People Perspectives on Climate Change Impacts and Adaptive Strategies: A Study of Vulnerabilities, Coping Mechanisms, and Resilience in Khyber Pakhtunkhwa (KP), Pakistan

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Abstract

This research investigates public perspectives on the impacts of climate change and adaptive strategies in Khyber Pakhtunkhwa, Pakistan, with a focus on vulnerabilities, coping mechanisms, and resilience at both individual and community levels. Using a mixed-methods approach that includes field surveys, focus group discussions (FGDs), and expert interviews, the study provides an in-depth analysis of how climate change affects various aspects of life in the region.

The findings reveal that climate change presents a significant threat to the public, leading to widespread consequences for health, daily activities, and livelihoods. Key vulnerabilities include limited access to resources, healthcare, and decision-making processes, which further exacerbate the community's challenges. Gaps in awareness programs and capacity-building efforts hinder effective preparedness and response, leaving the community inadequately equipped to handle climate-related risks.

The study emphasizes the critical role of existing social structures, such as families, community elders (Jirgas), and local leaders, in supporting resilience, although coordination with local authorities remains inadequate. Recommendations highlight the need for inclusive climate adaptation strategies that integrate culturally appropriate communication in local

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languages, ensure equitable distribution of resources, and empower local leadership in decision-making. The research advocates investments in education, healthcare, and economic opportunities to build resilience, with a particular focus on promoting gender equality in climate change adaptation efforts.

By addressing these gaps and using traditional support systems, this study proposes community-centered solutions to enhance climate resilience. It aims to inform policies and interventions that improve preparedness and resilience to climate emergencies, contributing to a more sustainable and equitable future for all residents of Khyber Pakhtunkhwa. This study adds to the growing body of knowledge on climate change adaptation by integrating public perspectives and suggesting strategies to address vulnerabilities and build long-term resilience in vulnerable regions.

Keywords: Climate Change Adaptation, Vulnerability, Resilience, Khyber Pakhtunkhwa, Coping Mechanisms, Public Perspectives, Community-Based Solutions, Early Warning Systems, Social Structures, Gender Equality.

1. Introduction

Climate change refers to long-term shifts in temperature and typical weather patterns in a place. Primarily driven by human activities that release greenhouse gases into the atmosphere, climate change disrupts natural ecosystems and weather patterns (Intergovernmental Panel on Climate Change [IPCC], 2021). The IPCC reports a global average temperature rise of 1°C since pre-industrial times, with projections indicating further warming if significant mitigation efforts are not undertaken (IPCC, 2021). This warming has various consequences, including rising sea levels, melting glaciers, and more extreme weather events (IPCC, 2021).

Pakistan ranks among the most vulnerable countries to climate change due to its geographical location and socio-economic factors (Rasul et al., 2012). The country experiences variations in climate across its regions, with mountainous areas in the north facing glacial melting and floods, while the southern plains grapple with droughts and heatwaves (Rasul et al., 2012). A study by Rasul et

al. (2012) highlights a rise in average temperatures across Pakistan, with projections indicating further increases and changes in precipitation patterns (Rasul et al., 2012). These alterations pose significant challenges for Pakistan's water resources, agriculture, and overall socio-economic development (Rasul et al., 2012).

Khyber Pakhtunkhwa, a mountainous province bordering Afghanistan, is particularly vulnerable to climate change. The Hindu Kush Mountain range plays a crucial role in regulating regional weather patterns. However, glacial melting due to rising temperatures threatens water security and increases the risk of flash floods downstream (Khan et al., 2020). Studies by Khan et al. (2020) warn of potential water scarcity in the province due to erratic rainfall patterns and increased irrigation demands (Khan et al., 2020). Furthermore, extreme weather events like heatwaves and droughts threaten agricultural productivity, impacting livelihoods and food security in the region (Khan et al., 2020).

Understanding the gendered dimensions of climate change is crucial for effective adaptation strategies. Women often play a central role in household food security, water management, and childcare in communities. However, they face unique challenges in coping with climate change due to limited access to resources, information, and decision-making power (Ford et al., 2015). For instance, droughts and water scarcity can disproportionately burden community members responsible for water collection within households (WEDO, 2019). Similarly, heatwaves can exacerbate existing gender inequalities in healthcare access, particularly impacting the health of the public (Watts et al., 2015).

Climate change is a complex issue with far-reaching consequences. In Pakistan, and particularly in Khyber Pakhtunkhwa, the impacts of climate change threaten livelihoods, water security, and overall well-being. Understanding how these impacts disproportionately affect the public is

essential for developing effective adaptation strategies. Gender-inclusive approaches that empower community members and address their specific needs are crucial for building resilient communities capable of withstanding the challenges posed by a changing climate.

Climate change poses a significant threat to communities worldwide, with its impacts disproportionately affecting vulnerable populations, including the public (Ford et al., 2015). Pakistan, a country with diverse geographical features, is highly susceptible to the adverse effects of climate change, experiencing rising temperatures, erratic rainfall patterns, and more frequent extreme weather events like floods, heatwaves, and droughts (Rasul et al., 2012).

This study explores the specific case of Khyber Pakhtunkhwa (KP), a province in northwest Pakistan, highlighting the importance of understanding climate change's impact on the public in this region.

This baseline survey/study was conducted to explore community members' perspectives on climate change at individual and community levels. The study aimed to understand the adverse effects of climate change within the targeted community, identifying specific needs, challenges, adaptive measures, and proposed solutions. The goal was to devise effective strategies to address climate-related challenges, particularly during pre- and post-climate emergency situations.

To achieve this, a comprehensive interview schedule/questionnaire was developed. The baseline survey employed three primary data collection methods/tools for data collection including Interviews Schedules/questionnaire, Focus Group Discussions (FGDs) with key respondents from community members, men in the target communities of selected areas, and in-depth interviews with relevant experts especially government departments. The interview schedule/questionnaire was

implemented across four selected areas/districts of Khyber Pakhtunkhwa, Pakistan. These four distinct geographical zones within Khyber Pakhtunkhwa strategically divided the study to provide a comprehensive understanding of climate change dynamics across diverse terrains.

