

Global Climate Change Adaptation: Mitigating Flooding Impacts in Pakistan

Afshin Akram¹, Arifa Tahir¹, Asifa Alam², Saima Khan²

¹Department of Environmental Sciences, (Lahore College for Women University (LCWU), Lahore, Pakistan)

²Global Studies Department, IGHS (Government College University, Lahore, Pakistan).

*Correspondence: asifa.alam@gcu.edu.pk

Citation | Akram. A, Tahir. A, Alam. A, Khan. S, “Global Climate Change Adaptation: Mitigating Flooding Impacts in Pakistan”, IJIST, Vol. 5 Issue. 4 pp 648-660, Dec 2023

Received | Sep 25, 2023; **Revised** | Oct 08, 2023; **Accepted** | Oct 18, 2023; **Published** | Dec 11, 2023.

Climate change is indeed a wide-reaching problem with noteworthy consequences. The climate in Pakistan has been experiencing a quick-changing pattern, accompanied by an increase in the intensity and frequency of extreme events due to global warming. The capacity of people to adapt to climate change is crucial in reducing its impacts. Over the past decade, the irregular incidents of weather events such as floods, droughts, heat waves, and cyclones have had a significant impact on the economic growth of the country. The main goal of this study is to assess how well the local community is able to adapt to the challenges posed by climate change. The study was specifically conducted in Mianwali district, Punjab province, Pakistan focusing on this specific location allows for a more in-depth analysis of the adaptive capacity of its local community to climate change. A thorough survey of the district was conducted, and the responses of the people were recorded through questionnaires and interviews. People were asked about their views on climate change and the adaptive strategies they are implementing to tackle its effects. The findings unfolded the fact that the limitations of being unaware of environmental issues are not only the lack of education but also the financial constraints are there. The study also explained that the residents of Mianwali who are aware of climate change and flood trends are more concerned about growing and using a variety of crops as a resilience tactic. Although there is a greater number of people who are not even aware of climate change and the association of floods with it, the public also claimed that the local authorities are not providing them with any information in time. So, the results suggest a clear insight for the stakeholders and policymakers to manage flooding and climate change by providing the people with crucial information beforehand and managing the situation by suggesting and implementing multiple adaptive measures.

Keywords: Adaptation; Climate Change; Floods; Adaptive Strategies.

Abbreviations: Geomorphological Information System (GIS)



Introduction:

Global climate change is a major and urgent concern that impacts our planet. Global climate change refers to the long-term changes in precipitation patterns, temperature, and other weather conditions worldwide. These changes are primarily caused by human activities like deforestation and burning of fossil fuels. It has wide-ranging effects on ecosystems, sea levels, weather patterns, and human societies. It is of utmost importance that we join forces and collectively take action to reduce greenhouse gas emissions, adapt to the changing climate, and safeguard the environment for future generations.

Pakistan has experienced a rise in the occurrence of natural disasters like floods and droughts in recent decades. This vulnerability to climatic changes has played a role in these events [1][2]. According to the 2020 Global Climate Risk Index report, Pakistan is ranked 5th among the top 10 countries that are most affected by natural hazards from 1999 to 2018 [3]. By 2050, climate projections suggest that Pakistan will experience a temperature rise of 2°–3° and significant changes in rainfall patterns [4]. Pakistan is not only highly susceptible to natural disasters induced by climate change but also ranks among the world's most disaster-prone regions [2].

In Pakistan, the frequency of natural hazards has been on the rise, and monsoon floods have become an almost annual occurrence. These floods have caused significant damage to the Pakistani economy [5][6][7]. The government's response to monsoon flooding in Pakistan has been insufficient and ineffective due to limited resources, reactive planning, emphasis on post-disaster relief, poor coordination between agencies, lack of local-level preparedness, and limited community involvement [8][9][10][11]. The government's focus on urban infrastructure development and supporting the growing urban population and industrial activities has led to limited investments in disaster preparedness and response, contributing to the inadequate response to monsoon flooding [12]. Approximately two-thirds of Pakistan's population resides in rural areas and relies on agriculture, so it becomes crucial to enhance the resilience of rural farming communities to climate change-induced monsoon floods through the implementation of farm-level adaptation measures [13][12]. So far, the implementation of adaptation measures has been quite limited, primarily due to a lack of knowledge and resources [14][15][16].

Pakistan is at a crucial turning point in a world that is coping with the enormous effects of climate change. A new era of extreme events has begun in this country as a result of the constantly changing climatic patterns brought on by the unavoidable force of global warming. The range of events, spanning from heat waves to cyclones, droughts to floods, is not only altering Pakistan's landscape but also its economic prospects. It is more important than ever to comprehend how its people can adjust to this constant challenge. This study delves far into Pakistan's inside, in particular the Punjab province's Mianwali area. By concentrating on one particular area, we are able to see a microcosm of resiliency in the face of climate hardship. We aimed to record the opinions and observations of residents through vigilant surveys, questionnaires, and open interviews.

There are three hypothesis statements that are focused in this study. These hypotheses are stated below;

- Higher public awareness of climate change is positively correlated with the adoption of adaptive measures.
- The perceived threat from climate change is positively correlated with community resilience.
- Increased local climate knowledge leads to greater policy advocacy.

Unexpectedly, a lot of people still don't properly understand the social and cultural intricacies of climate change. This study unveils the significant challenges faced by the Mianwali community in their struggle against climate change and also highlights the current extent of

adaptation within that community. We discover a narrative as we dig into the details of how they live and their objectives that cross beyond national boundaries and connects with the worldwide effort against the ruthless power of climate change.

