

Assessing The Effects of Climate Change On Wheat Cultivation, Production Constraints, And Extension Services in North Waziristan

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Abstract

The focus of the study was to determine the effect of climate change on wheat cultivation and production in District North Waziristan, Khyber Pakhtunkhwa, Pakistan. The objectives were to know the current situation of wheat cultivation, problem identification and the effect of climate change on wheat cultivation and production in the study area. A total of 122 farmers were sampled at 20 percent of total wheat producers using a proportional allocation technique from the six selected villages, namely Khassukhel, Khushali, Hurmaz, Zaraki, Khadi, and Eidak, through multistage sampling technique. The primary data was collected using a well-designed and carefully validated interview schedule. The data was then analysed using SPSS, and the findings were reported as counts and percentages. It was found that 63.1% of wheat growers were illiterate who belonged to middle and old age group. About 46.7% farmers had allocated 1-3 acres of land for wheat cultivation, 44.3% had 20 years of farming experience in agriculture and 66.4% had agriculture as their primary source of income. All wheat growers were aware of agriculture extension department and visits paid by extension agents were need based. The main problems faced in marketing of produce were high transportation costs, high taxes, remote markets, while high input prices, climate change effect, pests and diseases, lack of extension visits and up-to-date information and non-availability of quality seed were general problems faced. Common wheat diseases found were rust, brown rot and smut. It is concluded that all the wheat growers were aware of climate change and reported that change in sowing time, pest/disease attack, post-harvest losses, seed rate increases, less rainfall and rise in temperature were some of the effects of climate change on wheat cultivation while decreased yield and seed size and weight are effects of climate change on production in the study area. It is recommended that appropriate trainings should be arranged by the agriculture extension department to pass on latest, practical and technical knowledge about the effects of climate change on production and cultivation. It is also recommended that Enhance Climate-Resilient Agricultural Training and Extension Services **and** Improve Access to Affordable Inputs and Credit Facilities.

Key words: Agriculture Extension Services, Climate Change, Wheat Production, North Waziristan, Adaptive Strategies, Food Security

Introduction

Majority of the people in developing countries rely on agriculture for their livelihood. In developing countries, agriculture serves as the main source of food, employment, foreign exchange,

and raw materials (Tadesse, 2008). Pakistan is also an agrarian country, with agriculture serving as the chief supplier of income of vast bulk of the rural population. It also serves as the backbone of Pakistan's economy and is vital to the country's overall well-being. Pakistan has an enormous natural resource and fertile fields along with a broad spectrum of climatic zones. Agriculture is the largest employer of both direct and indirect workers, accounting for around 18.9 percent of yearly Gross Domestic Product (GDP). It not only absorbs labour and gives employment to 38.5 percent of the work force but also serves as the largest provider of raw materials to a variety of industries (GoP, 2020-21).

Wheat in Pakistan

Millions of people depend on wheat, which is the third-largest food crop in the world after corn and rice, for their carbohydrate needs. Pakistan's environment is ideal for growing a wide range of crops. Winter wheat (*Triticum aestivum*) is the most extensively grown arable crop in Pakistan, and it is sown preferably in November. In Pakistan, the current wheat yield is 2797 Kg/ha (GoP, 2020-2021).

Wheat records 9.2 percent in agriculture value addition and accounts to 1.8 percent of GDP (Pakistan Economic Survey, 2020-21). Pakistan's wheat production increased by 3.7 percent to 25.248 million tons from previous years 24.349 million tons. The total area under cultivation increased by 1.5 percent to 8,805 thousand hectares from last year's land of 8,678 thousand hectares. The increased planted area resulted in getting more produce. Pakistan ranks 8th in terms of wheat production round the world (Wheat Production by Country, 2022; Ukr Agro Consult, 2022). The situation of wheat in Pakistan for the last five years is shown in Table 1.1 while the list of Top 10 wheat producing countries is given in Table 1.2.