By examining climate-related issues, mitigation efforts, and viable strategies, the study provided deeper insights into climate change resilience and justice in real-world contexts. Four districts were strategically selected for the study based on their geographical representation of Khyber Pakhtunkhwa's diverse landscapes: Dir Upper represented the northern mountainous areas, Mansehra represented the Eastern region, Lakki Marwat represented the southern region, and Peshawar represented the middle plain area, also covering the middle-western part of KP. By incorporating the voices of community members, the baseline survey identified their specific needs and challenges, thereby informing effective mitigation strategies and promoting inclusive adaptation plans.

1.1 Methodology and Sample Distribution

A mixed-methods approach was employed to evaluate climate resilience across four strategically selected districts in Khyber Pakhtunkhwa (KP). The districts chosen to represent the geographical diversity of the region, were Dir Upper from the northern mountainous zone, Lakki Marwat from the southern region, Mansehra from the eastern zone, and Peshawar from the central plains in the western-central zone. This selection provided insights into climate resilience across varied terrains and communities.

The study involved both literate (individuals with at least primary or 12 years of education) and non-literate heads of households, utilizing three primary data collection methods. First, 40 interviews were conducted with heads of households (male and female) using structured interview schedules. Second, eight focus group discussions (FGDs) were held, two in each target district,

with a minimum of 10 -participants per session. Gender balance was ensured through separate discussions for male and female participants, capturing diverse perspectives on climate change impacts. Third, in-depth expert interviews were conducted with five representatives from government departments in Peshawar to gain specialized insights.

The sample size for the study was calculated using Cochran's formula to achieve a 95% confidence level and a 5% margin of error. The formula, n0 = (Z^2 * p * (1 - p)) / e^2, with Z = 1.96, p = 0.5, and e = 0.05, yielded an initial sample size of 384.16, rounded to 384. Adjusting for the finite population of KP (40,856,097) (Population Census 2023), the refined sample size became 385, ensuring statistical accuracy.

The selected districts collectively represented a population of 8,680,361 based on the population 2023 census: Dir Upper (1,083,566), Lakki Marwat (1,040,856), Mansehra (1,797,177), and Peshawar (4,758,762). The total sample size of 385 was proportionally allocated across these districts using the formula ni = n * (Ni / N_selected), where ni is the sample size for district i, Ni is the population of district i, and N_selected is the combined population of the selected districts. The calculated sample sizes were: 48 for Dir Upper, 47 for Lakki Marwat, 80 for Mansehra, and 211 for Peshawar.

To further ensure a comprehensive understanding, a minimum of 80 participants were engaged in FGDs, with two discussions in each district (one male and one female group). Additionally, 10 in-depth interviews were conducted with heads of families in each district, equally divided between literate and non-literate respondents.

By integrating these diverse methods and ensuring proportional representation from each geographical zone, the study provided an in-depth understanding of climate resilience across KP. This approach highlights the perspectives and experiences of community members and experts alike, offering a holistic view of the challenges and opportunities related to climate change adaptation.

2. Findings and Discussion

This report analyzes data on climate change's impact on the public in selected four regions of Khyber Pakhtunkhwa, Pakistan. The analysis combines quantitative data obtained through field survey and qualitative data obtained through focus groups and expert interviews. This mixed-methods approach provides a comprehensive understanding of the issue. Survey establishes how common certain experiences and perceptions are, while focus groups and interviews offer deeper insights into daily life, challenges, and coping mechanisms, particularly for the public. By considering these perspectives together, this section aims to: i). present key findings on how climate change affects the daily lives, health, and well-being of the public, ii). give voice to the experiences and concerns of community members, especially community members, and iii). provide context for the survey data by using qualitative information to create a more complete picture of the situation. This integrated analysis informs the development of effective climate change adaptation strategies that are evidence-based and address the specific needs and vulnerabilities of the public in the region.

3. Respondent Demographic and Socio-Economic Characteristics

Table 3.1 presents the key findings on the demographics and socio-economic characteristics of the survey respondents. The survey included an equal number of men and women, ensuring balanced gender representation. The age distribution indicates that most respondents (50%) are young adults (18-30 years old), with the remaining respondents fairly distributed across other age groups (31-45, 46-60, and over 60).

The respondents were proportionally distributed across the four selected districts, consistent with the geographic scope of the study and the calculated sample size: Peshawar (211 respondents, 54.8%), Mansehra (80 respondents,

20.8%), Dir Upper (48 respondents, 12.5%), and Lakki Marwat (47 respondents, 12.2%).

Regarding family size, the most common family sizes reported were 5-6 members (40%) and 7 or more members (40%), with a smaller portion having families of 3-4 members (20%). None of the respondents reported family sizes of 1-2 members.

In terms of education, half of the respondents (50%) reported having no formal education, while others attained primary (7.5%) or secondary (5%) education. A notable proportion (37.5%) held college or university degrees.

Table 3.1: Respondent Demographic and Socio-Economic Characteristics

Variables	Values	Frequency	Percentage
Gender of the Respondent	Male	192	50.0%
	Female	192	50.0%
	Total	**384**	**100%**
Age of the Respondent	Under 18	0	0.0%
	18-30	192	50.0%
	31 – 45	115	30.0%
	46 – 60	58	15.0%
	Over 60	19	5.0%
	Total	**384**	**100%**
Location of Living	Peshawar	211	54.8%
	Lakki Marwat	47	12.2%

	Dir Upper	48	12.5%
	Mansehra	80	20.8%
	Total	**384**	**100%**
Number of Family Members	1 – 2	0	0.0%
	3 – 4	77	20.0%
	5 – 6	154	40.0%
	7 or More	154	40.0%
	Total	**384**	**100%**
Education Level of Respondent	No Formal Education	192	50.0%
	Primary School	29	7.5%
	Secondary School	19	5.0%
	College/University	144	37.5%
	Total	**384**	**100%**

This distribution ensures proportional representation from all selected districts and captures a comprehensive understanding of the socio-economic characteristics and perspectives on climate resilience from diverse communities in KP.