However, the flood mitigation strategies adopted worldwide are public awareness and coordination, repair and retrofit of the facilities, use of natural infrastructure, monitoring of operational capabilities, use of climate and land data, and planning for climate change. The strategies adopted in this research are public awareness, use of natural infrastructure along with migration from flooding areas, and changes in household sizes. This study employed a mixed-methods research design to investigate the impact of climate change in Mianwali, Pakistan, as well as public responses to these changes. Data collection and analysis were conducted over a six-month period, from January to May 2020.

- The aim of this study was to evaluate the infrastructural and socio-economic effects of floods in the Mianwali District, Pakistan, particularly during the monsoon season. With an emphasis on the tehsils that have been most badly affected, like Isa Khel, the aim of this study is to calculate the percentage of the population and geographic area in the Punjab region that has been affected by flooding.
- The investigation of local community responses to flooding, such as rural-to-urban migration, and an evaluation of such responses' efficacy in reducing flood impacts are the key objectives.
- This study also aims to examine the relationship between respondents' educational backgrounds and their understanding of climate change in order to assess the degree of climate change awareness among the populace in the Mianwali District.

Material and Methods:

Site of Data Collection:

In pursuit of the objectives of this study, data was gathered from the Mianwali community, encompassing both urban and rural areas, as well as local officials. The Mianwali District is administratively divided into seven town committees, three tehsils, sixty union councils, and one municipal committee. Each union council has unique physical conditions and socio-economic features. The union council was selected for the survey because all current members are local officials and have a strong connection to their respective areas.

Desk Study:

The study considers a wide range of literature that focuses on the impacts of climate change on the local community and their ability to adapt. Before heading out to study the Mianwali area, we conducted an extensive review of literature, including articles, journals, and published works.

Data for the Study:

Data for this study was collected by three different methods that are elaborated below.

Surveys and Questionnaires:

In addition to the desk study, we collected data from the relevant stakeholders. We selected a sample size of 200 stakeholders, comprising members of the civil society, farmer community, and local officials, in order to establish an evaluation estimation at the district level.

In-depth (Semi-structured) Interviews:

In addition to surveys, in-depth interviews were conducted with local community members to gather qualitative data about their experiences and perceptions of climate change impacts. Their everyday conversations around the climate disaster revealed their cultural perceptions of their houses as infrastructure of shelter, and how they get affected when their shelter is affected by any natural disaster.

Climatic data:

Historical climate data, including temperature changes and precipitation patterns, were collected from relevant sources. A total of 03 districts were chosen to showcase the locals' capacity to adapt to climate change. Figure 1 shows the map of Mianwali. To get an overview, we conducted a survey using a standard questionnaire to assess the level of awareness about climate change effects and adaptation measures among the nearby locals and local officials in each union council of Mianwali District. The survey took place from January to May 2020 in the district of Mianwali.