Table 1.1 Area, production and yield of wheat in Pakistan

Year	Area (Hectares)		Production (Tons)		Yield (Kg/ha)	
	Thousand hectares	Percent change	Thousand hectares	Percent change	(Kg/Ha)	Percent change
2015-16	9,224	-	25,633	-	2,779	-
2016-17	8,972	-2.7	26,674	4.1	2,973	7.0
2017-18	8,797	-1.9	25,076	-6.0	2,851	-4.1
2018-19	8,678	-1.4	24,349	-2.9	2,806	-
2019-20	8,805	1.5	25,248	3.7	2,868	2.2

Source: Crop Statistics, 2015-2020.

Table 1.2 Top 10 wheat producing countries in the world (2022)

Position	Country	Production (Million Metric Ton)
1 st	China	138
2 nd	European Union	134.7
3 rd	India	103
4 th	Russia	91
5 th	United States	44.9
6 th	Canada	35
7 th	Australia	33
8 th	Pakistan	26.4
9 th	Ukraine	20.5
10 th	Argentina	17.5

Source: Ukr Agro Consult, 2022.

Wheat is the main source of total caloric consumption as 42 percent and it constitutes almost

60 percent of daily diet content of the country's population. In Pakistan the average per capita consumption of wheat is 110 Kg (PACE Working Paper, 2022). The top producing province is Punjab followed by Sindh and Khyber Pakhtunkhwa. In 2019-20, wheat production was 25 million tons out of which Punjab contributed 19 million tons, Sindh 3.8 million tons and 1.13 million tons come from Khyber Pakhtunkhwa (Agricultural Statistics of Pakistan, 2020).

The most widely utilized crop and staple food in Pakistan is wheat, which is grown on the largest acreages of land and used in a number of ways to produce other byproducts as well (Kiani and Iqbal, 2018). Climate change affects different stages of wheat crop such as germination, vegetative growth and maturity. Temperature is a key factor that affects wheat crop at all stages along with rainfall which also has positive effect when occurs in proper amount and at important stages of growth (Ashfaq et al., 2011).

Climate Change

Weather refers to short-term atmospheric circumstances, whereas climate relates to long-term atmospheric situation decade, or century. Climate change is defined as "a change in climate caused by natural or artificial actions that lasts for a long time" (IPCC, 2007).

Intergovernmental Panel on Climate Change (IPCC) defined climate change as a change in climate cause by a change in its mean and variability in its attributes that persists over time. Natural or anthropogenic involvement in the atmosphere or on land causes these changes (Bukhari and Bajwa, 2012).

As mentioned by United Nations Framework Convention on Climate Change (UNFCCC), human activities alter the climate composition of the atmosphere, resulting in climate variability that can be observed throughout time Changes in the Earth's climate are referred as global climate change. Variations in weather-related factors like wind, rainfall, and temperature are referred to as climatic variability (Bukhari and Bajwa, 2012).

Climate Change's Impact on Agriculture

Change in climate is caused by a number of factors and worldwide these ecological changes are seriously influencing agriculture. Change in climate has the greatest impact on agriculture. Agriculture is a sophisticated and advanced industry, but it is dependent on the environment. Climate change has a number of effects on agricultural development and output, including variations in rainfall, temperature, date/time of sowing and harvesting, water accessibility and site suitability and so on (Harry et al., 1993, and Janjua et al., 2010). Environmental factors can have positive benefits on agriculture, such as a lengthy growing season and hot temperatures, while negative effects include water table decline and extreme weather (Singh and Grover, 2013).

Climate change has an impact on the global environment, but the impact varies from region to region and ecosystem to ecosystem, generating changes and affecting socioeconomic and physical assets. Agricultural, woodland, and pasture land encompass almost 60percent of the earth's surface, leaving it vulnerable to climate change and variation. Random variations in rainfall, storm, and temperature are putting the ecosystem at danger, increasing the risks and severity of floods and droughts. Climate change and variability have a substantial impact on agricultural and food production (Singh and Grover, 2013). Agriculture is a basic human requirement, but it is sadly the most vulnerable to climate change.

All over the world, one of the major determinants of agricultural production is climate. High temperature, change in season length and rainfall pattern, unexpected floods and drought are major effects of climate change that are posing food security risks especially in developing countries like Pakistan. According to research and surveys, Pakistan is one of the nation's most impacted by the effects of climate change, According to the World Climate Risk Index from 1997 to 2016, it is rated seventh. (Kiani and Iqbal, 2018).

