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FOSTERING ANTICIPATORY ACTION TO CLIMATIC AND SOCIO-ECONOMIC RISKS AT SUB-NATIONAL SCALES IN THE HINDU KUSH HIMALAYA REGION

Analysis of Sector-wise Risks and Vulnerabilities in Chitral and Swat Districts of Khyber Pakhtunkhwa (KP), Pakistan

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BACKGROUND

'Fostering anticipatory action to climatic and socio-economic risks at sub-national scales in the Hindu Kush Himalaya region' is the main theme of this scoping paper for which Sustainable Development Policy Institute (SDPI) conducted a research study in Pakistan with the support of International Center for Integrated Mountain Development (ICIMOD). The overarching objective of the study is to develop locally driven gender-responsive anticipatory adaptation framework that may ensure ownership of local communities to address the impact of climate change and socio-economic risks. The study aims to engage local communities of Hindu Kush Himalaya (HKH) region of Pakistan to identify, map and plan anticipatory actions to adapt to current and future climate and socio-economic risks based on their priorities, needs, knowledge and capacities. In other words, it intends to co-develop multiple future scenarios and identify adaptation pathways and anticipatory actions to reach the desired results.

As a first step, the authors conducted a desk study to identify the risks faced by different sectors on HKH region of Pakistan. The study presents an analysis of sector-wise risks in the selected districts of Chitral and Swat located in Khyber Pakhtunkhwa (KP) province of Pakistan. Based on the existing literature and information, the study also presents stakeholders' mapping in the context of climate change adaptation.

1.1 Challenges faced by HKH region

The HKH region of Pakistan is highly vulnerable to climate-related disasters, including floods, landslides, GLOFs, heatwaves, cloud bursts and invasive pest infestation. These challenges have threatened the livelihoods and food system of local communities besides posing serious threats to the ecosystem (Hussain and Qamar, 2020; Zainab et al. 2021). During the past two decades, the region was hit by some of the worst disasters of which floods and earthquakes remained very common. Thus, the vulnerability of this region has increased manifold due to climate change at global level (Ishaque et al. 2021). KP is particularly vulnerable to floods and other extreme weather events. The region experienced catastrophic floods in 2010, 2022 and 2023. The mean increase of 0.63°C in temperature observed in Pakistan over the century indicates that the warming was twice as fast as the global mean temperature rise. The number of heatwave days per year has increased substantially in the last 30 years. (Ministry of Climate Change 2022).

The climate-induced disasters have caused significant losses to the livelihoods and food system of the HKH region, thus the consequences of climate change are visible in almost every sector. Agriculture sector suffers the most, water is becoming increasingly scarce, and growing population requires more resources and services in a country that is losing a substantial amount of its GDP to climatic hazards (Khurshid et al. 2022).

To address the climate-related challenges, Pakistan has ratified several global conventions and agreements, including Kyoto Protocol, Paris Agreement, Sendai framework, Hyogo framework, besides taking many climate action initiatives such as Eco-System Restoration Initiative (ESRI), Clean Green Pakistan Movement, Recharge Pakistan Initiative, etc. In July 2023, Pakistan unveiled its first National Adaptation Plan (NAP) covering a period from 2023 to 2030. This strategic plan focuses on the redressal of climate change impacts. The plan provided a framework for adaptation strategies, policy guidelines and actions to implement these strategies. One of the key guiding principles of NAP is to act locally.

Contextualizing the risks each community faces due to climate change is critical for developing adaptation strategies tailored to the local needs. Similarly, mainstreaming climate change adaptation is also a guiding principle of NAP (MoCC, 2023).

1.2 Need for anticipatory adaptation

An analysis of Pakistan's climate change-related policies and initiatives reveals an over-reliance on short-term approaches to response and relief efforts. The adaptation does not seem to be a priority at local level. Though current adaptation strategies generally discuss reactions on immediate impacts, climate models emphasize the need for long-term anticipatory measures. To be future-fit, it is important to understand future risks, local livelihood realities and take anticipatory actions for the disaster risk reduction, disaster risk management, and proactive climate change adaptation in the HKH region. For anticipatory and participatory action for a safer future, there is a dire need to understand future risks, risk governance, and risk financing (The News, 2023; The Nation, 2023).

It is obvious that anticipatory action to address climatic risks and anticipatory adaptation framework are essential. This necessitates integrating local wisdom and context into an adaptation plan that is proactive, participatory, and anticipatory, aimed at enhancing gender-responsive community resilience.

In this backdrop, this study presents an analysis of the sector-wise risks in KP, particularly in Chitral and Swat districts. The study is divided into three distinct sections: i) a brief profile of the study areas, ii) a sector-wise risk assessment, and iii) stakeholder mapping. It begins with an overview of the socio-economic, demographic and climatic profile of KP, particularly Chitral and Swat districts (Section 2). The risks associated with agriculture, forestry, economy, livelihoods, infrastructure and tourism sectors have been delineated in Section 3, followed by a concise mapping of the stakeholders in the context of climate change adaptation with particular emphasis on Chitral and Swat districts of Khyber Pakhtunkhwa.

PROFILE OF STUDY AREA

This section presents a brief socio-economic and climatic profile of KP province with particular emphasis on Chitral and Swat districts.

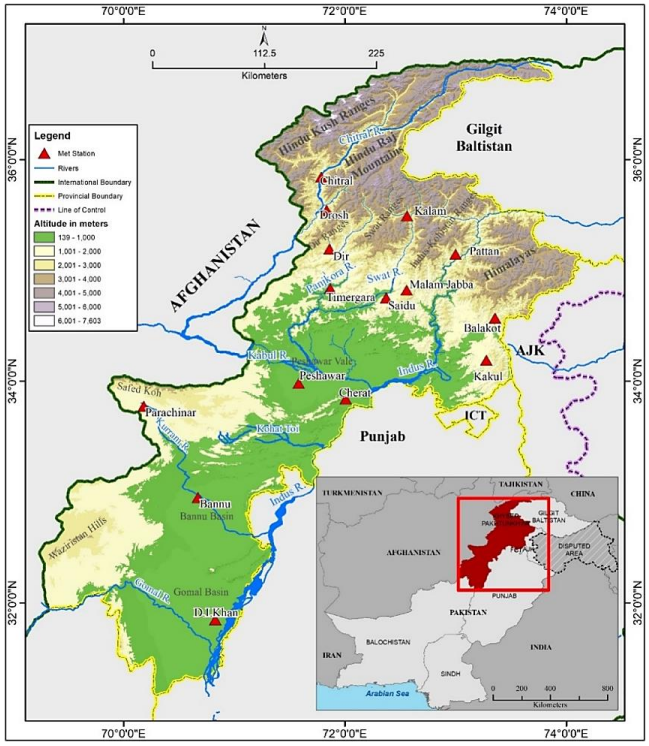
2.1 Geography and people

Khyber Pakhtunkhwa, formerly known as North West Frontier Province, is bounded by the Hindukush, Himalaya and Karakorum mountains in the north, Afghanistan to the northwest, the Punjab province to the southwest, Gilgit-Baltistan in the east and northeast, and Balochistan province in the southwest (Figure 1). The main rivers flowing through KP are Indus, Kabul) Swat, Chitral, Kurram, and Gomal. Total area of the province is 101,771 KM^2 with a population of 41 million out of which 52% are males and 48% females. The average household size is 6.95 people and an annual population growth rate is 2.38% (PBS, 2023). The province is divided into 34 districts, which are clustered into seven divisions. Around 80% of the KP population resides in rural areas. Pashtun (Pathan) is the major ethnic group while Gujjars, Chitralis, Hindkowan, Syeds, Awans, etc. make up about one third of the population. Major artisan classes include *tarkhans* (carpenters), *julahas* (weavers), *lohars* (blacksmiths), *mochis* (cobblers), and

sonars (goldsmiths). Most widely spoken language is Pushto while Hindko, Gojri, Kohistani and Saraiki are also spoken in the province.