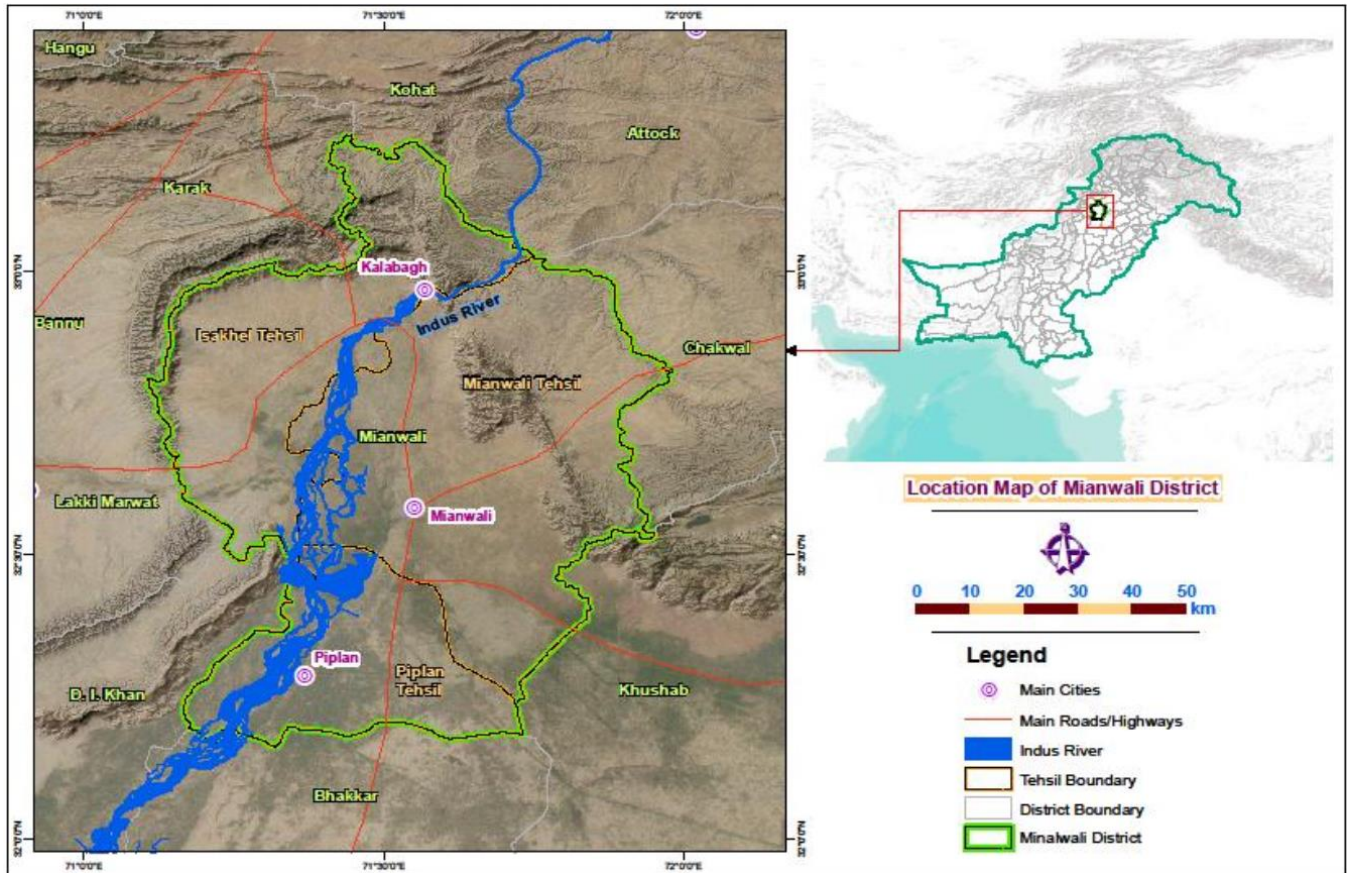


Figure 1: Map of Mianwali

Interviews and Questionnaires:

Data was collected from male respondents in the family unit, which included information about their family profile, ranch attributes, crop patterns, years of managing crops, perception of climate change, adapting techniques, specific crops, and common adaptation procedures. We also gathered data on their access to information about climate change, farming advancements, and support from formal and informal establishments due to the risks posed by environmental change.

Residents were invited to discuss the strategies they had employed to adapt to their environment and the particular weather-related challenges they had faced in relation to these strategies. When it came to identifying the crops they cultivated, weather-related conditions, and their ability to adapt, individuals were provided with multiple response options. They were also given the opportunity to provide additional answers in the provided spaces. When asked about climate-related conditions, the respondents were asked to indicate whether each condition they chose had a positive outcome, negative impact, or both.

Flow Diagram of Methodology:

Figure 2 shows the schematic diagram of the methodology used for this research. The steps carried out are as follows

Step 1: Initially, we collected secondary data by surfing the web for articles, journals, and published literature.

Step 2:

After completing step 1, a questionnaire was developed to survey the adaptation capacity of the local community against climate change.

Step 3:

During the study, a field visit was conducted to the study area of interest, and the locals were asked about their resilience against climate change through questionnaires and interviews.

Step 4:

The last step was to carefully analyze to interpret the results in detail.

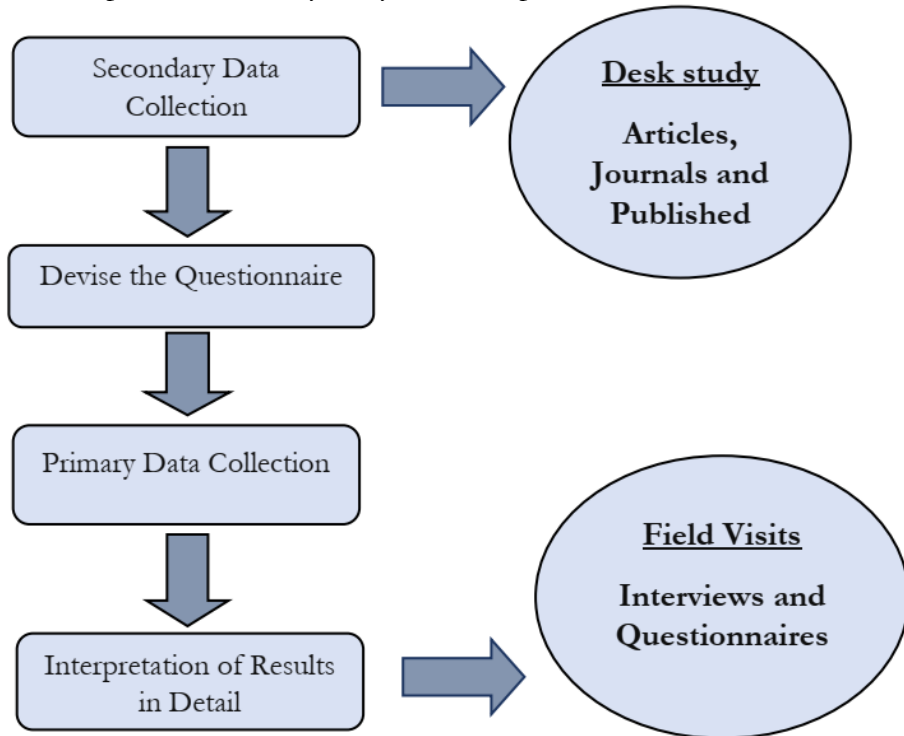


Figure 2: Flowsheet diagram of Methodology

Variables Used:

The variables in this study were independent, dependent, and mediating variables.

Independent Variables:

Independent variables were climate change indicators i.e. temperature changes, precipitation patterns, extreme weather events, and local environmental factors (geographical features, land use, water resources).

Mediating Variables:

Mediating variables were public awareness, local climate knowledge, perceived threat and vulnerability, and community factors (social cohesion, access to resources).

Dependent Variables:

Public responses include adaptive measures, community resilience, and policy advocacy.