According to IPCC (2001) the average air temperature will face a rise of 1.4 to 5.8°C from

1990-2100. It will cause shortening of growth period, early flowering and fruiting, shorten the growth period due to early flowering and fruit bearing, and decrease the food intake by seed which will result in under-developed seeds (Ashfaq et al., 2011).

Objectives of the Study

1. Know the current situation of wheat cultivation in the North Waziristan.
2. Solicit the effect of climate change on wheat cultivation and production.

Materials and Methods

The study universe is District North Waziristan, which is significant due to its fertile terrain and suitable climatic conditions for various crops, vegetables and fruits. Crops like wheat, maize and rice are major source of revenue for farmers in this region. Wheat is the most valuable of these crops due to its extremely favorable climatic conditions. The research population consisted of all wheat producers. The sampling design for the present study was based on a multistage sampling technique to ensure adequate representation of wheat growers from the study area. Multistage sampling involves the selection of samples in successive stages, where sampling units at each stage are drawn from the units selected in the previous stage (Cochran, 1977). At the first stage, District North Waziristan, comprising nine tehsils, was considered, and Tehsil Mirali was purposively selected due to its relatively higher wheat cultivation. In the second stage, all three union councils of Tehsil Mirali, namely Mussaki, Wazirabad, and Essori, were purposively selected on the basis of having a maximum number of wheat growers. At the third stage, a list of villages within the selected union councils was obtained from the Agriculture Extension Department, and two villages were randomly selected from each union council, resulting in the selection of six villages: Khassukhel and Khushali from Mussaki, Hurmaz and Zaraki from Wazirabad, and Khadi and Eidak from Essori. At the final stage, a list of all wheat growers in the selected villages was prepared with the assistance of local extension workers. From a total population of 610 wheat growers, a sample size of 122 respondents, representing 20 percent of the total population, was selected using a proportionate sampling technique to ensure fair representation from each village. Accordingly, the number of respondents selected from each village was proportional to the total number of wheat growers in that village. Data were collected using a well-structured and pre-tested interview schedule developed in line with the objectives of the study. Although the interview schedule was prepared in English, questions were asked in the local language to ensure clarity and accurate responses. Both primary and secondary data were used in the study, with primary data obtained through face-to-face interviews conducted at farmers' fields and residences. The collected data were analyzed using the Statistical Package for Social Sciences (SPSS), and the results were presented in the form of frequencies and percentages to facilitate clear interpretation of the findings.

Results and Discussion

Age of the Respondents

Age is a crucial factor in the acceptance and diffusion of the most recent technology in terms of improved agricultural techniques and improved variety, and effective fertilizer usage. It also plays an important role in the dissemination of innovation throughout the farming community (Agwu et al., 2008). It is believed that young people are more inclined to adopt new ideas, have good decision making ability and creativity (Khan and Akram, 2012).

Table 3.1 Distribution of the respondents regarding respondents' age

Village	Age of the Respondents (years)				Total
	20-30	31-40	41-50	Above 50	
Khassukhel	0 (0.0)	2 (1.6)	7 (5.7)	12 (9.8)	21

Khushali	4 (3.3)	2 (1.6)	4 (3.3)	8 (6.6)	18
Hurmaz	2 (1.6)	4 (3.3)	5 (4.1)	10 (8.2)	21
Zaraki	3 (2.5)	5 (4.1)	9 (7.4)	7 (5.7)	24
Khadi	0 (0.0)	2 (1.6)	9 (7.4)	10 (8.2)	21
Eidak	4 (3.3)	3 (2.5)	5 (4.1)	5 (4.1)	17
Total	13 (10.6)	18 (14.8)	39 (32.0)	52 (42.6)	122

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Table 3.1 presents the distribution of respondents regarding age in the study area. Maximum (42.6%) respondents were observed in the age group of above 50 years while 10.6% of respondents were found to be between the ages of 20 and 30; 14.8 percent were found to be between the ages of 31 and 40; and the remaining 32% were found to be between the ages of 41 and 50 in the study area,. The data results clearly demonstrate that younger and middle-aged farmers are less prevalent than older farmers, who tend to be between the ages of 41 and 50 i.e. almost 73 percent in the study area.