4. Understanding Climate Change, its Impacts and Adaptation

The following table 4.1 provides an understanding and awareness of climate change, its impacts, and adaptation strategies within the studied communities, the extent to which climate change has affected lives in the past decade, the most common climate hazards experienced in the communities, and the

frequency of these climate-related hazards. This data will provide valuable insights into the vulnerabilities and adaptation needs of the population in the context of a changing climate.

Table 4.1: Understanding Climate Change, its Impacts, and Adaptation

Variables	Frequency	Percentage
Do you know about climate change?		
Yes	317	82.5%
No	67	17.5%
Total	**384**	**100%**
What describes climate change to you?		
A long-term alteration of temperature and typical weather patterns in a place	29	7.5%
An increase in average global temperatures, primarily caused by human activities that release greenhouse gases	86	22.5%
More extreme weather events, such as heat waves, droughts, floods, and stronger storms	249	65%
Change in weather	20	5%
Total	**384**	**100%**
To which extent has climate change affected your life over the last 10 years?		
To minimal extent	182	47.5%
To higher extent	202	52.5%
Not at all	0	0%
Total	**384**	**100%**

Which of the following climate-related hazards have you experienced in your community? (Select all that apply)		
Flooding, Drought, Extreme heat, and Heavy rainfall	259	67.5%
Flooding, Drought, Extreme heat, Landslides, and Heavy rainfall	125	32.5%
Total	**384**	**100%**
How often do you experience climate-related hazards in your community?		
Rarely	115	30%
Occasionally	125	32.5%
Frequently	96	25%
Almost every year	48	12.5%
Total	**384**	**100**

Table 4.1 provides an overview of the community's awareness and understanding of climate change, its impact on daily lives, and the types of climate-related hazards experienced in the community.

A large majority of respondents (82.5%, or 317 out of 384) are aware of climate change, indicating strong general awareness across the surveyed population. However, 17.5% (67 respondents) are unaware of climate change, which highlights the need for further education and awareness campaigns to reach this group.

While a significant portion of respondents is aware of climate change, their understanding of its scientific basis appears limited. The majority (65%, or 249 respondents) define climate change primarily in terms of extreme weather events, such as heat waves, droughts, floods, and stronger storms, rather than

its long-term atmospheric and environmental changes. A smaller portion (22.5%, or 86 respondents) correctly identifies climate change as an increase in average global temperatures caused by human activities that release greenhouse gases. Only 7.5% (29 respondents) correctly describe climate change as "a long-term alteration of temperature and typical weather patterns in a place," reflecting a gap in scientific literacy about the issue. Additionally, 5% (20 respondents) describe it simply as "change in weather," showing a lack of awareness of its broader, long-term impacts.

In terms of the personal impact of climate change, over half (52.5%, or 202 respondents) feel that climate change has affected their lives to a higher extent in the past decade. Meanwhile, 47.5% (182 respondents) feel it has impacted them to a minimal extent, with no respondents indicating that climate change has had no effect at all. This suggests a widespread belief in the tangible effects of climate change, although the perceived severity of these effects varies.

Regarding climate-related hazards, 67.5% (259 respondents) have experienced a combination of flooding, drought, extreme heat, and heavy rainfall in their communities. A smaller proportion (32.5%, or 125 respondents) have encountered landslides in addition to the hazards, particularly in areas like Mansehra, which is more prone to landslides due to its mountainous terrain. This indicates that climate hazards vary by region, with some areas more vulnerable to specific types of extreme weather.

Climate-related hazards are experienced regularly across the surveyed communities. Most respondents report experiencing them occasionally (32.5%, or 125 respondents) or rarely (30%, or 115 respondents). A notable portion (25%, or 96 respondents) encounter these hazards frequently, and 12.5% (48 respondents) experience them almost every year. These figures highlight the varying frequencies of climate-related hazards, with some

communities facing them more regularly than others, underscoring the need for region-specific adaptation and mitigation strategies.

The data illustrates that while climate change is widely recognized, there are gaps in understanding its scientific causes. A significant portion of the population experiences climate-related hazards, with some facing these events more frequently than others. This highlights the importance of targeted climate adaptation strategies and educational programs to address the varying needs of different communities.

5. Impact on Daily Life

The impact on daily life of climate change has been gauged with how extreme heat affects daily activities during the summer months, focusing on aspects like household chores, health concerns, livelihood disruptions, and access to cooling measures and the emotional impact of climate extremes by analyzing how these events make people feel, exploring emotions such as worry, sadness, anger, and fear. This provides an understanding of the valuable insights of understanding the human cost of extreme heat and the need for adaptation strategies that address not only physical challenges but also the emotional well-being of the community.