The mountainous areas of KP include the Hindu Kush Mountains, the Himalayas, and the Kohistan ranges. The Hindu Kush range originates in Gilgit-Baltistan region, stretches westward through Chitral district of KP and continues into Afghanistan. Tirich Mir is the highest peak in the Hindu Kush located in Chitral at 7,690 meters. South of the Hindu Kush are the Kohistan, Swat, and Dir ranges, which run north south and are separated by rivers. The Kohistan range is bordered by the Indus river to the east and the Swat river to the west. The part of the Himalayas extends into KP, where it is classified into High or Greater Himalayas, Lesser Himalayas, and Sub-Himalayas. In KP, the Greater Himalayas are in Kohistan and eastern Mansehra districts whereas the Lesser Himalayas are in Battagram, Mansehra, and Abbottabad districts (Govt of Pakistan, 2017)

Figure-1: *The map of Khyber Pakhtunkhwa (KP) province of Pakistan (Source: Rahman, 2022)*



Covering an area of 14,850 square kilometers, ***Chitral district*** is located in the heart of Hindukush mountains. It is the largest district of KP that covers about 17% of the province's total area (PPAF, 2017). With its headquarters in Chitral town, Chitral is administratively divided into two districts (Upper Chitral and Lower Chitral). The total population of Chitral district is 515,935 as of the 2023 census[1] with the segregation of Lower and Upper Chitral that accounts for 320,407 and 195,528 respectively. The population density is low due to the mountainous landscape.

Chitral is bordered in the north and northeast by the Wakhan corridor of Afghanistan, in the east with Gilgit-Baltistan, in the west are Kunar and Nuristan provinces of Afghanistan. Upper Dir district of KP is in its south and Swat district is in its southeast[2]. The highest peak of the Hindukush range, Tirichmir (which is 7,700 meters high), is in Chitral, There are more than 40 peaks with heights more than 6,000 meters. Lowari Pass and Shandur Top connect Chitral to the rest of Pakistan by road, but it remains closed during the winter due to heavy snowfall.

The main ethnic groups in Chitral are Kho, Kalash, Gujjars, and Wakhi. Kho are the dominant ethnic group making up 91% of the district population. They speak Khowar (Chitrali) language and are of Indo-Aryan ancestry, and they follow age-old class system. Kalash is a unique indigenous ethnic group living in the southwestern valleys of Chitral (Bumburet, Rumbur, and Birir). The Kalash people are believed to be descendants of Alexander the Great and they have their distinct culture, traditions, and pre-Islamic

[1] https://www.dawn.com/news/1769390
[2] https://lowerchitral.kp.gov.pk/page/about

religion. Wakhi tribes are from Wakhan, Afghanistan), Gujar is a nomad tribe and inhabit the southern valleys of Chitral, and Afghani or Swati are from Kohistan area of Dir and Swat). Shubgali (or Nuristani) people are migrated from Nuristan, Afghanistan in the late 19th century and settled in various parts of Chitral. The main language spoken in Chitral is Khowar (Chitrali), but other languages such as Kalasha, Wakhi, and Pashto are also spoken.

Swat district, with population of 2.31 million and an area of 5337 sq kilometers, is located in the north of KP province. With its headquarters in Saidu Sharif, it is divided into eight Tehsils. Swat is enclosed by the Hindukush mountain range. This range has an elevation (within Swat district) of 600 meters to around 6,000 meters above sea level. The district is bordered with Upper Dir, while Lower Dir, and Chitral districts are in the west, Gilgit-Baltistan in the north, and Buner, Shangla and Kohistan districts are in the east and southeast.

Approximately 70% of the population of Swat lives in rural areas. Of the total population, 51% is male and 49% female. Average household size is 8.37, and the population growth rate from 1998 to 2017 remained 3.24. Population density stands at 432 per square kilometer[3]. A majority people of Swat belong to Yusufzai clan of Pakhtuns. There are also Kohistani and Gujjar people in the district. Pashto is widely understood and spoken by roughly 93 per cent of population as their mother tongue.

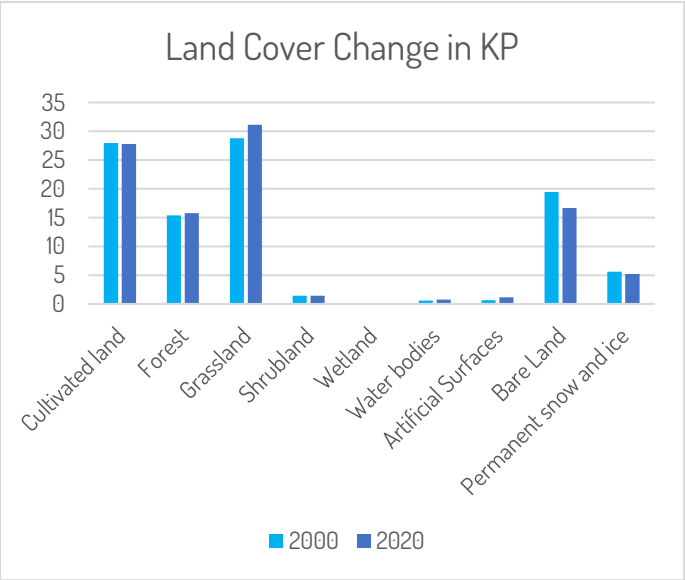
2.2. Land-use patterns

Agriculture, forestry, and grazing are the major land-uses in KP. The farmlands can be categorized into small farms (less than 5 acres), medium farms (5-12.5 acres), and large farms (over 12.5 acres). Small farms dominate the agriculture sector with 80% of the total farms, medium farms are 14% and large farms are only 3% of the total number of farms (PBS, 2010). The province is endowed with rich natural resources as 40% of the country's natural forests are located here which cover about 19% of the total KP land. The forests spread across the Hindukush and Himalayan mountain regions of the province (Poffenberger, 2000). These forests protect the country's watersheds, which yield power and water for the large agricultural economy of rest of the country.

Land-use pattern of the province (see Figure 2) indicates that agriculture extends over 28 per cent of the land area, while only 15.5 per cent of the area is under forests, around 30 per cent area is reported as grassland and 5 to 6 per cent is occupied by glaciers. The land cover change from 2000 to 2020 is also shown in Figure 2. The grassland has increased from 28.8 to 31.1 per cent while most of the other variables remained more or less similar (Ul Hassan, 2024).

[3] https://www.pbs.gov.pk/sites/default/files/population/2017/results/02201.pdf

Figure 2: Land cover change in Khyber Pakhtunkhwa from 2000 to 2020 (Source: Ul Hassan, 2024)



Agriculture sector (crops and livestock) is the main livelihood strategy in the rural areas of KP and it accounts for about 20% to the provincial GDP, and 40% employment to labour force[4].

The northern region of KP, which mainly comprises mountains, has less area suited for agriculture but major part of the south is covered by herbaceous rain-fed crops, while central region major land cover is crop on irrigated lands and orchards[5].