Data Analysis:

To execute the descriptive statistics, SPSS was used to highlight the important aspects of the data like the respondents' demographics, educational backgrounds, and distribution throughout the several union councils in the Mianwali District. Based on the responses to the survey, the percentage of respondents who are aware of climate change was estimated. The main results and data were displayed using bar charts.

Results and Discussion:

Assessing Flood Impacts:

Flooding poses a substantial disaster risk in Pakistan, with the Mianwali District being especially susceptible during the monsoon season. This district has consistently ranked among the most severely impacted regions in the nation, leading to considerable damage to both infrastructure and the overall welfare of its residents. The flooding in Mianwali caused harm to approximately 6% of the total estimated affected population in the district and affected about 29% of the geographical area in Punjab. Figure 3 illustrates the impacts of floods on three tehsils in Mianwali. It reveals that Tehsil Isa Khel suffered severe devastation, particularly in terms of the affected population. According to the survey findings, some households responded to the floods by relocating from rural to urban areas as an adaptive measure.

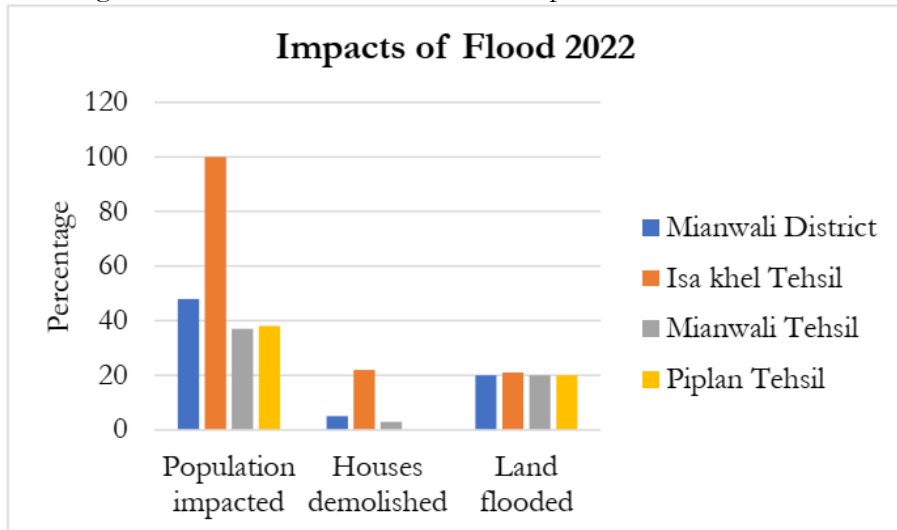


Figure 3: Impacts of flood 2022

Analyzing Adaptive Measures:

It is conceivable that these changes can be attributed to rural-to-urban migration, especially in Isa Khel. It seems that the decline in household sizes observed during the post-flood period could be a result of people adapting to mitigate the impact of floods. This could be a strategic response to effectively deal with the challenges posed by flooding.

Public Responses:

The phase of Adaptation:

The process of climate change adaptation can be divided into three stages. The first stage is understanding, where specific issues are identified and defined. The second stage is planning, where different options for action are identified and evaluated. And finally, the third stage is implementation, where selected approaches are put into practice, monitored, and evaluated [17]. Figure 4 displays the feedback from individuals when they were asked about the stage of adaptation, they are currently engaged in. The majority of people mentioned that they are currently not involved in climate change adaptation. However, a small number of individuals responded that they are well aware of the impacts of changing climate and are actively working on implementing adaptation measures.

Perceived Threats and Vulnerability:

Barriers to Adaptations:

The IPCC's fifth assessment report describes barriers to adaptation as "factors that make it more difficult to plan and implement adaptation activities or that restrict available options" [18]. Many researchers worldwide have begun identifying barriers that individuals may encounter while attempting to cope with climate change. Some examples of these obstacles include

vulnerability, the cost of mitigation strategies, limited awareness, lack of information, inadequate national attention to climate change, preexisting beliefs, and a poor understanding of the potential impacts of climate change [19].

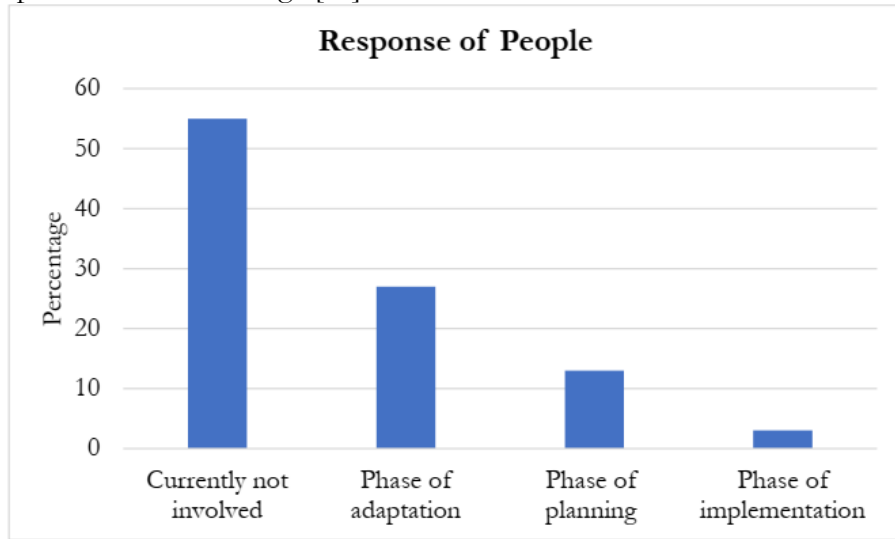


Figure 4: Response of People against the phase of Adaptation

The limited awareness and utilization of adaptation strategies indicate that the local community faces several constraints in climate change resilience. The local community was surveyed and interviewed to gather information about the challenges they encountered in implementing adaptation strategies. Figure 5 displays the feedback from individuals regarding the barriers they encounter in implementing adaptation strategies. Many people expressed that the lack of financial resources is a significant hurdle in implementing coping mechanisms. Approximately 36% of the respondents identified the lack of finance as a major constraint, while 31% mentioned the lack of awareness about climate change. Additionally, 18% expressed concerns about trying new coping techniques, and 15% cited other constraints.