Literacy Status of the Respondents

An individual's education is a critical aspect in bringing about a desired change in behavior. Education is also crucial in the spread of new technologies, improved agricultural methods, and technique adoption (Hassan, 1991). Iqbal and Nawab (2013) stated that literate farmers possess more favorable attitude towards adoption of new agricultural technologies and skills.

Table 3.2 Distribution of respondents regarding literacy status

Village	Literacy Status		Total	Educational Level				Total
	Illiterate	Literate		Primary	Middle	Matric	Above	
Khassukhel	11 (9.1)	10 (8.2)	21	2 (1.6)	4 (3.3)	3 (2.5)	1 (0.8)	10
Khushali	8 (6.6)	10 (8.2)	18	3 (2.5)	2 (1.6)	3 (2.5)	2 (1.6)	10
Hurmaz	12 (9.8)	9 (7.4)	21	3 (2.5)	3 (2.5)	3 (2.5)	0 (0.0)	9
Zaraki	17 (13.9)	7 (5.7)	24	0 (0.0)	1 (0.8)	5 (4.1)	1 (0.8)	7
Khadi	16 (13.1)	5 (4.1)	21	3 (2.5)	1 (0.8)	1 (0.8)	0 (0.0)	5
Eidak	13 (10.7)	4 (3.3)	17	2 (1.6)	1 (0.8)	0 (0.0)	1 (0.8)	4
Total	77 (63.1)	45 (36.9)	122	13 (10.6)	12 (9.8)	15 (12.4)	5 (4.1)	45

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Table 3.2 display the distribution of respondents regarding literacy status of the respondents in the study area. In the study area, the majority of respondents (63.1%) were illiterate, compared to 36.9 % respondents who were literate. The percentage of illiterate respondents was high in village Zaraki 13.9 % and in village Khadi 13.1 %, Khassukhel 9.1 %, Khushali 6.6 %, Hurmaz 9.8 % and Eidak 10.7 % respondents were found illiterate. Among literates, 8.2 % literate respondents each was found in village Khassukhel and Khushali, Zaraki 5.7 %, Khadi 4.1 % while Eidak 3.3 %. The educational level of the respondents is also shown in the above Table 3.2. The results show that among literate respondents, 10.6 % farmers had primary level education, followed by middle pass 9.8 %, matric 12.4 % and above matric were 4.1 % in the study area.

Land Holding

In general, farmers with more land are perceived to be more likely for acceptance of innovation and have greater access to agricultural knowledge than farmers with less acreage to cultivate (Chaudhary, 2006). When size of land and fertility is enhanced then consequently income and production is also enhanced.

Table 3.3 Distribution of respondents regarding land holding size

Village	Size of Landholding			Total
	1-3 Acres	3.1-5 Acres	Above 6 Acres	
Khassukhel	9 (7.4)	9 (7.4)	3 (2.5)	21
Khushali	5 (4.1)	8 (6.6)	5 (4.1)	18
Hurmaz	6 (4.9)	9 (7.4)	6 (4.9)	21
Zaraki	8 (6.6)	8 (6.6)	8 (6.6)	24
Khadi	7 (5.7)	7 (5.7)	7 (5.7)	21
Eidak	8 (6.6)	6 (4.9)	3 (2.5)	17
Total	43 (35.3)	47 (38.5)	32 (26.2)	122

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Table 3.3 shows the distribution of respondents regarding size of landholding in the study area. The maximum (38.5%) of respondents have 3.1-5 acres land for crop cultivation, minimum 26.2 percent of the respondents have above 6 acres land while 35.3 percent of the respondents have 1-3 acres land for cultivation in the study area. Din (2015) reported 59 percent of respondents were having land holding size of 1-5 acres whereas, Khan et al. (2012) reported 72 percent of the respondents with land size of up to 5 acres.

Farming Experience

The cumulative years of a farmer's involvement to agricultural operations is referred to as farming experience. Farming is an organization inside him that aggravates information gained over the course of his life and done with care. Experience plays a significant role in both agriculture and social science and is a typical component of farmer education (Khan et al., 2012). However, Aldosari et al. (2019) commented that having more experience means having more knowledge and yield. Table 4.6 shows the distribution regarding farming experience in the study area.