There are two distinct farming systems in the province – *Rabi* (winter) and *Kharif* (summer). Wheat is the major *Rabi* crop, while rice, maize, tobacco and fruits are the main *Kharif* crops. The residues of wheat and maize are major by-products used for livestock feeding. Seasonal vegetables and fruits are grown in most of the areas, which are important sources of both food and household income. Water scarcity is one of the major issues facing agriculture sector. Some flat areas and valleys have good water supply for irrigation supported by rain, surface and groundwater. In other parts, agro climatic conditions are harsher and rainfall can be as low as 100 mm per year, and irrigation canals only provide water seasonally with groundwater plays an important role. In the arid areas, where crop productivity is very low, livestock is more important for livelihoods than crops.

Along with crops, livestock farming is also an important livelihood source for the rural population of KP. It is dominated by small farmers. At least 84% of the total livestock farmers in the province[6] have one to four animals each. Cattel, buffalos, sheep and goats are the main livestock. At high altitude mountainous regions, yak is also a common animal. According to Israr et al. (2023), a survey conducted by Livestock and Dairy Development Department (with a sample size of 4.42 million households in 34 districts of KP), 46% respondents (about 2.03 million) were rearing livestock. Out of the total livestock population, goats were in the highest number (10.04 million heads), followed by cattle (8.84 million), sheep (4.22 million), and buffalo (3.4 million heads).

The land-use of Chitral is mainly composed of rangeland and glacier/snow-covered areas, with smaller portions of forests, farmland, and other land uses. Rangeland is the predominant land use category in Chitral, which constitutes 62% of the total land area. The second largest category glaciers, mountains and snow make up 24.5% of the land area. Forests occupy only 698 square kilometers, representing 4.7% of the land area. Only 3% of the area is farmland (PPAF, 2017).

The farmers of the Chitral district grow a variety of cereals and grains, including maize, barley, rice, wheat, and pearl millet (locally known as *bajra*). Pulses such as *mash*, *masoor* (lentils), and moong

[4] https://agriculture.kp.gov.pk/
[5] https://www.adb.org/sites/default/files/project-documents/56151/56151-001-iee-en.pdf
[6] https://kpboit.gov.pk/agriculture-livestock/

(mung beans), and crops like sorghum are also grown in the valleys. This agricultural profile supports the local economy and dietary needs of its residents. The climate and agronomic conditions of Chitral also support the cultivation of fruits such as apples, apricots, pears, mulberries, grapes, citrus, peaches, plums, pomegranates, cherries, walnuts, persimmons, etc. In Chitral, vegetables grown include potatoes, onions, carrots, turnips, tomatoes, chilies, garlic, peas, and cauliflower. These vegetables are a big support to local market on the one hand, and on the other they are widely used by the local people in their daily diet. The district has a forest area of 50,860 hectares, which provides resources for timber and non-timber forest products. Chitral is also known for its marble and chips industry, with six units operating in the region.

Swat district is also famous for its diverse agricultural activities, including fruit orchards and vegetable farming. A wide range of crops are grown in the district, including wheat, barley, rapeseed and mustard, maize, rice, lentils, walnuts, etc. Fertile soil, favourable weather conditions and water availability have supported a robust agricultural economy. Swat is also well-known for its fruits, particularly peach, persimmons and apples. The vegetables grown in Swat are potatoes, peas, tomatoes, turnips, okra, chilies, spinach, cauliflower, and onions. Forests and grazing fields are also the major land-use of Swat. Its forest area spans 138,280 hectares, which significantly contributes to the district's natural resources and ecological sustainability. Livestock plays an important role in the lives of Swat people. Similarly, fishery is a growth industry, as there is a growing demand of trout fish. Marble, cosmetics and plastics manufacturing is the main industrial activity of the district.

2.3 Demographic and socio-economic profile

The Human Development Index of KP is low compared to other provinces. As of 2022, the HDI of KP was 0.515, while in Punjab, Sindh and Gilgit-Baltistan it was 0.550, 0.579 and 0.517 respectively7. Similar disparities exist in other development indicators. For instance, literacy rate in KP is only 55%, which is significantly lower as compared to the national average of 62.8%. Huge disparities also exist in the rural versus urban areas and with respect to genders as evident in Table 1, which shows the overall literacy rates of Pakistan, especially Khyber Pakhtunkhwa, broken down by gender and urban/rural areas, for the years 2018-19 and 2020-21 (Ministry of Finance 2024). Though overall literacy rate in the province improved from 52.4% to 55.1%, the gender gap increased from 34.6 to 35.4 points, indicating worsening gender disparities. Similarly, rural-urban gap in education increased from 16.8 to 20.6 points, indicating growing disparities.

Table 1: Literacy rate (10 years and above) in Pakistan and KP

Province/Area	2018-19			2020-21		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Pakistan	**73.0**	**51.5**	**62.4**	**73.4**	**51.9**	**62.8**
Rural	**67.1**	**40.4**	**53.7**	**67.2**	**40.8**	**54.0**
Urban	**82.2**	**69.7**	**76.1**	**83.5**	**70.8**	**77.3**
Khyber Pakhtunkhwa	**70.1**	**35.5**	**52.4**	**72.8**	**37.4**	**55.1**

[7] https://globaldatalab.org/shdi/shdi/PAK/?levels=1%2B4&interpolation=1&extrapolation=0&nearest_real=0&colour_scales=global

Rural	**68.1**	**31.8**	**49.4**	**70.1**	**33.5**	**51.7**
Urban	**79.4**	**53.2**	**66.2**	**85.8**	**57.8**	**72.3**

Source: Economic Survey of Pakistan, 2024

Similar situation exists in health-related indicators, as KP is facing huge challenges in the health sector. For instance, infant mortality is 53.2 per 1,000 live births, which is significantly higher than the average (30.4) for lower and middle-income countries. Similarly, there are only 0.8 hospital beds per 1000 people as compared to 0.6 for Pakistan and 2.0 for lower and middle- income countries (Asian Development Bank, 2022)[8]. Maternal mortality ratio in KP is 165 per 100,000 cases, whereas in the Punjab and Gilgit-Baltistan, this ratio is 157 per 100,000 live births[9]. For the newly merged districts (previously called Federally Administered Tribal Area), some indicators are substantially worse (e.g. maternal mortality ratio of 261 deaths per 100,000 live births (ibid). Likewise, the statistics regarding access to safe drinking water are generally lower in KP than the national average.

The district-wise literacy rate for Chitral and Swat districts, as per most recent data in PSLM (2020) indicate that literacy rate (15 years and above) in Chitral and Swat is 56% and 51% respectively, with a significant gender disparity. Male literacy is comparatively better (i.e. 72% for Chitral and 69% in Swat) compared to the female literacy rate of 39% in Chitral and 34% in Swat. This gap is even more pronounced in rural areas, where male literacy is 70% and 65%, while female literacy far less, i.e. 38% and 30% in Chitral and Swat districts respectively[10]. The trend of literacy rate in both districts indicates a gradual increase in the literacy rate in Chitral from 60% in 2004-05 to 72% in 2019-2020. However, in case of Swat, the increase was from 61% in 2004-05 to 65% in 2019-2020 (see Figure 3).