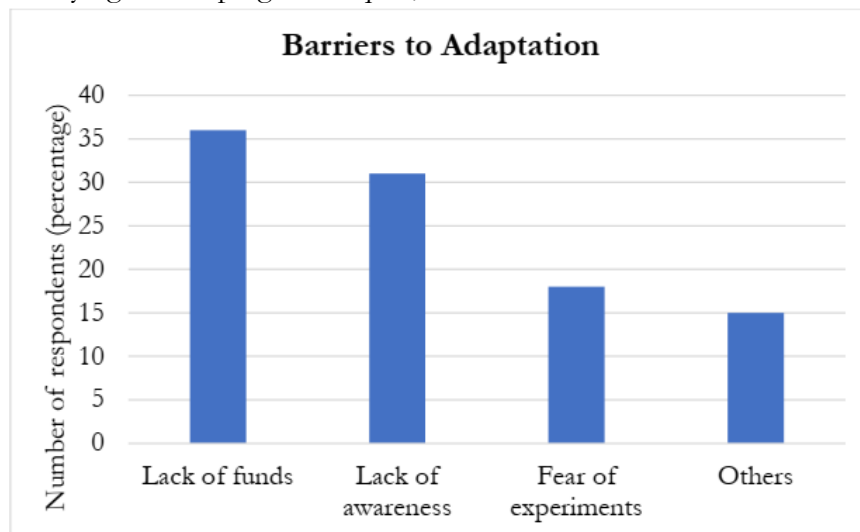


Figure 5: Barriers to Adaptation

A whopping 91% of the respondents shared that their union council in Mianwali does not have any plans to accommodate climate changes in place to address the impacts of environmental change. It's really concerning to see such a significant level of irresponsibility in managing the overwhelming effects of environmental changes in Mianwali. It appears that there is a dearth of climate change planning and awareness sessions focused on adaptation strategies in Mianwali, Pakistan. This implies a pressing need for the development and implementation of

comprehensive plans and educational initiatives to effectively address the challenges posed by climate change in the region.

Adaptation Strategy for Crops:

In Figure 6, a significant percentage of respondents indicated that they are employing the adaptation strategy of crop diversification to combat the effects of climate change. The majority of people are indeed using crop diversification as their primary adaptation strategy against climate change. Additionally, other strategies such as using short-duration varieties, hybrid varieties, and practicing organic farming are also being implemented by some individuals. Farmers might choose to focus on crop diversification as an accommodation strategy due to factors such as limited awareness, skills, and financial resources.

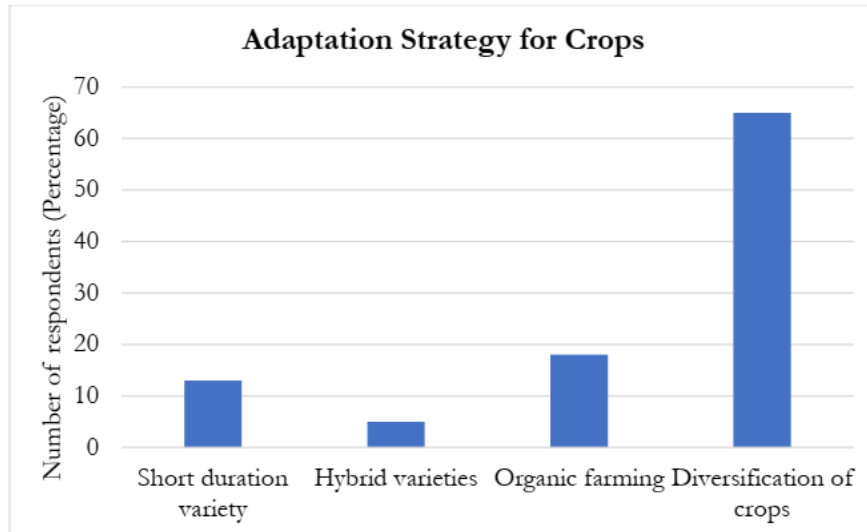


Figure 6: Response of people against adaptation strategy for crops

Climate Change Awareness:

It turned out that a significant number of respondents, around 60%, were unaware of the concept of climate change. This means that out of the 200 respondents, only 80 had knowledge about climate change. Out of the questionnaires filled, 25 of them were actually completed by local officials. This indicates that the level of awareness about climate change among the people of Mianwali District is relatively low. Table 1 presents the responses of the individuals regarding their level of awareness regarding climate change phenomena. Mianwali district has a higher proportion of rural areas compared to urban areas. Interestingly, all respondents from rural areas were unaware of the concept of climate change. On the other hand, those who claimed to have knowledge about climate change had limited understanding beyond just the term itself.