Table 3.4 Distribution of respondents regarding farming experience

Village	Farming Experience			Total
	1-10 Years	11-20 Years	Above 20 Years	
Khassukhel	4 (3.3)	6 (4.9)	11 (9.0)	21
Khushali	3 (2.5)	5 (4.1)	10 (8.2)	18
Hurmaz	2 (1.6)	6 (4.9)	13 (10.7)	21
Zaraki	5 (4.1)	6 (4.9)	13 (10.7)	24
Khadi	3 (2.5)	13 (10.7)	5 (4.1)	21
Eidak	3 (2.5)	12 (9.8)	2 (1.6)	17
Total	20 (16.4)	48 (39.3)	54 (44.3)	122

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Maximum (44.3%) of respondents have above 20 years farming experience while minimum (16.4%) of respondents have 1-10 years farming experience and the remaining 39.3 percent of the respondents

have 11-20 years farming experience in the study area. Adisa and Adekunle (2010) in a study reported that 31.1 percent reported had experience of about 15 years in the study area, whereas, Muhammad et al. (2012) reported that 62.8 percent of respondents had 11 to 15 years farming experience.

Agricultural Extension Services

An extension agent's job is to educate the agricultural community about methods and strategies for increasing production and persuade them for their use. To communicate the relevant information appropriately and efficiently, extension agents must effectively employ existing tools and strategies. Constant and regular contact of extension workers with farmers helps to create awareness about innovations and their subsequent adoption by farming community (Wossen et al., 2017). As a result, respondents were asked about agriculture extension services in the research area as presented in Table 3.5.

Table 3.5 Distribution of respondents regarding agricultural extension services

Village	Agricultural Extension Services	If yes, Benefits of these Services for Farming Community			
	Yes	Provide Training	Arranged field days, exhibition	Organize demonstration on fields	Solve our problems
Khassukhel	21 (17.2)	9 (7.4)	8 (6.6)	7 (5.7)	7 (5.7)
Khushali	18 (14.8)	8 (6.6)	5 (4.1)	6 (4.9)	8 (6.6)
Hurmaz	21 (17.2)	11 (9.6)	6 (4.9)	7 (5.7)	8 (6.6)
Zaraki	24 (19.7)	10 (8.2)	7 (5.7)	8 (6.6)	10 (8.2)
Khadi	21 (17.2)	10 (8.2)	5 (4.1)	5 (4.1)	9 (7.4)
Eidak	17 (13.9)	8 (6.6)	5 (4.1)	5 (4.1)	6 (4.9)
Total	122	56 (45.9)	36 (29.5)	38 (31.1)	48 (39.3)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

Table 3.5 presents the data regarding agriculture extension services which shows that all the sampled respondents utilized extension services in the study area. Aziz and Khan (2021) found that 67 percent of the respondent had knowledge about agriculture extension department while 37 percent had no knowledge about agriculture extension department. In the study area, services provided by extension department to the farming community unclouded training, field days and exhibitions, demonstration and solve farming community problems. Maximum (45.9%) of the respondents got training from extension department regarding different cultivation techniques while 29.5 percent of the respondents were benefited from field days and exhibition etc. arranged by extension department in the study area. Extension department also organized demonstrations which were reported by 31.1 percent while the solution of problems was mentioned by 39.3 percent of the respondents. Khan et al. (2019) reported that 80percent of the extension agents claimed to provide services to farming community in the form of trainings, demonstrations, exhibitions and provision of needed inputs. Khan (2012) also stated that 97 percent of extension agents communicate research findings to the farming community.

Main Problems in Wheat Cultivation

Farmers were the poorest members of society. Shortage of credit, lack of necessary agricultural supplies, an absence of sufficient irrigation systems and equipment, lack of storage facilities, remote markets, lack of pesticide availability, and high market prices, as well as transportation issue, are all challenges to effective field service (Aslam, 2016).