Figure 3: Adult literacy rate in percentage in Chitral and Swat districts (Source: PSLM dashboard)

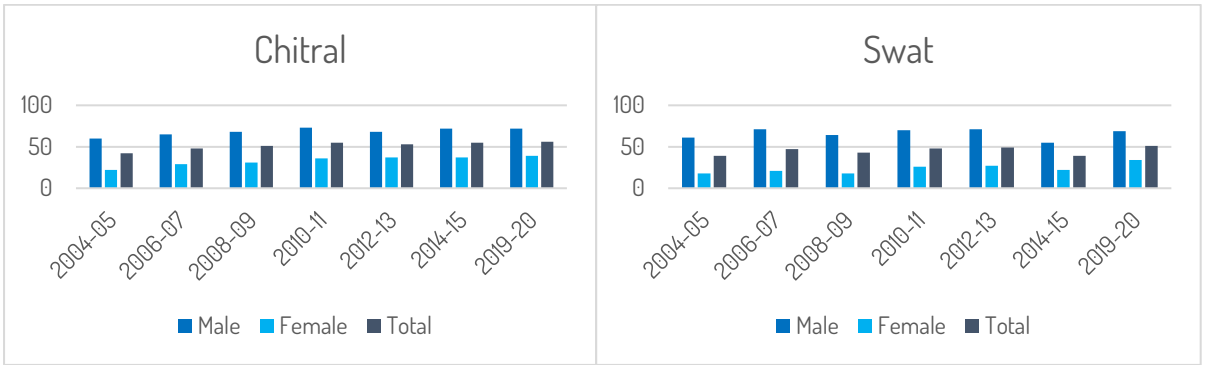
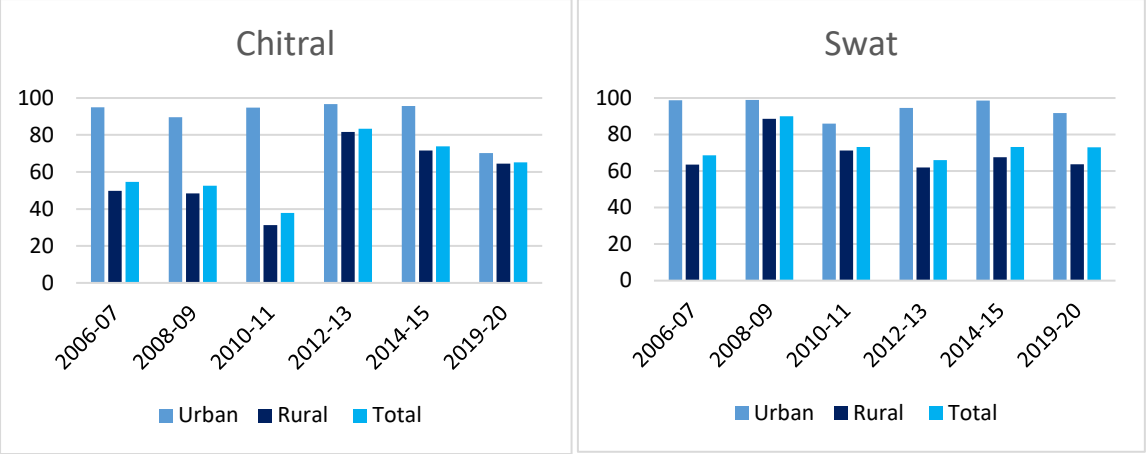


Figure 4 presents the percentage of households with improved sources of drinking water in Chitral and Swat districts. This indicator is calculated in line with the definition of SDGs which includes hand pump, tap water, dug well protected, motor pump, spring protected, tanker/water Bearer, bottled water, and filtration plant (PSLM, 2019). Around 70% of the population of both districts lives in rural areas, therefore, rural-urban divide is evident with significant disparities.

[8] www.adb.org/sites/default/files/linked-documents/54297-001-ssa.pdf
[9] https://pakistan.unfpa.org/en/news/maternal-mortality-decreased-186-deaths-100000-live-births
[10] https://www.pbs.gov.pk/publication/pakistan-social-and-living-standards-measurement-survey-pslm-2019-20-provincial

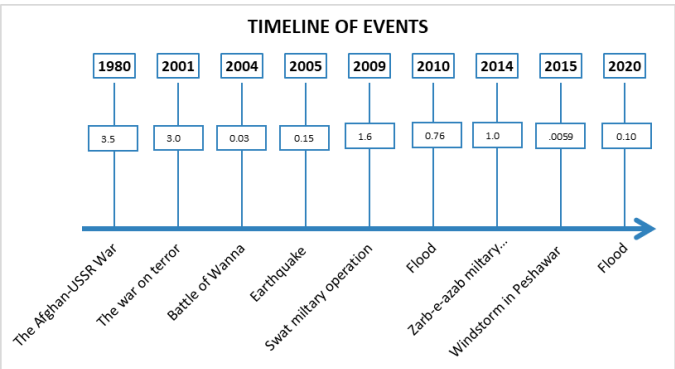
Figure 4: Percentage of household for access to improved drinking water (Source: PSLM dashboard)



Migration is a widespread phenomenon in KP. According to the Economic Survey of Pakistan 2024, during the year 2023, the largest number of workers (489,301), who migrated abroad for employment belonged to the Punjab, followed by KP (210,150) and Sindh (72,382). KP is the third highest populus province of Pakistan, but it accounts for the second highest number of outgoing migrants. This indicates that people from KP are more inclined towards foreign employment mainly due to limited options in their home districts (Government of KP, 2021).

The KP province has not only been the victim of climate-related catastrophes during the past four decades but also the wars and violent conflicts over the past four decades. The details of climate related disasters in the province will be given in section 3. The recent history of violence in KP can be traced back to the Soviet invasion of Afghanistan. The Soviet-Afghan war that continued from 1979 to 1989 displaced millions of Afghan residents who took refuge in Pakistan, particularly in KP. This has transformed the geopolitical landscape of the province. This massive migration resulted in severe consequences, including a rise in drug sectarianism, trafficking, gun culture, and deteriorated law and order situation (Hilali 2002). After the 9/11 events, the US and allied forces initiated the 'war on terror' in Afghanistan and consequently the Afghan militants were pushed into the tribal areas of Pakistan. Later, they along with tens of thousands of Afghan citizens took refuge in Pakistan and mainly settled in KP. Subsequently, Pakistan' army conducted several operations to stop the activities of the militants (Figure 5).

Figure 5. *Timeline of events in KP. The figure highlights numbers of affected persons in millions by year. (**source**: Muzamil et al. 2024)*



Since then, Pakistan army conducted several operations in the tribal area and other regions of KP, which caused thousands of civilian and military deaths. The Swat district became a hub of violent conflict during 2007-09 when the local groups of Taliban entered Swat, took over the control of the district and started advancing towards adjoining districts (Waseem, 2011). The situation became normalized in 2009 after a fierce military operation. Tens of

thousands of residents of Swat and other war-affected districts were displaced during this war, while public infrastructure was severely affected. Another military operation (Zarb-e-Azab) was launched in 2014 in the areas along the Afghanistan border, which once again displaced nearly a million residents to the southern districts of KP (Muzamil et al. 2024).

Along with conflicts, several climatic catastrophes hit the districts. For instance, the 2010 floods severely damaged the public infrastructure. Their impact was recorded in 24 districts, while 10 districts were severely affected. In 2020, the flash floods in the province again caused massive damage and casualties. These climatic catastrophes and violent conflicts have had serious consequences on the economy of the province and livelihoods of the households. The details are given in Section 3.