Table – 5.1: Impact on Daily Life

How does extreme heat affect your daily life and activities during the summer months?		
Impact	**Frequency**	**Percentage**
Difficulty in performing outdoor household chores (e.g., cooking, cleaning, laundry)	77	20.0%
Health issues such as dehydration, heat exhaustion, or heatstroke	58	15.0%
Challenges in caring for children or elderly	58	15.0%

family members due to extreme heat		
Limited access to cool shelter or relief from high temperatures	29	7.5%
Impact on livelihood activities (e.g., agriculture, small-scale businesses) due to heat-related disruptions	77	20.0%
Increased financial burden due to higher utility bills for cooling measures	58	15.0%
Psychological stress or anxiety related to coping with extreme heat	19	5.0%
Impact on mental well-being, including sleep disturbances or irritability	0	0.0%
Restrictions on outdoor leisure activities or social gatherings due to extreme heat	0	0.0%
Concerns about food safety and spoilage in hot weather conditions	0	0.0%
Greater vulnerability to heat-related illnesses due to lack of access to healthcare or medical services	10	2.5%
Other (please specify):	0	0.0%
Total	**384**	**100.0%**
How do extreme climate events make you feel emotionally?		
Emotion	**Frequency**	**Percentage**
Scared	48	12.5%
Worried	182	47.5%
Sad	86	22.5%
Angry	67	17.5%
Other (Please specify):	0	0.0%

Total	**384**	**100.0%**

Table 5.1 highlights how extreme heat disrupts daily life and its emotional toll on the respondents in the studied communities. Field data reveals that extreme heat significantly reduces physical capacity, with 20% (77 respondents) reporting difficulty performing outdoor household chores such as cooking, cleaning, and laundry. This strain on daily routines negatively impacts productivity. Health concerns like dehydration, heat exhaustion, and heatstroke were noted by 15% (58 respondents), indicating serious risks to well-being. Additionally, 15% of respondents faced challenges in caring for vulnerable groups, including children and elderly family members, during periods of extreme heat. Access to cool shelter or relief from high temperatures remained a problem for 7.5% (29 respondents). Livelihoods were also disrupted by 20% (77 respondents), especially in agriculture and small-scale businesses, while increased utility bills for cooling measures created financial strain for 15% (58 respondents). Although a smaller portion (5%, 19 respondents) reported psychological stress or anxiety, it is important to note that the emotional toll may be underreported in the data.

Emotional responses to extreme climate events further illustrate the profound psychological effects. Nearly half of the respondents (47.5%, 182 individuals) expressed feelings of worry, highlighting a widespread sense of unease about the future impacts of climate change. Sadness (22.5%, 86 respondents) and fear (12.5%, 48 respondents) underscore the emotional distress caused by these events, while 17.5% (67 respondents) reported anger, which could reflect frustration over the lack of effective solutions or control over the situation. Collectively, these findings underscore the multifaceted impact of extreme heat on physical and emotional well-being.

While 82.5% of respondents acknowledged climate change (Table 3.1), a significant knowledge gap persists, with many associating it solely with

extreme weather events rather than its broader implications. This gap was especially pronounced in Lakki Marwat and Dir Upper, as indicated in focus group discussions (FGDs). Health impacts remain a major concern, with respondents frequently citing dehydration, heat exhaustion, waterborne diseases, and malnutrition during extreme weather events. Women, who are primarily responsible for water collection, face amplified challenges during droughts and floods (FGDs in Lakki Marwat Male and Female). Respondents in Dir Upper emphasized the struggles of securing clean water during such events (Female FGD Dir Upper), further complicating their ability to meet household needs. These disruptions also damage infrastructure, with significant impacts on livelihoods, particularly in agriculture, as noted by male participants in the Peshawar FGD.

The emotional toll of these events is significant, with fear, sadness, and anger being reported by respondents across different regions. For instance, community members in Lakki Marwat and Dir Upper highlighted the psychological burden of frequent flooding events (Female FGDs in Lakki Marwat and Lower Dir). Interviews with experts confirmed these findings, emphasizing the exacerbating effects of socio-economic inequalities, limited access to resources, and insufficient decision-making power. These factors leave vulnerable groups, including women and children, disproportionately affected by climate change.

Cultural norms further intensify these vulnerabilities. FGDs in Lakki Marwat and Dir Upper revealed how norms restrict women's mobility, making it harder for them to access essential resources during disasters (FGD Lakki Marwat Male). This limitation compounds the challenges faced during climate emergencies, highlighting the intersection of environmental and social inequalities.

The findings confirm that climate change disproportionately impacts the public, exacerbating health risks, disrupting livelihoods, and taking a

significant emotional toll. These effects are compounded by socio-economic disparities and cultural norms, as highlighted by both quantitative data and qualitative insights from FGDs and expert interviews. Experts stressed the urgency of addressing these vulnerabilities through equitable resource allocation and inclusive decision-making processes to enhance resilience in the affected communities.

6. Impact on Health, Wellbeing and Access to Healthcare & Services

The following table 6.1 provides details on the health and well-being of the public in the context of climate change by exploring how climate hazards affect their health and investigates access to healthcare services during emergencies. The two themes health effects and access to healthcare are analyzed. That is how climate hazards disproportionately impact the health of the public in the community. The access to adequate healthcare services for the public during emergencies is discussed. This is particularly important because timely medical attention can be crucial in mitigating the health consequences of climate-related events.

Table – 6.1: Impact on Health, Wellbeing, and Access to Healthcare & Services

Question	Frequency	Percentage
Have climate-related hazards affected the health of the public in your community?		
Yes, significantly	163	42.5%
Yes, to some extent	211	55.0%
No, not significantly	0	0.0%
Not sure	10	2.5%

Total	**384**	**100.0%**
Which extreme climate event do you believe is primarily causing health issues in your community?		
Floods	28	7.5%
Extreme heat	202	52.5%
Drought	58	15.0%
Excessive and unseasonal rainfall	38	10.0%
Hailstorms	0	0.0%
Landslides	10	2.5%
Uncertain weather	10	2.5%
Total	**384**	**100.0%**
Which of the following health issues are commonly observed during extreme climate events?		
Heat-related illnesses (e.g., heatstroke)	106	27.5%
Respiratory problems (e.g., asthma)	19	5.0%
Waterborne diseases (e.g., diarrhea)	115	30.0%
Skin infections	106	27.5%
Malnutrition	29	7.5%
Abortion/Miscarriage	10	2.5%
Total	**384**	**100.0%**
Do public members have access to adequate healthcare services during climate-related emergencies?		
Yes, easily accessible	96	25.0%

Yes, but limited access	173	45.0%
No, inadequate access	106	27.5%
Not sure	10	2.5%
Total	**384**	**100.0%**

Table 6.1 provides an insightful overview of the significant impact of climate-related hazards on health, well-being, and access to healthcare services for the public. A large majority of respondents (97.5%) acknowledged the negative impact of climate hazards on health, with 42.5% (163 respondents) reporting significant effects and 55% (211 respondents) indicating that the impact was to some extent. Only 2.5% (10 respondents) were unsure, while no respondents reported that climate hazards had no significant impact on health.