Table 3.6 Distribution of respondents regarding wheat cultivation problems

Villages	Main Problems in Wheat Cultivation					
	Climate Change	High Prices of Inputs	Pest And Diseases	Lack of up to date Information	Non availability of quality seeds	No Visits by extension staff
Khassukhel	10 (8.2)	15 (12.3)	16 (13.1)	16 (13.1)	12 (9.8)	7 (5.7)
Khushali	11 (9.0)	15 (12.3)	11 (9.0)	11(9.0)	10 (8.2)	6 (4.9)
Hurmaz	13 (10.7)	12 (9.8)	12 (9.8)	12 (9.8)	13 (10.7)	5 (4.1)
Zaraki	10 (8.2)	14 (11.5)	11 (9.0)	13 (10.7)	10 (8.2)	9 (7.4)
Khadi	10 (8.2)	15 (12.3)	13 (10.7)	10 (8.2)	11 (9.0)	6 (4.9)
Eidak	9 (7.4)	11 (9.0)	14 (11.5)	13 (10.7)	12 (9.8)	6 (4.9)
Total	63 (51.6)	82 (67.2)	77 (63.1)	75 (61.5)	68 (55.7)	39 (32.0)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

The distribution of respondents on wheat cultivation problems and issues in the research area is shown in Table 3.6 Majority (67.2%) of the respondents faced high prices of inputs, 63.1 percent of the respondents faced pest and diseases problem while 51.6 percent of the respondents faced climate change problem in the study area. Lack of up to date information was reported by 61.5 percent of the respondents, 55.7 percent faced problem of non-availability of quality seed and 32 percent of the respondents mentioned no extension visits by extension staff as a problem in the study area. Baloch and Hapa (2014) found that lack of contact with extension and irrigation facilities caused loss of yield by about 65percent.

Marketing Problems of Wheat

In the study area, wheat producers encountered a variety of marketing challenges. It consisted of lost transportation costs, high taxes, and a distant market. Wheat production has been diminished as a result of these issues, which has had a negative impact on the farming community's economics.

Table 3.7 Distribution of respondents regarding marketing problems of wheat

Villages	Marketing problem	If yes, Type of Marketing Problems		
	Yes	High Transportation Cost	High Taxes	Distant Market
Khassukhel	21 (17.2)	16 (13.1)	19 (15.6)	16 (13.1)
Khushali	18 (14.8)	15 (12.3)	19 (15.6)	14 (11.5)
Hurmaz	21 (17.2)	18 (14.8)	16 (13.1)	17 (13.9)
Zaraki	24 (19.7)	19 (15.6)	12 (9.8)	13 (10.7)
Khadi	21 (17.2)	15 (12.3)	10 (8.2)	16 (13.1)
Eidak	17 (13.9)	13 (10.7)	11 (9.0)	13 (10.7)
Total	122	96 (78.7)	87 (71.3)	89 (73.0)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

Table 3.7 displays respondent's distribution related to marketing problems faced in the research area. Wheat marketing problems is shown in Table 4.30 that includes high transportation cost, high taxes and distant market in the study area. The main problem was high transportation cost which was reported by 78.7 percent respondents, high taxes as a problem was reported by 71.3 percent while 73 percent faced distant market problem in the study area.

Source of Awareness regarding Climate Change

Changes in weather and climate pose serious threats to agricultural production and food security. Agriculture is vulnerable to climate change as fluctuation in temperature; rainfall and CO₂ concentration have substantial effect on crop growth. Some of the detrimental effects of climate change on agriculture can be witness in the form of change in growing seasons, floods, rainfall shortage, pest and disease attacks etc. (Verge et al., 2007). A question was asked to get the views of respondents regarding climate change awareness in the study area.

Table 3.8 Distribution of respondents regarding awareness of climate change

Villages	Awareness about Climate Change	Source of Awareness of Climate Change			
	Yes	Extension workers	Realized yourself	Fellow farmers	Mass media
Khassukhel	21 (17.2)	10 (8.2)	8 (6.6)	15 (12.3)	6 (4.9)
Khushali	18 (14.8)	8 (6.6)	9 (7.4)	13 (10.7)	7 (5.7)
Hurmaz	21 (17.2)	9 (7.4)	7 (5.7)	15 (12.3)	7 (5.7)
Zaraki	24 (19.7)	12 (9.8)	8 (6.6)	12 (9.8)	10 (7.4)
Khadi	21 (17.2)	8 (6.6)	6 (4.9)	14 (11.5)	8 (6.6)
Eidak	17 (13.9)	10 (8.2)	7 (5.7)	13 (10.7)	5 (4.1)
Total	122	57 (46.7)	45 (36.9)	82 (67.2)	43 (35.2)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

The distribution of respondents' knowledge and awareness about climate change in the research area is shown in Table 3.8. All 122 respondents knew that the research area was seeing a shift and change in the climate. Most of the respondents i.e. 67.2 percent said that fellow farmers or elders were their main source of awareness, 46.7 percent respondents' source of awareness was extension workers, and 36.9 percent realized themselves while mass media as a source of awareness regarding climate change was reported by 35.2 percent respondents in the study area. Nowadays climate change is the burning issue which should be addressed by all the stakeholders.