Table 2: Profiles of Chitral and Swat districts

Name of district	**Chitral district**	**Swat district**
Headquarters	Chitral Town	Saidu Sharif town
Main Crops	Maize, barley, rice, wheat, bajra, mash, masoor, moong, and sorghum	Wheat, barley, rapeseed & mustard, maize, rice, lentils sugarcane, tobacco
Major Fruits	Apples, apricots, pears, mulberries, grapes, citrus, peaches plums, pomegranates, cherries, walnuts, persimmons, strawberries, prunes, almonds, hazelnuts, and loquats	Melons, citrus, fig, grapes, apples, pears, loquats, apricots, mulberries, almonds, walnuts and pistachios
Major Vegetables	Potatoes, onions, carrots, brinjal, turnips, tomatoes, chilies, garlic, peas, cauliflower, lettuce, okra, Chinese cabbage, and turnips	Peas, tomatoes, potatoes, turnip, okra, pumpkin, radish, carrots, chilies, spinach, cauliflower, cabbage, garlic, onion, green beans
Forests (Area)	50,860 ha	138,282 ha
Major Industry	Marble and Chips	Marble, Chips, Cosmetics, Plastics
Houses with Piped Water	25.1%	24.5%
Houses with Electricity	29.4%	68%

2.4 Climatic and environmental profile

The climatic profile of the province is very diverse owing to its diverse geography, vegetation cover, altitudes and topography. The KP Government, in its climate change policy, has divided the province into four broader zones, i.e. the Northern, Eastern, Central and Western zones. The Northern Zone or Zone A covers the northern mountains regions. These areas are characterized by rugged terrain and higher altitudes. The Eastern Zone or Zone B is the sub-humid eastern mountains and wet mountainous regions. Central Zone or Zone C represents the Central Valley Plain, known for its flat terrain and is

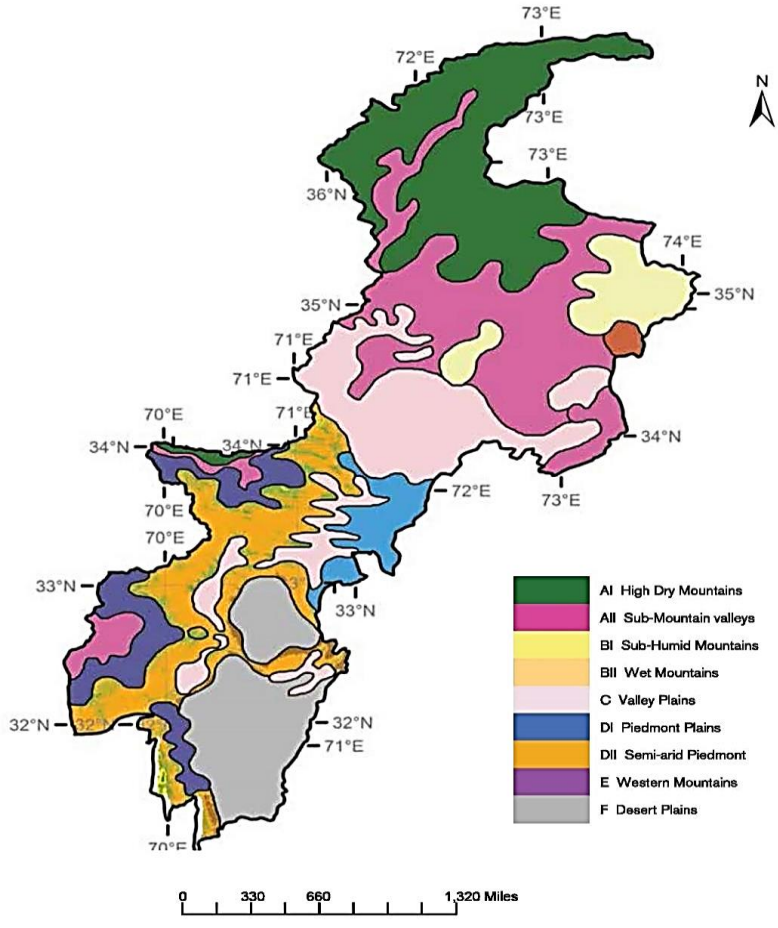
supposed to be important area for agricultural due to its fertile plains. The Western Zone or Zone D comprises Piedmont plain and Suleiman piedmont. This area lies at the foothills of mountains, characterized by relatively flat land transitioning from mountainous regions to plains.

Table 3: Agro-ecological zones of KP with districts (Source: Govt. of KP, 2016)

Zone	Description	Districts
A	Northern mountains	Chitral, Swat, Buner, Shangla, Upper and Lower Dir
B	Sub humid eastern mountains and wet mountain	Haripur, Mansehra, Batagram, Abbottabad, Kohistan
C	Central Valley Plain	Peshawar, Charsadda, Mardan, Nowshera, Swabi, Kohat, Hangu
D	Piedmont plain, Suleiman piedmont	Bannu, Lakki Marwat, Karak, Tank, D.I. Khan

However, more recently, the Government of KP referred to nine agro-ecological zones suggested by the Swiss Agency for Development and Cooperation (Figure 6).

Figure 6: Agro-ecological zones of KP (Source: Govt. of KP, 2022)



Rahman (2022) calculated the rainfall variability, trend and its distribution in KP, from the temporal data on rainfall that was provided by Pakistan Meteorological Department (PMD). The rain pattern in the province is highly variable in space ranging from 1570 mm in the mountainous region of Balakot to as low as 315 mm in the plain areas such as D.I. Khan district (Figure 7).

Figure 7: Annual rainfall distribution and trend in KP (Source: Rahman 2022)

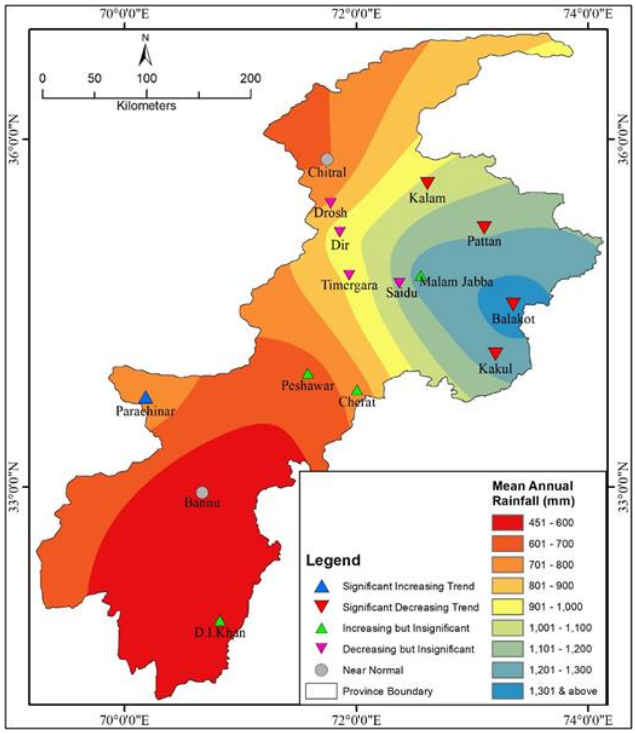
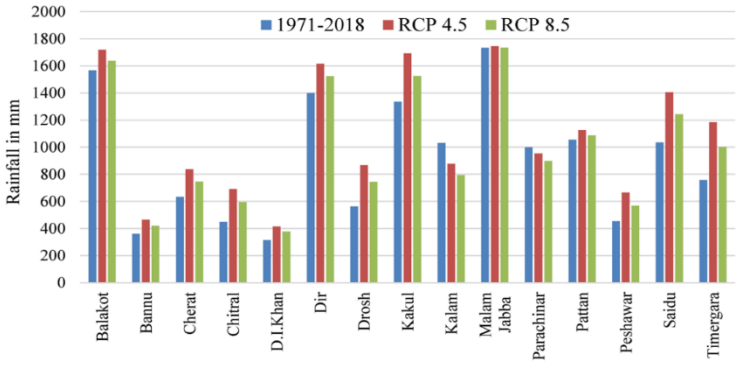