In terms of the types of climate hazards affecting health, over half of the respondents (52.5%, 202 respondents) identified extreme heat as the primary cause of health issues in their community. This was supported by the finding that heat-related illnesses, such as heatstroke, were among the most reported health issues, affecting 27.5% (106 respondents). Other health problems included waterborne diseases (30%, 115 respondents) and skin infections (27.5%, 106 respondents), which were likely linked to flooding and inadequate sanitation during extreme weather events. Malnutrition (7.5%, 29 respondents) was also reported, which may be related to drought and food security issues. Less frequent health concerns included respiratory problems (5%, 19 respondents) and a smaller number (2.5%, 10 respondents) reporting cases of miscarriage or abortion due to extreme heat.

Access to healthcare services during climate-related emergencies was another critical issue. While 25% (96 respondents) reported easy access to healthcare services, 45% (173 respondents) experienced limited access, and 27.5% (106 respondents) had inadequate access. These barriers to healthcare access can

worsen health outcomes during climate-related emergencies, particularly when timely medical attention is crucial for mitigating the health risks associated with extreme climate events.

The findings of FGDs conducted in Lakki Marwat, Peshawar, Mansehra, and Dir Upper further confirmed these results. Participants noted an increased incidence of dehydration, fatigue, heatstroke, diarrhea, skin disorders, respiratory issues, and malnutrition during and after extreme weather events. Notably, FGD respondents from Lakki Marwat also reported health complications such as miscarriage due to extreme heat.

Expert interviews underscored the role of socio-economic factors in exacerbating the vulnerabilities of the public to health impacts. Physiological differences, coupled with socio-economic disparities, make the public more susceptible to climate-related health risks. Women, who are often responsible for water collection and household chores, are particularly vulnerable during extreme weather events such as droughts and floods. Limited access to resources and decision-making power further complicates these challenges, as highlighted by experts.

Beyond the health impacts, climate change also significantly disrupts access to healthcare services. Focus group discussions from Lakki Marwat, Peshawar, and Dir Upper pointed to specific challenges faced by the public, such as the distance to healthcare facilities, lack of transportation, high service costs, shortage of medical staff and supplies, and cultural barriers, including the preference for male doctors. These challenges emphasize the urgent need for improving healthcare infrastructure and service delivery, especially in remote areas.

Moreover, the impact of extreme weather events extends beyond health to affect livelihoods, particularly in agriculture. In Peshawar, male participants emphasized how heatwaves disrupt crop production, threatening food security

and the livelihood of households' dependent on agriculture. Similarly, in Dir Upper, female respondents discussed difficulties in securing clean water and maintaining sanitation during floods, which further exacerbated health risks and limited their ability to manage household responsibilities.

Experts confirmed that climate hazards such as floods and droughts damage infrastructure, which significantly impacts access to resources and livelihoods, particularly in agriculture and informal sectors. The collective insights from both FGDs and expert interviews highlight the multifaceted challenges faced by the public due to climate change.

The findings confirm that climate change disproportionately impacts the health, well-being, and livelihoods of the public. Extreme weather events cause a range of health issues, and limited access to healthcare services during emergencies exacerbates these challenges. Women's roles in water collection and household management make them especially vulnerable to climate shocks. Socio-economic factors, cultural norms, and limited decision-making power further disadvantage the public. These findings underscore the need for integrated strategies that address health risks, improve healthcare access, and empower communities to adapt and build resilience in the face of a changing climate.

7. Community Preparedness and Resilience

Table 7.1 focuses on preparedness and coping mechanisms within the community and explores how prepared the community feels to deal with the health impacts of climate change. Table-7.1 identifies existing measures employed to enhance resilience to climate-related health risks. Furthermore, access to safe drinking water, a critical element for health and well-being, is examined specifically by the public during extreme weather events. The areas where the community is vulnerable have been discussed with a highlight on potential gaps in preparedness.

Table – 7.1: Community Preparedness and Resilience

Question	Frequency	Percentage
How prepared do you feel the community is in dealing with the health impacts of climate change?		
Very prepared	0	0.0%
Somewhat prepared	125	32.5%
Not very prepared	154	40.0%
Not at all prepared	106	27.5%
Total	**384**	**100.0%**
Which of the following measures are in place to enhance community resilience to climate-related health risks?		
Early warning systems	67	17.5%
Community health education programs	77	20.0%
Emergency shelters	96	25.0%
Access to clean water and sanitation facilities	96	25.0%
Community-based disaster risk reduction initiatives	48	12.5%
Other (Please specify)	0	0.0%
Total	**384**	**100.0%**
Do public members have access to safe drinking water during extreme climate events?		
Yes, always	173	45.0%
Yes, sometimes	96	25.0%

No, rarely	96	25.0%
Not sure	19	5.0%
Total	**384**	**100.0%**

Table 7.1 highlights the existing gaps in community preparedness and resilience to the health impacts of climate change. A significant portion of the respondents (40%, 154 respondents) expressed that the community is "not very prepared" to handle the health risks associated with climate change, and 27.5% (106 respondents) felt that the community is "not at all prepared." This indicates a critical need for intervention and capacity-building efforts to strengthen the community's ability to cope with climate-related health risks.

Regarding the measures in place to enhance community resilience, access to clean water and sanitation facilities, and emergency shelters were the most reported measures, each cited by 25% (96 respondents). These resources are essential in mitigating health risks during climate-related emergencies. Community health education programs (20%, 77 respondents) and early warning systems (17.5%, 67 respondents) also play significant roles in improving preparedness and reducing risk. However, community-based disaster risk reduction initiatives were cited by only 12.5% (48 respondents), suggesting a gap in empowering local communities to take ownership of their preparedness efforts. This gap is particularly concerning as community-driven approaches are crucial for long-term resilience.

