are increases with time, some of the disease that are respondents reported is *Leaf rust* 32% in village Ayun, *Leaf rust* and *Aphids* diseases are 28% and 40% are respondents reported in village Barenis. *Leaf Rust* appeared in barely crop at temperature 23°C with humidity of 30% in air. *Aphids* 34% in Khost, 36% in village Khot and in village Rabat it is 40%. The *Aphids* disease favored condition is sunny day with temperature 18 °C to 25 °C.

Table 1.7
Barely Crop Diseases

CZ	Double Cropping Zone												Single Cropping Zone											
Village	Ayun				Barenis				Shamisabad				Kosht				Khot				Rabat			
Diseases	A	R	La	Ri	A	R	La	Ri	A	R	La	Ri	A	R	La	Ri	A	R	La	Ri	A	R	La	Ri
Percent of Respondent	20	18	32	30	28	14	40	18	26	44	10	20	34	22	12	12	36	20	26	18	40	18	10	32

A: Aphids **R**: Root rot **La**: Leaf rust **Ri**: Rhizoctonia rot

Emergence of Diseases in Rice Crop (*Oryze sativa*) with Climate Change

Rice is cultivated over a small area in Chitral, where few diseases are found in rice crops. In village Ayun and Barenis the respondent reported that the *Stem Rot* disease is more common 50%, *Bacterial Blight* disease is higher in village Ayun 26% and low in village Barenis where it is 8% but the case is 180-degree opposite in *Brown Leaf Spot* disease which is 8% in Ayun and 26% in village Barenis. *Brown Leaf Spot* and *Bacterial Blight* disease appeared in rice crop at 30°C to 36 °C

Temperature and 80% relative humidity but the former one is also favored by shortage of water, 2 to 3 days.

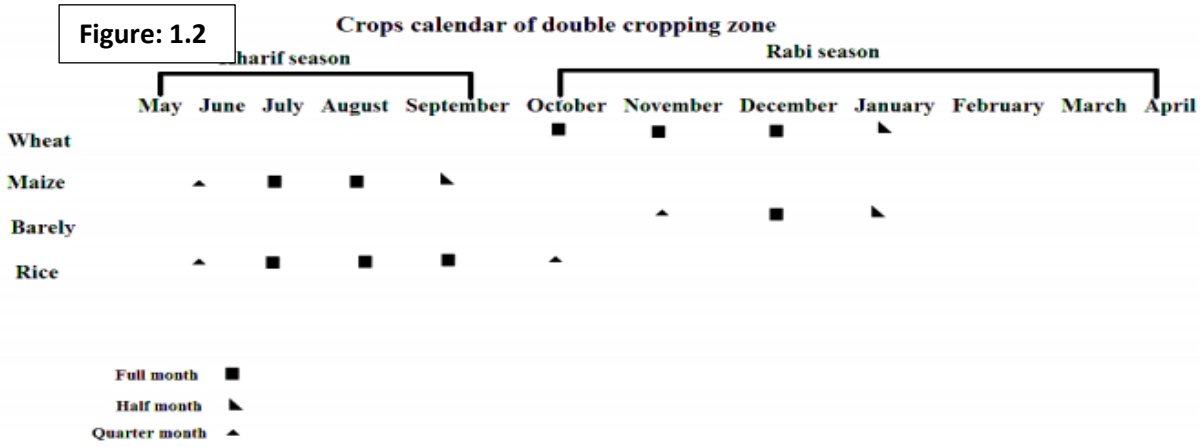
Table 1.8
Rice Crop Diseases

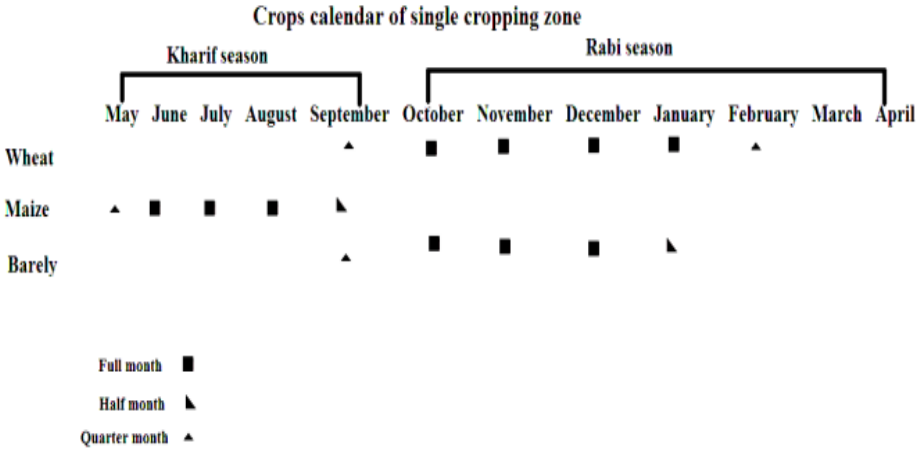
CZ	Double Cropping Zone						Single Cropping Zone			
Village	Ayun			Barenis			Shamisabad	Kosht	Khot	Rabat
Diseases	BB	SR	BL	BB	SR	BL				
Percent of Respondent	24	50	26	8	64	24				

BB: Bacterial Blight SR: Stem Rot BL: Brown Leaf Spot

In Chitral two crops Kahirf and Rabi are cultivated. The Kharif crops are sowing on last quarter of the month of May, while the Rabi is in the first week of October (upper sketch). The harvesting month of Kharif crops are September and the Rabi crops is April.

Figure: 1.2





Conclusion:

Climate change has positive effects on crops cultivation in Chitral, the cultivation of Wheat (Tiriticum aestivum L.) is now possible in village Khot and Rabat where it was not possible 40 years ago and due to sever cold constantly crops failure occurred. The maize (Zea mays L.), Rice (Oryze sativa) and Barley (Hordeum vulgare, L) crops sowing days changes is also quite cleared that in both the cropping zones where it become early from that of the past. The increase or decrease in temperature has great influences on the sowing and harvesting of these crops.Chitral have subsistence type of agriculture where people grow crops for their own needs, the only increase is in food crops due to increases in population. The increase is more in double cropping zone. The crops losses due to diseases are increases in present time from that of 40 years ago.

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