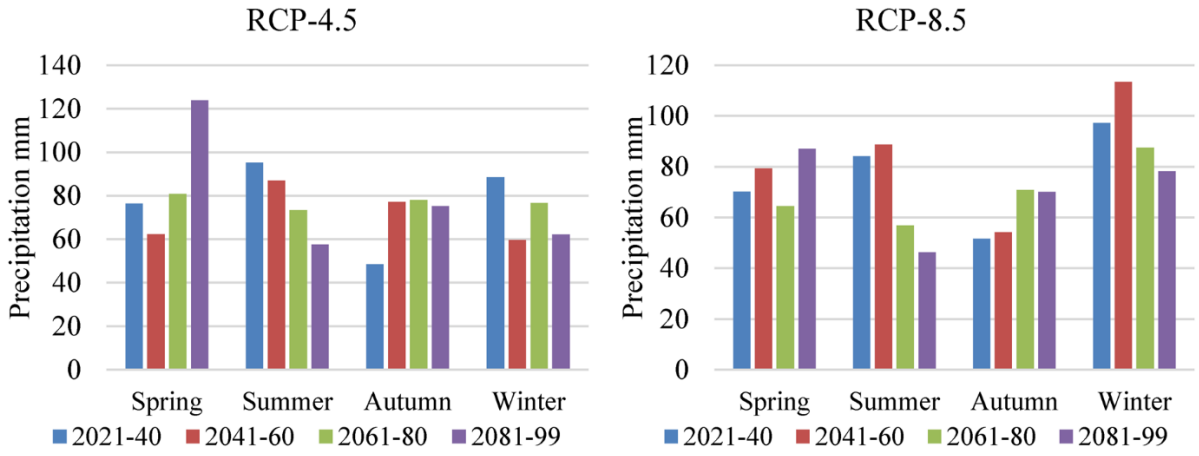
Figure 8 presents the future precipitation projections for the 21st century (RCP-4.5 and RCP-8.5) for different meteorological stations of KP compared with the historical reference data. Two meteorological stations such as Kalam (in Swat district) and Parachinar depicted a decreasing trend of precipitation for both RCPs. The highest projected precipitation receiving metrological stations are Timergara, Saidu Sharif (Swat district), and Kakul, which depicted the dominance of the monsoon pattern for the future (Rahman, 2022). As two rain patterns are dominated in KP, the spatial projections for the 21st century illustrated a strong dominant growing trend for the monsoonal receiving areas while the seasonal trend indicated an early monsoon dominating the spring season. The shifting of seasonal precipitation patterns may influence the agricultural activities of the province (ibid).

Figure 8: Future precipitation projections for the 21st century for different meteorological stations of KP (Source: Rahman 2022)



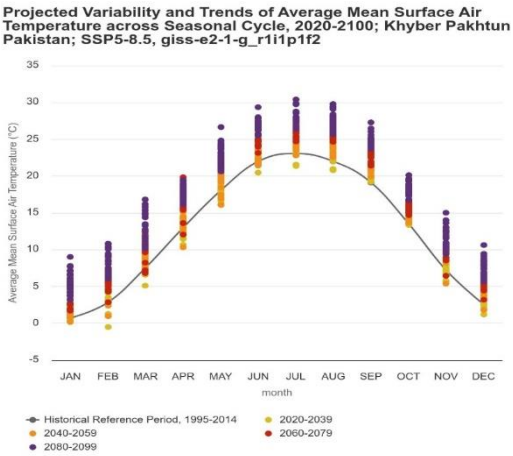
The projections for the winter and summer seasons indicated an increasing trend till the mid-century but after the midcentury projected a decline. These shifting patterns and seasonal changes may cause drought and flooding in the province. The lower precipitation during the winter is directly related to decrease in snow accumulation that affects the glaciation process of the mountain region of the province (Figure 9).

Figure 9: Seasonal changes for precipitation in KP for 2021–2040, 2041–2060, 2061–2080 and 2081–2099 under RCP-4.5 and RCP-8.5.



The projected variability and trends of average mean surface air temperature across the seasonal cycle for KP from 2020 to 2100 are shown in Figure 10. The projections are based on the SSP5-8.5 scenario using the giss-e2-1-g climate model. The figure demonstrates a clear warming trend in KP province, throughout the 21st century. The data suggests significant increases in temperature during the summer, which may have important implications for the region's climate, agriculture, and overall environmental conditions[11]. For RCP8.5, the temperature extremes are severe in the mountainous region of Northern Pakistan (4.8 °C increase), KP (4.6 °C increase) and Monsoon region (4.5 °C increase) (Ali et al. 2019), which makes the HKH region of Pakistan one of the most vulnerable areas to global temperature change. Such results may be a threating point to glacier melting and flash flood. The country's Northern region, which mostly comprised mountainous HKH region, and has large number of glaciers and huge reservoir of snow, may cause GLOF and floods due to snow and ice melting. Moreover, the increase in winter temperature may negatively affect wheat production, which in turn can distress the overall food security in the region (Ali et al. 2019)[12].

Figure 10: Projected trends of average mean surface air temperature[13]



2.5 Disasters and risks

Climate-related events such as floods, droughts, severe snowstorms, heatwaves, and natural hazards such as avalanches and landslides are all common occurrences in KP. These disasters severely affect the adaptive capacity and livelihood resilience of communities thus they become more vulnerable to other climate and non-climate related shocks (UNDRR, 2019). Climate projections indicate that increasing rainfall, including

[11] https://climateknowledgeportal.worldbank.org/country/pakistan/trends-variability-projections

[12] https://www.sciencedirect.com/science/article/pii/S016980951831425X?casa_token=tb4fDoss3MoAAAAA:tvAjusMoKjCiUc8bnEW3kQN8moGG8DyKApFYz1eh0az0vIeMoVSFlehNfqFVIgfGRmx_4knj1B8Z

[13] https://climateknowledgeportal.worldbank.org/country/pakistan/trends-variability-projections

cloud bursts, may further escalate the probability of fatal flash floods and GLOFs in KP. According to an assessment, the frequency and severity of disasters is expected to increase in KP (Miller et al. 2021). The riverine flooding poses a precarious risk in the mountainous districts, including Swat and Chitral because many villages and farmlands are situated near the river and within the maximum flood level range. Severe floods have been hitting KP since the 1960s. Highly devastating floods occurred in 1976, 1982, 1988, 2004, 2006-07, 2012-14, and worst of all in 2010 (PDMA, 2015).

Rasul et al. (2020) stipulated that the incidences of climate change related hazards have increased across HKH region of Pakistan in recent decades, resulting in a loss of lives and adverse impacts on rural economy, ecosystem services and infrastructure. The impact of climate change is visible in Upper Indus Basin, particularly in Chitral district. This region has experienced erratic and frequent spells of rain during the last decade despite the region is beyond the range of summer monsoon. The frequency and magnitude of floods and GLOFs in Chitral have also increased due to the combined effects of multiple factors such as increased temperatures.

3. SECTOR-WISE RISKS AND VULNERABILITIES

As discussed in the previous section, the HKH region of KP is highly vulnerable to a range of hazards, including floods, droughts, avalanches, heat stress, pest and disease outbreaks, landslides, earthquakes and glacial lake outbursts. The projected climatic changes are likely to increase the occurrence and severity of many such hazards (Millar et al. 2021). For this scoping study, our literature review has identified specific sectors that are crucial for the livelihoods of people living in the mountainous areas of the province and are highly vulnerable to climate change. The climate related hazards (such as floods) destroy agricultural land on the one hand, and on the other they are linked to the effects on rural livelihoods and food security in the province.