When it comes to access to safe drinking water during extreme climate events, 45% (173 respondents) reported that the public always has access to safe drinking water. However, 25% (96 respondents) said access is sometimes available, and another 25% (96 respondents) said access is rare, indicating uncertainties in the availability of this critical resource during emergencies. Safe drinking water is crucial in preventing waterborne diseases, a health risk identified earlier in this study.

Focus group discussions (FGDs) across different regions revealed varying levels of preparedness. In Lakki Marwat, respondents from both genders reported feeling excluded from decision-making processes and emphasized the lack of early warning systems. They described being caught in floods without warning, and many highlighted health complications due to extreme heat. In contrast, participants from Mansehra presented a more positive outlook, reporting the existence of early warning systems and effective local leadership during emergencies. However, respondents from Dir Upper confirmed the complete absence of warning systems or any other measures to enhance preparedness, underscoring significant regional disparities in preparedness efforts.

Experts also reinforced these findings. They emphasized the importance of strengthening early warning systems and disaster risk reduction measures. Experts also stressed that these efforts must be inclusive, involving all community members, especially women and marginalized groups. Barriers such as cultural norms, limited resources, and a lack of awareness about gender issues in climate change adaptation were identified as major challenges to building resilience. Experts also pointed out that empowering community members through economic opportunities and education is vital for improving preparedness and resilience.

The findings from both the FGDs and expert interviews reveal that while some measures are in place to enhance community resilience, significant gaps remain in terms of comprehensive preparedness, inclusivity, and access to vital resources such as safe drinking water. The lack of effective early warning systems and community-driven risk reduction initiatives further exacerbates vulnerabilities, particularly for women, who are often responsible for water collection and household management. Addressing these gaps requires a multi-pronged approach that includes strengthening early warning systems, improving community health education, promoting local disaster risk

reduction efforts, and ensuring that women and marginalized groups are actively involved in decision-making processes.

The data highlights the urgent need to build community resilience through targeted interventions. Efforts should go beyond basic resources and focus on empowering communities to take ownership of their preparedness efforts, particularly by integrating early warning systems, community education, and gender-inclusive approaches. By addressing these challenges, communities can better prepare for and mitigate the health impacts of climate change, particularly for the most vulnerable members of society.

8. Awareness Programs and Capacity Building

Table-8.1 provides details about the critical areas of awareness, capacity building, and access to services in the context of climate change preparedness. Table-8.1 discusses the knowledge and information of the respondents by exploring the existence of awareness programs on climate mitigation and adaptation strategies. Additionally, identifies the primary sources of information for the public regarding climate emergencies understanding how informed the community is about climate risks is crucial for effective adaptation. Table-8.1 also examines the main barriers preventing access to services during emergencies. This includes limitations related to transportation, communication, or financial constraints. Identifying these barriers is essential for developing solutions to ensure everyone can access critical support during crises. Regarding capacity building, the availability of training programs to enhance resilience for the public, equipping the public with the knowledge and skills to cope with climate hazards is vital for building a more resilient community.

Additionally, coordination between stakeholders by evaluating the effectiveness of coordination between local authorities and communities. Effective communication and collaboration between these groups are

fundamental for successful implementation of climate change adaptation strategies. By analyzing these aspects, there are different areas where improvements are needed to empower the community to be better prepared for the challenges posed by climate change.

Table – 8.1: Awareness Programs and Capacity Building

Question	Frequency	Percentage
How effective is the coordination between local authorities and community members during climate-related emergencies?		
Very effective	19	5.0%
Somewhat effective	105	27.5%
Not very effective	173	45.0%
Not at all effective	87	22.5%
Total	**384**	**100.0%**
Have there been any awareness programs conducted in your community regarding climate-related mitigation and measures?		
Yes, regularly	0	0.0%
Yes, occasionally	38	10.0%
No, never	317	82.5%
Not sure	29	7.5%
Total	**384**	**100.0%**
Where do women and children in your community primarily obtain information about climate-related emergencies?		

Local departments	0	0.0%
Community meetings	29	7.5%
Radio/TV broadcasts	48	12.5%
Social media	211	55.0%
Word of mouth	96	25.0%
Other (Please specify)	0	0.0%
Total	**384**	**100.0%**
What are the main barriers preventing women and children from accessing services during extreme climate events?		
Distance to healthcare facilities	77	20.0%
Cost of healthcare services	125	32.5%
Lack of transportation	77	20.0%
Lack of awareness about available services	87	22.5%
Cultural or social barriers	19	5.0%
Other (Please specify)	0	0.0%
Total	**384**	**100.0%**
Have there been any training or capacity-building programs conducted for women and children in your community to enhance their resilience to climate-related emergencies?		
Yes, regularly	0	0.0%
Yes, occasionally	0	0.0%
No, never	365	95.0%
Not sure	19	5.0%

Total	**384**	**100.0%**

Table 8.1 reveals several concerning trends regarding awareness, capacity building, and access to services within the community. A significant portion of respondents (45%, 173 respondents) felt that coordination between local authorities and community members during climate-related emergencies is "not very effective." Additionally, 22.5% (87 respondents) reported that the coordination was "not at all effective." This indicates a clear communication gap, which could hinder the implementation of climate adaptation strategies. On the other hand, 27.5% (105 respondents) viewed the coordination as "somewhat effective," and only 5% (19 respondents) believed it was "very effective." This suggests a need for more effective communication and collaboration between authorities and the community to ensure better preparedness and response to climate emergencies.