Table 1: Extent of climate change awareness in the District Mianwali

Responses		Frequency	Percentage
Valid	Only heard	35	20%
	Know a little about it	32	14 %
	Knows a great deal about it.	13	6 %
Total		80	40%
Didn't Respond		120	60 %
Total		200	

Public Awareness and Knowledge:

Awareness to Climate Change and Education:

Education plays a crucial role in raising awareness about environmental issues, such as climate change. According to Raudsepp (2001) [20], people with higher education tend to be

more concerned about environmental issues and have a better understanding of climatic crises. Pakistan lags behind many countries in terms of providing access to environmental education. Unfortunately, the quality of the education that is available is quite low. This study suggests that the respondents who were aware of climate change had slightly higher levels of education compared to those who were unaware. Figure 7 indicates that there are more respondents with a master's degree among those who are aware of climate change. However, overall, both categories of respondents seem to have low levels of education. This probably reflects the general low level of education and literacy in Mianwali.

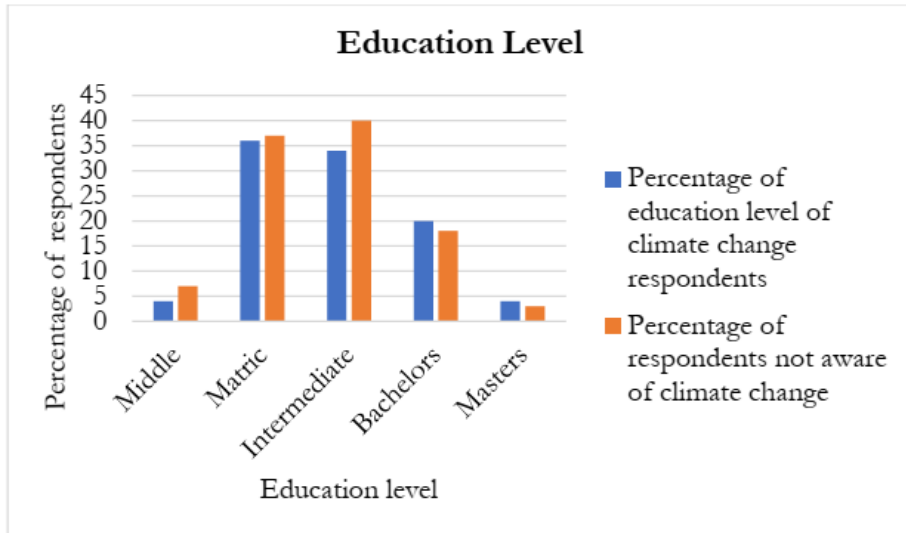


Figure 7: Educational level

Community Resilience:

Response of Local Community Against Adaptive Strategies:

The local community in Mianwali was surveyed through questionnaires and interviews to gather insights on the adaptive strategies they are employing against environmental issues. Table 2 provides the breakdown of responses received from the local community regarding their stance on climate change.

Table 2: Percentage distribution of responses

Response Against Adaptive Strategies	Yes (%)	No (%)
Conservation of water and soil	50%	49%
Use of organic manures	75%	25%
Use of inorganic fertilizer	76%	24%
Planting pest and disease-resistant crop	41%	59%
Cover cropping	71%	29%
Use of minimum tillage system (zero or minimum)	57%	42%
Use of irrigation system/water storage	52%	48%
Protection of watersheds and mulching	64%	36%
Use of a weather-resistant variety	25%	75%
Planting of crops with early rainfall	80%	20%
Changing the dates of harvesting	47%	53%
Listening to information regarding climate change	40%	60%
Use of windbreaks	37%	63%
Reclamation of wetlands	21%	79%

Changes in Household Sizes:

While studying climate, researchers often focus on the financial impacts, they tend to overlook important demographic factors such as household size, living arrangements, and age

structures. These factors are crucial for understanding adaptive responses to climate change and assessing the vulnerability and resilience of populations facing future risks [21][22]. In Isa Khel, the size of households in 2023 decreased by 1.3 persons, as shown in Figure 8. Similarly, other tehsils also experienced a decline in household sizes in the same year.

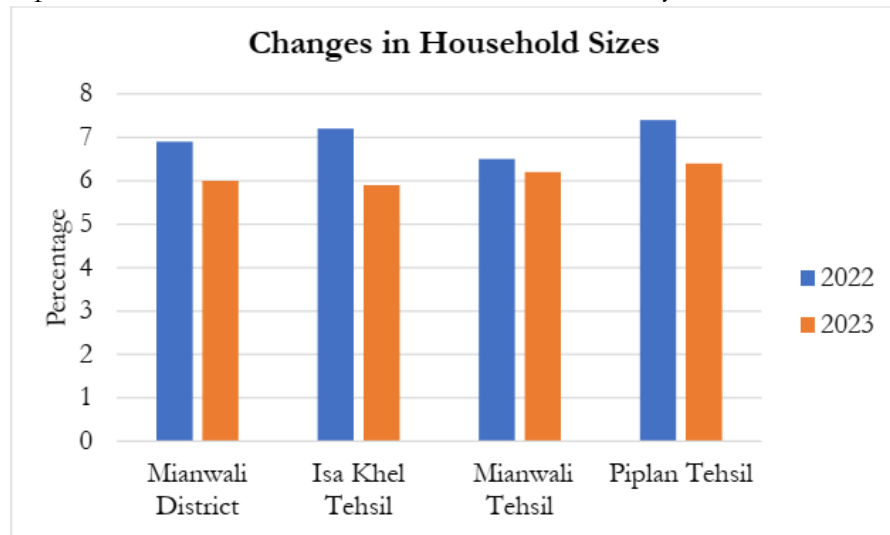


Figure 8: Changes in household sizes

Climate Change and Agriculture:

Changing climate can have varied impacts on farming and cultivation in Pakistan. For instance, the widespread increases in temperature over a country can lead to a decrease in crop yields amid this climatic condition [23]. Water accessibility is expected to decrease in the future, according to predictions [24]. To minimize the losses caused by climate change, it is crucial to prioritize farmers' resilience techniques. Despite the known impact of climate change, implementing various measures in agricultural management can help mitigate its negative effects [25].