The following sub-sections present a sector-wise overview of risks and vulnerabilities by focusing on agriculture, livestock and forestry, infrastructure, economy and livelihood and tourism sectors.

3.1 Agriculture, livestock and forestry

Agriculture, livestock, and forestry are among the major sources of livelihood for the rural people of both Chitral and Swat districts. The major food crops are wheat, maize and rice. Alongside these crops, farmers grow different fruits such as apples, peaches, persimmons, apricots, walnuts as well as vegetables like tomatoes, potatoes, onions, etc. (Ullah et al. 2018). The rearing of sheep, goats, cattle and poultry is also common in both districts, while yaks are important animals in high altitude regions of Chitral. The livestock not only contributes to households' dietary requirements but also provides manure for crops and financial support during emergencies, serving as a source of cash (Ullah and Ahmad, 2021). The forests are also an important component of rural economy as they provide timber, fuelwood, non-timber forest products (NTFPs), and grazing fields for livestock.

However, climate change, socio-political issues, and environmental degradation pose significant risks and vulnerabilities to these sectors. The following sub-sections give an overview of the risks and vulnerabilities in both the districts.

Agriculture

The agriculture sector of HKH region of KP is highly susceptible to climate-induced hazards including floods, droughts, and changing rainfall patterns. The floods in the HKH region of KP have caused widespread damage across various sectors, including infrastructure, housing, education, transportation, communications, water resources, agriculture, fisheries, and protective structures. For instance, the 2010 flood impacted a larger portion of farmland in Swat, as around 60% of agri land (equivalent to 60,700 hectares) had washed away (Khaliq, 2011; Bacha et al. 2018). Likewise, the 2023 flood in both Upper and Lower Chitral severely damaged cereal crops, cash crops, and fodder production. In Upper Chitral, it is estimated that cereal crops incurred 22% damage, cash crops 15%, and fodder production 21%, while orchards have experienced 24% damage. Similarly, in Lower Chitral, cereal crops incurred 28% damage, cash crops 15%, fodder production 15%, and orchards 13% (Secours Islamique France, 2023). These losses have had a severe impact on the income of farmers and their ability to support their families.

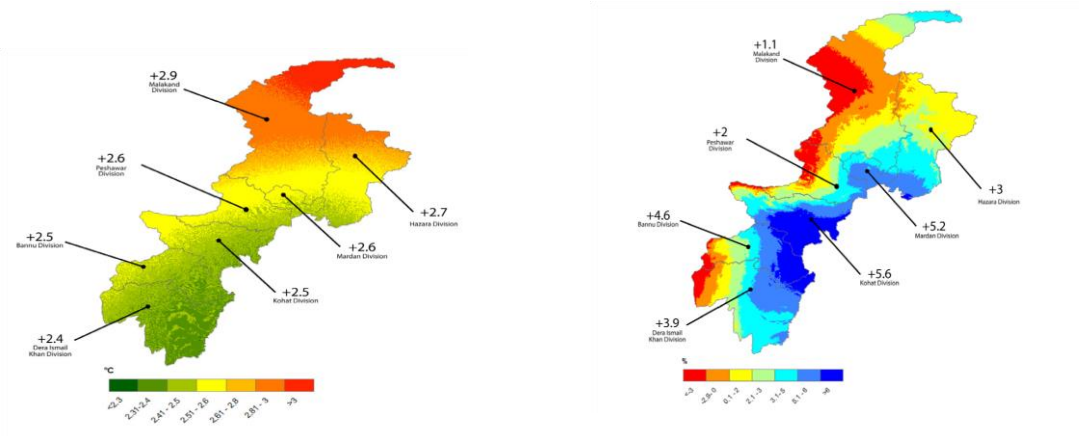
Along with floods, the mountainous regions are also vulnerable to the Glacial Lake Outburst. In July 2015, Chitral faced a massive GLOF event, which caused flooding in various valleys, including Mastuj, Lotkoh, Laspur, and Kalash Valley. This event has destroyed many irrigation channels, hundreds of acres of cropland, and thousands of livestock (Rasul et al. 2020). Many farmers, particularly those dependent on fruit orchards, experienced total crop losses. In Brep village in Yarkhoon valley of Chitral, for example, over three-fourths of the apple orchards were destroyed, affecting both immediate income and long-term agricultural productivity (DAWN, 2023). Similarly, changes in the rainfall patterns have also significantly impacted the sowing and harvesting patterns of various crops and orchids, thereby reducing the yield of agricultural products (Naveed 2024; Ullah et al. 2018).

The annual mean temperature in Pakistan[14] has made substantial impacts on agricultural productivity. This increase in annual mean temperature has affected the flowering and grain-filling stage of various agricultural products and particularly reduced the wheat yield (Shaheen et al. 2020). Similarly, the temperature rise has also altered the pest and disease dynamics, which leads to new infestations that become hard for local farmers to deal with through old farming practices. Limited access and ineffective pest control measures exasperate the situation, as the majority of farmers rely on traditional methods which are often ineffective against new species (Hussain et al. 2017).

The future scenario of temperature and precipitation (Figure-11) indicates the greatest warming effect in the HKH region of KP. The Malakand Division (where Swat district is located) is likely to experience greatest warming effect (2.9°C). Similarly, the precipitation is expected to reduce in the mountainous areas as compared to the plain areas (Miller et al. 2021), and this variation will have profound impact on agriculture sector.

[14] https://scp.gov.pk/Conference2024/downloads/Climate_Chage_in_Pakistan.pdf

Figure 11. Projected changes in annual mean temperature and total annual precipitation in KP by 2050 for RCP 4.5 scenario (Source: Miller et. al. 2021)



Changes in annual mean temperature (°C) Changes in total

Soil erosion due to deforestation and unsustainable land use practices coupled with disasters are another critical risk to the agriculture sector. The 2010 flood swept away the forests and degraded the soil that requires decades to be replenished. This loss of forest cover and soil erosion has directly affected the local biodiversity and lives of many livestock animals, which are either washed away by the flood or forced to relocate (Ali, 2012; Zaidi, 2015). The steep slopes and deforestation further exacerbate soil erosion and contribute to the loss of arable land.

The agricultural land of Chitral is highly susceptible to soil erosion. A very high (13%) and high (18%) erosion has been reported in the valley, which makes the area highly vulnerable to soil erosion (Aslam et al. 2021). Deforestation, unsustainable agriculture practices, and overgrazing are some of the major causes of soil erosion. The agriculture productivity in the region has declined over the past decades due to land degradation (Akbar, 2020). This decline in productivity affects around 30% of the provincial population and 62% of the population of the most vulnerable districts pushing farmers to either abandon their farms or switch to less productive crops (Miller et al. 2021).

Scarcity of irrigation water is also an emerging concern in both Swat and Chitral districts. The reliance on traditional inefficient irrigation methods leads to water scarcity and lower agriculture production. Over-extraction of groundwater, inefficient irrigation practices, and changes in rainfall patterns are some of the main drivers leading to water scarcity in the valley. Ullah et al. (2018) found that the sources of drinking water (well and springs) and irrigation water had shown a decreasing trend. The water coming from the glacial melt is the main source of irrigation in Chitral. Climate change has a significant impact on the flow of water coming from glaciers. With the accelerated retreat of glaciers and erratic rainfall patterns, the flow in the Chitral river has been observing a declining trend (Naeem et al. 2013). This decline in water availability for irrigation may lead to conflict over water use and delayed sowing, resulting in decreased crop yields.