The findings point to a major gap in awareness programs within the community. Most respondents (82.5%, 317 respondents) reported that no awareness programs had been conducted in their community regarding climate mitigation and adaptation strategies. Only 10% (38 respondents) indicated that occasional programs were held, and no respondents reported regular awareness programs. This lack of awareness significantly limits the community's capacity to prepare for and respond to climate-related emergencies effectively. This gap is concerning, as informed communities are better equipped to adopt mitigation measures and adapt to changing climate conditions.

Social media (55%, 211 respondents) emerged as the primary source of information about climate-related emergencies, followed by word of mouth (25%, 96 respondents) and radio/TV broadcasts (12.5%, 48 respondents). Local departments and community meetings, which could be more reliable and direct sources of information, were cited by a much smaller portion of the respondents (0% for local departments, 7.5% for community meetings). While

social media provides wide-reaching access to information, it can be unreliable, and the accuracy of climate-related information can vary. The FGDs revealed concerns regarding the reliability of social media as a source of information, particularly in areas like Lakki Marwat and Peshawar, where access to technology and phone ownership may be limited, further exacerbating communication barriers.

The study identified several key barriers preventing the community, especially women and children, from accessing services during extreme climate events. The primary barriers include the cost of healthcare services (32.5%, 125 respondents), lack of transportation (20%, 77 respondents), distance to healthcare facilities (20%, 77 respondents), and a lack of awareness about available services (22.5%, 87 respondents). These barriers highlight the need for improved infrastructure, better healthcare access, and more effective outreach to ensure that vulnerable groups, especially women and children, can receive the support they need during climate emergencies.

A concerning finding is the complete lack of training or capacity-building programs for the public, with 95% (365 respondents) reporting that no such programs have been conducted. Only 5% (19 respondents) indicated uncertainty regarding the availability of training programs. This gap suggests a critical need to equip the public with knowledge and skills to better cope with climate hazards and build resilience. The absence of capacity-building initiatives leaves the community ill-prepared to face future climate-related challenges.

The findings from Table 8.1 highlight significant gaps in the community's preparedness, access to services, and capacity to respond to climate-related emergencies. The lack of effective coordination between local authorities and the community, limited awareness programs, barriers to accessing services, and the absence of capacity-building efforts all point to the need for urgent interventions. To enhance climate resilience, a more inclusive and multi-

faceted approach is necessary, one that includes strengthening communication channels, providing reliable sources of information, addressing barriers to healthcare access, and implementing training programs to build community resilience. These efforts should focus on empowering all community members, particularly women and marginalized groups, to participate in climate change adaptation planning and response efforts.

9. Solutions and Recommendations

The preceding tables and discussions have presented a clear picture of the vulnerabilities faced by the community due to climate change. A significant portion of the population experiences negative health impacts, particularly the public. There is limited preparedness to handle these health risks, and a gap in communication and access to essential services during emergencies.

Table – 9.1 analyzes the suggestions provided by the respondents regarding immediate solutions for addressing climate emergencies and identifies long-term solutions for building community resilience. A combination of immediate interventions and long-term strategies is crucial for effectively managing climate risks.

Besides, specific strategies are proposed to improve access to services and information for the public (a focus group particularly vulnerable to climate hazards). This could encompass measures to bridge the identified barriers and empower them to participate actively in preparedness efforts. By outlining these solutions and recommendations, this section provides a roadmap for the community to move forward and build a more resilient future in the face of climate change.

Table – 9.1: Solutions and Approach during Disasters

Question	Frequency	Percentage

What kind of immediate solutions should be considered for addressing climate-related emergencies in your community?		
Safe spaces	87	22.5%
Food and clean drinking water	96	25.0%
Non-food items	58	15.0%
Medical aid	144	37.5%
Total	**384**	**100.0%**
What kind of long-term solutions should be considered for addressing climate-related emergencies in your community?		
Enhancing community awareness and education	96	25.0%
Strengthening early warning systems	106	27.5%
Providing access to clean water and sanitation	48	12.5%
Coordination with relevant departments	106	27.5%
Drill practices under Disaster Risk Reduction (DRR)	29	7.5%
Other (Please specify)	0	0.0%
Total	**384**	**100.0%**
Who do you usually approach at the time of disaster?		
Community elder/Jirga	87	22.5%
Influential leader	58	15.0%
Family member	144	37.5%
Extended family members	38	10.0%

Department	58	15.0%
CBO	0	0.0%
Shopkeeper	0	0.0%
Total	**384**	**100.0%**

Table 9.1 offers valuable insights into the community's perspective on immediate and long-term solutions for managing climate emergencies and building resilience.

The responses indicate a clear priority for addressing basic needs during climate-related emergencies. Medical aid was cited by 37.5% (144 respondents) as the most urgent need, followed by food and clean drinking water (25%, 96 respondents). Safe space (22.5%, 87 respondents) and non-food items (15%, 58 respondents) were also considered critical. These findings underscore the importance of ensuring access to essential resources such as medical care and food during times of crisis to alleviate immediate suffering.

Regarding long-term solutions, enhancing community awareness and education (25%, 96 respondents) and strengthening early warning systems (27.5%, 106 respondents) were highlighted as key strategies. These solutions are vital for equipping the community with the knowledge and tools to respond effectively to climate emergencies. Coordination with relevant departments (27.5%, 106 respondents) was also identified as crucial for improving the efficiency of emergency responses. The data also shows some support for providing access to clean water and sanitation (12.5%, 48 respondents), although this was less frequently mentioned as a priority for long-term action. Drill practices under Disaster Risk Reduction (DRR) were suggested by 7.5% (29 respondents), but it was not seen as a dominant solution.

The data sheds light on existing social structures and the networks people relies on during disasters. Family members (37.5%, 144 respondents),

community elders (22.5%, 87 respondents), and influential leaders (15%, 58 respondents) were cited as the primary sources of support during emergencies. Government departments (15%, 58 respondents) were also mentioned but were not seen as the first point of contact. This highlights the importance of incorporating these established social networks into emergency response strategies. It also suggests the potential to enhance collaboration between traditional community support systems and formal disaster response organizations.