Future Trends for Floods:

There are several models and tools that are used to predict future flood trends and risks. Some of the flood prediction models are; hydrological models, weather forecast models, Geographical Information System (GIS), flood plain mapping tools, and satellite and remote sensing data. These models rely on various data sources and computational methods to make predictions about floods. Although these models and future flood forecast trends are out of the scope of this study, these models are really effective in predicting and minimizing the effects of floods in the future.

Impact of Climate Change on Women:

Women of the region were slightly less aware of the changes in climate patterns. However, they were concerned about the impacts of floods as a repercussion of climate change. Women in Pakistan are culturally encouraged to stay at home, especially women of lower-middle and middle-class backgrounds. This cultural practice is also true for the women of rural regions. However, rural women also participate in agricultural activities, which allow them to move out of their homes. Hence, these women of Urban and rural background, along with their children, are the most impacted individual from climate change. Houses serve as the shelter, space for honorable survival, and zone of exercising piety for the women of Pakistan and this region. With the increase in flooding and the threat of destruction of their homes, the women of Mianwali will be unable to feel secure and express their identity. Furthermore, the decrease in water accessibility, a threat to agriculture along with the lack of financial resources, the women of the Mianwali region are expected to face the high impact of inequalities and gender exclusivity. In

short, climate change is impacting the women of Mianwali in multiple dimensions; like, socio-cultural, economic, infrastructural, and gender equality, because of which neither it is not possible for them to maintain their individual consent over matters of their lives but also are hindered in adjusting themselves with the cultural norms.

The results of this study align with the hypotheses outlined in our conceptual framework. They highlighted the crucial role of public awareness and knowledge in driving adaptive measures and influencing community resilience. However, the findings also emphasized the need for increased efforts to raise awareness about climate change, particularly in rural areas. The study suggests that public responses to climate change are influenced by a combination of factors, including awareness, education, perceived threat, and access to resources. To enhance resilience and promote policy advocacy, targeted interventions are needed, especially in areas with limited access to adaptive measures.

Overall, the results provide valuable insights into the complex relationships between climate change, public responses, and community resilience in Mianwali. These findings have significant implications for local policymakers and organizations striving to address the challenges posed by environmental changes in the region. For future recommendations, this study suggests that public awareness and climate change education shall be the prime focus of the local authorities. Also, the flood prediction models shall be effectively used to predict and deal with this catastrophe.

Conclusion:

In this study, we have evaluated the adaptive capacity of the residents' community in Mianwali, Punjab, Pakistan, specifically focusing on identifying the impacts of climate change in the district and assessing the locals' ability to adapt to these changes. The study involved using questionnaires and conducting interviews with the local community in Mianwali. The findings revealed that a significant number of people in the study area are not familiar with the term "climate change." Due to the high risk of floods in Mianwali district, many people choose migration as an adaptive strategy. The residents were asked about their utilization of different resilience techniques, and the results were documented. Moreover, when the locals were questioned about managing crop patterns, they responded that the changes in crop patterns are attributed to factors other than environmental issues. In the study area, the locals commonly employed the adaptive strategy of adopting new crop varieties along with enhancing the water system. The study further concluded that limited financial resources, low awareness, and the fear of experimentation due to poverty conditions are significant barriers to modifications among the locals in the Mianwali district.

References:

- [1] J. Abid, M., Schneider, U. A., & Scheffran, "Adaptation to climate change and its impacts on food productivity and crop income: Perspectives of farmers in rural Pakistan," *J. Rural Stud.*, vol. 47, pp. 254–266, 2016.
- [2] W. Ullah, M. Nafees, M. Khurshid, and T. Nihei, "Assessing farmers' perspectives on climate change for effective farm-level adaptation measures in Khyber Pakhtunkhwa, Pakistan," *Environ. Monit. Assess.*, vol. 191, no. 9, pp. 1–18, Sep. 2019, doi: 10.1007/S10661-019-7651-5/METRICS.
- [3] "Global Climate Risk Index 2020 | Germanwatch e.V." Accessed: Oct. 22, 2023. [Online]. Available: <https://www.germanwatch.org/en/17307>
- [4] A. Gorst, A., Groom, B., & Dehlavi, "Crop productivity and adaptation to climate change in Pakistan. Centre for climate change economics and policy," *Work. Pap. No. 214.change Adapt. Nat. Clim. Chang.*, vol. 4, no. 10, pp. 867–872, 2015.
- [5] P. Wester, A. Mishra, A. Mukherji, and A. B. Shrestha, "The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People," Hindu Kush