Farmer's Views on Climate Change Effect on Wheat Production

Climate change has manifold effects on agriculture and crop production. High temperatures and less rainfall can cause decrease in overall production and size and weight of the grains etc. (International Food Policy Research Institute, 2013). Therefore, respondents were asked about their views regarding climate change effect on wheat production in the study area as presented in Table 4.9.

Table 3.9 Distribution of respondents regarding their views on climate change effect on wheat production

Villages	Effect Climate change on Wheat Production	Types of Effect on Wheat Production	
	Yes	Production Decreases	Seed size & Weight Decreases

Khassukhel	21 (17.2)	17 (13.9)	15 (12.3)
Khushali	18 (14.8)	15 (12.3)	14 (11.5)
Hurmaz	21 (17.2)	17 (13.9)	15 (12.3)
Zaraki	24 (19.7)	15 (12.3)	17 (13.9)
Khadi	21 (17.2)	12 (9.8)	13 (10.7)
Eidak	17 (13.9)	13 (10.7)	11 (9.0)
Total	122	89 (73.0)	85 (69.7)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

Table 3.9 displays respondents' distribution about climate change effect on wheat production in the study area. All the 122 respondents viewed that climate change has effected wheat production in the study area. The majority i.e. 73 percent of the respondents' claimed that production decreases due to climate change while 69.7 percent of the respondents' reported seed size and weight decreases as the results of climate change in the study area.

Main Diseases of Wheat in the Area

Agricultural crops are vulnerable to a wide range of insects, pests and diseases. A number of diseases such as rust, smut, powdery mildew and septoria attack wheat crop which cause loss in the quantity and quality of the grains and ultimately reduce wheat yield. Resistant varieties and seed treatment can be used as precautionary measures to combat diseases and improve yield. As a result, respondents were questioned about the most common wheat diseases in the research area.

Table 3.10 Distribution of respondents regarding main diseases of wheat

Villages	Main Diseases of Wheat in your Area		
	Rust	Brown rot	Smut
Khassukhel	15 (12.3)	15 (12.3)	12 (9.8)
Khushali	16 (13.1)	16 (13.1)	13 (10.7)
Hurmaz	15 (12.3)	12 (9.8)	14 (11.5)
Zaraki	18 (14.8)	14 (11.5)	16 (13.1)
Khadi	15 (12.3)	13 (10.7)	15 (12.3)
Eidak	14 (11.5)	11 (9.0)	12 (9.8)
Total	93 (76.2)	81 (66.4)	82 (67.2)

Source: Survey Data, 2022

Note: Figures in parenthesis are percentages

Totals may not tally due to multiple answers

Table 3.10 shows the distribution of respondents regarding major wheat diseases in the study area. Respondents in the study area reported different types of wheat diseases which include rust, brown rot and smut. Majority (76.2%) of the wheat growers faced rust, 66.4 percent of the wheat growers faced brown rot disease while 67.2 percent of the wheat growers reported smut in the study area.

Conclusion

This study confirms that climate change is adversely impacting wheat cultivation and production in District North Waziristan. Farmers are aware of its effects, which include altered sowing times, increased pest/disease outbreaks, reduced rainfall, higher temperatures, and ultimately, decreased yields and poorer grain quality. Major challenges such as high input costs, lack of quality seeds, and limited extension support exacerbate these climate vulnerabilities. Urgent, targeted

interventions are needed to enhance the resilience of local wheat farming and protect farmers' livelihoods.

Recommendations

1. Enhance Climate-Resilient Agricultural Training and Extension Services.
2. Improve Access to Affordable Inputs and Credit Facilities
3. Strengthen Market Linkages and Infrastructure

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