The findings from Table 9.1 underscore the urgent need for both immediate interventions and long-term strategies to address the health and well-being challenges posed by climate change. Immediate solutions such as food, clean drinking water, medical aid, and safe spaces are essential to mitigate the suffering of the public during climate emergencies. Long-term strategies, particularly improving community awareness and strengthening early warning systems, are vital for enhancing resilience and ensuring the community is better prepared for future climate risks.

FGDs provided further insights into the specific needs of different communities. For instance, participants from Lakki Marwat highlighted the importance of adequate health staff, readily available medicines, and establishing hand pumps for clean water. The Lakki Marwat Female FGD emphasized the need for crisis management committees and emergency rooms, especially for pregnant women. Peshawar's FGDs recommended utilizing the Jirga system for raising community awareness and enhancing communication with government departments. In Mansehra**,** participants called for water management infrastructure and education on climate change in schools. The Dir Upper Male FGD highlighted the need for medical camps, water bores, and awareness sessions for the community.

Experts corroborated these findings. They emphasized the need for inclusive solutions that consider the socio-economic vulnerabilities of the community,

particularly marginalized groups like women and youth. Experts also suggested using a multi-pronged approach, including community radio, mobile messaging, and participatory communication methods, to bridge the information gap.

The findings reinforce the necessity of addressing both immediate and long-term solutions for building resilience in the face of climate change. Effective solutions require collaboration between local authorities, community members, and stakeholders, with a focus on enhancing awareness, improving infrastructure, and ensuring equitable access to resources. By implementing these strategies, Khyber Pakhtunkhwa can create a more resilient and sustainable future, particularly for its most vulnerable populations.

10. Conclusion

This research study comprehensively investigates the impact of climate change on the public in Khyber Pakhtunkhwa, Pakistan. The findings reveal a concerning scenario, highlighting the heightened vulnerability of these populations to the adverse health consequences stemming from climate hazards. A significant portion of the community experiences negative health impacts, particularly the public, due to climate extremes. Heat-related illnesses, waterborne diseases, and skin infections are prevalent concerns. The situation is further exacerbated by limited access to healthcare services, especially during emergencies. This underscores the critical need for increased awareness and preparedness within communities to effectively handle the health ramifications of climate change. A concerning gap in communication and coordination between local authorities and the community further hinders these efforts.

The study emphasizes the paramount importance of adopting inclusive approaches for formulating effective adaptation strategies. Given the disproportionate impact of climate change on the public, their specific needs

must be central to developing solutions. The study recommends a multi-pronged approach, advocating investments in awareness campaigns, strengthened early warning systems, improved service accessibility, capacity building and enhanced collaboration. By implementing these recommendations and integrating gender-responsive strategies, Khyber Pakhtunkhwa can build a more resilient future for all its citizens in the face of climate change.

This research provides a valuable foundation for further exploration and targeted interventions. A deeper analysis of the health burden attributable to climate change and a closer examination of the existing coping mechanisms employed by the public would offer invaluable insights for policymakers and aid organizations striving to address the evolving climate crisis.

Building resilience is an ongoing endeavor that necessitates collective action. Collaboration among communities, authorities, and all stakeholders is key to creating an equitable and sustainable future for generations to come. This report serves as a roadmap, based on a combination of quantitative data analysis and qualitative insights from focus group discussions and expert interviews, to address existing gaps and advance equitable climate adaptation efforts in the studied community.

11. Recommendations

Based on the study findings, a comprehensive set of recommendations to enhance climate change adaptation and build resilience, with a particular focus on empowering the public is given below.

The recommendations provided focus on both immediate and long-term strategies to build resilience against climate change and improve adaptation in the community.

- **Awareness and Communication**: There is a clear need for improving communication and awareness around climate risks and adaptation measures. The data suggests that social media remains a major information source, but its reliability is questionable. Thus, a more diversified approach that includes local communication methods (community meetings, radio, etc.) is essential to ensure that reliable and culturally appropriate information reaches all community members, especially vulnerable groups.
- **Early Warning Systems and Preparedness**: Strengthening early warning systems is crucial for reducing the impact of climate-related disasters. This involves not only implementing robust systems but also ensuring that communities are actively involved in monitoring and responding to climate-related risks. Regular drills and capacity-building activities will further enhance community readiness.
- **Access to Services**: Addressing barriers such as distance to healthcare, transportation, and cost is vital for ensuring equitable access to essential services during climate-related emergencies. The inclusion of marginalized groups, particularly women and children, in the design and implementation of these systems is crucial to reduce vulnerabilities.
- **Capacity Building and Training**: There is a significant gap in training and capacity-building programs for the public, especially women and other vulnerable groups. By equipping individuals with the necessary skills to adapt to climate risks, communities can become more resilient and self-reliant.
- **Gender Equality and Empowerment**: Promoting gender equality in climate change adaptation efforts is essential. Empowering women, particularly in leadership and decision-making roles, ensures that climate adaptation strategies are more inclusive and effective.

This includes addressing cultural barriers and providing targeted support for women in the community.

- **Sustainable Livelihoods**: Diversifying livelihoods is a critical strategy for reducing dependence on climate-sensitive sectors like agriculture. Supporting the development of non-farm income-generating activities, such as ecotourism and small-scale businesses, helps build economic resilience.
- **Collaboration and Resource Mobilization**: Effective collaboration between local authorities, researchers, and community members is necessary for the successful implementation of climate adaptation strategies. By leveraging existing community structures, such as the Jirga system, and fostering partnerships, adaptation efforts can be strengthened.

To sum up, the recommendations focus on empowering communities to better prepare for and respond to climate change. The emphasis on capacity building, gender inclusion, improved communication, and resource mobilization aims to ensure that vulnerable populations are equipped to handle the impacts of climate change and contribute to the development of sustainable solutions.

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