- Himalaya Assess. Mt. Clim. Chang. Sustain. People, pp. 1–627, Jan. 2019, doi: 10.1007/978-3-319-92288-1/COVER.
- [6] A. Jamshed, I. A. Rana, U. M. Mirza, and J. Birkmann, “Assessing relationship between vulnerability and capacity: An empirical study on rural flooding in Pakistan,” *Int. J. Disaster Risk Reduct.*, vol. 36, p. 101109, May 2019, doi: 10.1016/J.IJDRR.2019.101109.
- [7] I. A. Rana and J. K. Routray, “Actual vis-à-vis perceived risk of flood prone urban communities in Pakistan,” *Int. J. Disaster Risk Reduct.*, vol. 19, pp. 366–378, Oct. 2016, doi: 10.1016/J.IJDRR.2016.08.028.
- [8] F. Ahmad, S. F. Kazmi, and T. Pervez, “Human response to hydro-meteorological disasters: A case study of the 2010 flash floods in Pakistan,” *J. Geogr. Reg. Plan.*, vol. 4, no. 9, pp. 518–524, 2011, Accessed: Oct. 22, 2023. [Online]. Available: <http://www.academicjournals.org/JGRP>
- [9] S. Deen, “Pakistan 2010 floods. Policy gaps in disaster preparedness and response,” *Int. J. Disaster Risk Reduct.*, vol. 12, pp. 341–349, Jun. 2015, doi: 10.1016/J.IJDRR.2015.03.007.
- [10] G. of Pakistan, “Annual flood report 2016”. Federal Flood Commission, Ministry of Water and Power, Government of Pakistan, 2016.”
- [11] Atta-ur-Rahman and A. N. Khan, “Analysis of flood causes and associated socio-economic damages in the Hindukush region,” *Nat. Hazards*, vol. 59, no. 3, pp. 1239–1260, Dec. 2011, doi: 10.1007/S11069-011-9830-8/METRICS.
- [12] K. Bakhsh and M. A. Kamran, “Adaptation to Climate Change in Rain-Fed Farming System in Punjab, Pakistan,” *Int. J. Commons*, vol. 13, no. 2, pp. 833–847, 2019, doi: 10.5334/IJC.887.
- [13] A. Ali and O. Erenstein, “Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan,” *Clim. Risk Manag.*, vol. 16, pp. 183–194, Jan. 2017, doi: 10.1016/J.CRM.2016.12.001.
- [14] M. Abid, M. Scheffran, J. Schneider, U. A., & Ashfaq, “Farmers’ perception of an adaptation strategies to climate change and their determinants: The case of Punjab Province, Pakistan,” *Earth Syst. Dyn.*, vol. 6, pp. 225–243, 2015.
- [15] D. Ahmad, M. Afzal, and A. Rauf, “Analysis of wheat farmers’ risk perceptions and attitudes: evidence from Punjab, Pakistan,” *Nat. Hazards*, vol. 95, no. 3, pp. 845–861, Feb. 2019, doi: 10.1007/S11069-018-3523-5/METRICS.
- [16] S. Rauf, K. Bakhsh, A. Abbas, S. Hassan, A. Ali, and H. Kächele, “How hard they hit? Perception, adaptation and public health implications of heat waves in urban and peri-urban Pakistan,” *Environ. Sci. Pollut. Res.*, vol. 24, no. 11, pp. 10630–10639, Apr. 2017, doi: 10.1007/S11356-017-8756-4/METRICS.
- [17] K. Thomas et al., “Explaining differential vulnerability to climate change: A social science review,” *Wiley Interdiscip. Rev. Clim. Chang.*, vol. 10, no. 2, p. e565, Mar. 2019, doi: 10.1002/WCC.565.
- [18] K. Eisenack et al., “Explaining and overcoming barriers to climate change adaptation,” *Nat. Clim. Chang.* 2014 410, vol. 4, no. 10, pp. 867–872, Sep. 2014, doi: 10.1038/nclimate2350.
- [19] R. Biesbroek, J. Klostermann, C. Termeer, and P. Kabat, “Barriers to climate change adaptation in the Netherlands,” *Clim. Law*, vol. 2, no. 2, pp. 181–199, Jan. 2011, doi: 10.1163/CL-2011-033.
- [20] M. Raudsepp, “SOME SOCIO-DEMOGRAPHIC AND SOCIO-PSYCHOLOGICAL PREDICTORS OF ENVIRONMENTALISM,” *Trames. J. Humanit. Soc. Sci.*, vol. 5, no. 4, p. 355, 2001, doi: 10.3176/TR.2001.4.06.
- [21] S. Bartlett, “Climate change and urban children: impacts and implications for adaptation

- in low- and middle-income countries,” <http://dx.doi.org/10.1177/0956247808096125>, vol. 20, no. 2, pp. 501–519, Oct. 2008, doi: 10.1177/0956247808096125.
- [22] A. G. Patt, A. Dazé, and P. Suarez, “Gender and climate change vulnerability: What’s the problem, what’s the solution?,” *Distrib. Impacts Clim. Chang. Disasters Concepts Cases*, pp. 82–102, 2009, doi: 10.4337/9781849802338.00013.
- [23] S. Babar, E. H. Siddiqi, I. Hussain, K. Hayat Bhatti, and R. Rasheed, “Mitigating the Effects of Salinity by Foliar Application of Salicylic Acid in Fenugreek,” *Physiol. J.*, vol. 2014, pp. 1–6, Apr. 2014, doi: 10.1155/2014/869058.
- [24] I. Jan, M. Ashfaq, and A. A. Chandio, “Impacts of climate change on yield of cereal crops in northern climatic region of Pakistan,” *Environ. Sci. Pollut. Res.*, vol. 28, no. 42, pp. 60235–60245, Nov. 2021, doi: 10.1007/S11356-021-14954-8/METRICS.
- [25] Q. Schiermeier, “Quest for climate-proof farms,” *Nature*, vol. 523, no. 7561, pp. 396–397, Jul. 2015, doi: 10.1038/523396A.



Copyright © by authors and 50Sea. This work is licensed under Creative Commons Attribution 4.0 International License.