Livestock

The extended drought period, followed by scanty winter precipitation has exerted negative effects on the grazing land of livestock in the area. A significant portion of households in these districts depend primarily on livestock for their livelihoods (Shah et al. 2019), therefore, a reduction in grazing lands due to climate change, overgrazing, and conversion of grazing land to agriculture fields would have a devastating effect on the food security and overall socio-economic well-being of the pastoral communities (Uddin and Kebreab, 2020).

Erratic snowfall and avalanche events also have a significant impact on livestock in the HKH region of KP. For example, in April 2021, a huge number of cattle, yaks, goats, sheep, and donkeys died after being struck by a snow avalanche while grazing in a pasture in the Yarkhoon Lusht area of Upper Chitral (Dwan, 2021). The snow also hinders access to grazing pastures and fodder sources, therefore, livestock owners in Chitral are left with no choice but to feed their animals inadequate and nutritionally deficient diets, leading to lower milk yields, reduced growth rates, and increased susceptibility to diseases.

The flood of 2023 has had a severe impact on the livestock sector. Animals such as cows, goats, sheep, and poultry suffered significant losses in Upper and Lower Chitral. In Upper Chitral, the losses included 114 cows, goats, sheep, 76 poultry, and 100 cattle sheds. Lower Chitral's losses comprised 27 cows, goats, sheep, 108 poultry, and 85 cattle sheds. Given the crucial role of livestock in supporting the local population, these losses exacerbated the economic hardships faced by the communities (Secours Islamique France, 2023). Floods also caused erosion of grazing lands resulting in a decline in the availability of pastures and increases the burden on already scarce resources. Owing to the lack of grazing land and the declining productivity of pastures, many livestock owners face chronic fodder shortages, particularly during winter months.

Limited market access due to poor road infrastructure and socio-political instability is another challenge faced by the pastoral communities of the mountainous region. This limited market access has a direct impact on the income and livelihood of the pastoral communities as it shrinks the opportunity to sell livestock and its by-products (Safdar et al. 2021).

The increase in annual mean temperature and irregular rainfall patterns cause drought-like situations in some parts of Chitral (Baig et al. 2020). Higher temperatures have led to reduced water availability, causing drought-like conditions (Naeem et al. 2013), which may have a severe impact on livestock health and productivity. Drought has been considered one of the major climatic risks that severely affect livestock productivity, especially dairy production (Abbas et al. 2019).

An overall apparent prevalence of foot-and-mouth disease (FMD) of 67% was recorded in goats, sheep, buffaloes and cattle in the northern border regions of Pakistan, which indicates that FMD remains a significant disease affecting ruminants in this area (Ullah et al. 2023). Limited veterinary infrastructure and services exacerbate the disease outbreak as many villages in Chitral have no access to veterinary services (NWFP and IUCN Pakistan, 2004).

Forestry

The natural forests of mountain areas of KP are also under severe pressure from deforestation driven by forest fires, illegal logging, overgrazing, and land conversion for agriculture. For example, a study conducted by Shehzad et al. (2014) analyzed the changes in forest cover in Chitral tehsil over the past two decades using supervised land cover classification of Landsat TM satellite images from 1992, 2000, and 2009, employing a maximum likelihood algorithm. It was found that in 2009, the forest cover accounted for 10.3% of the total land area of Chitral, which is approximately 60,000 hectares. The rate of deforestation increased from 0.14% per year from 1992 to 2000 to 0.54% per year between 2000 and 2009, resulting in a loss of 3,759 hectares of forest over 17 years.

Deforestation has many implications, including loss of biodiversity, and increase in landslides & soil erosion, which ultimately affects the agriculture production of the valley (Hussain et al. 2018). During the past few decades, deforestation in Swat has been increasing at an alarming rate (Dawn News 2024a).

During the summer season, forest fires frequently occur due to various natural and human-induced factors (Dawn News 2024b). The loss of trees and vegetation due to forest fire not only diminishes the area's natural beauty but also poses a threat to the delicate habitats of various plant and animal species. Prolonged dry spells, coupled with poor forest management, and human activities have led to an increase in the frequency and intensity of forest fires in Swat (Nafees et al. 2024). The forest degradation due to forest fires has led to a decline in biodiversity. This loss of biodiversity has far-reaching implications for the ecological balance and the livelihoods of local communities that rely on forest resources. The incidents of forest fires have increased in Chitral because of an increase in mean temperature, prolonged dry spells, and increased human activity in the forests. For example, a fire that erupted in the core zone of Chitral Gol National Park has affected over 100 acres of coniferous forest and destroyed valuable timber and wildlife habitat (Dawn, 2021). The fires caused extensive damage to local flora and fauna, affecting both biodiversity and the ecosystem services provided by these forests.

3.2 Infrastructure

The infrastructure of both Chitral and Swat Valley is susceptible to multiple risks and vulnerabilities due to its complex topography, climate-induced disasters, and multifaceted socio-political dynamics. Natural disasters, particularly floods, earthquakes, and landslides, have had a profound impact on the infrastructure of HKH region of KP. The 2010 floods, which are often cited in literature, caused widespread destruction to roads, bridges, power supply systems, and water supply infrastructure. The region's infrastructure was unable to withstand the magnitude of disaster, leading to significant economic losses and long-term disruptions. In this section, we will discuss the risks and vulnerabilities related to transportation, water supply, and energy infrastructure in the valley.

The transportation infrastructure, including roads and bridges, is highly vulnerable to natural disasters such as floods, landslides, and earthquakes. During the monsoon seasons, floods frequently damage roads and bridges, especially on river stretches with extreme deposits and bank erosion. The 2010 flood was a devastating event that washed away key bridges and cut off entire communities from essential services (FFC, 2010). Similarly, the 2022 flood washed away entire road sections, bridges, and other

infrastructure, which requires around USD 16.3 billion for reconstruction and rehabilitation (Christoph, and Pascal 2023).

Chitral's mountainous terrain and inadequate infrastructure limit market access, which affects both trade and livelihoods (Rasul et al. 2019). The remoteness of Chitral has hindered the growth of local businesses further, the poor road conditions and the lack of storage facilities result in high transportation costs and significant post-harvest losses, particularly for perishable goods. Access to formal sources of financial services such as microcredit, insurance, and banking is also limited in Chitral. This lack of access constrains local businesses and households from investing in adaptive measures, such as climate-resilient infrastructure or new income-generating activities, further increasing their vulnerability (Nadeem et al. 2009).

Landslides triggered by rains and earthquakes are also one of the significant risks leading to frequent road blockages and accidents. During the monsoon season frequency of landslide incidents increased, causing damage to transportation infrastructure leading to disrupted transportation and cutting off access to the communities (Government of Khyber Pakhtunkhwa, 2024).

The majority population in rural areas of Swat and Chitral lacks proper water supply and sanitation infrastructure. The areas where such services are available are also inadequate and face challenges of contamination, damage from natural disasters, and shortage of clean water supply in the dry season. The increasing frequency of floods and landslides in the valley further contributes to water and sanitation infrastructure vulnerability. Floods severely damage the water supply schemes in the region, which leads to a water crisis leaving thousands without access to drinkable water (WaterAid, 2022). During the dry season, people face chronic water shortages, and the lack of water storage facilities and distribution infrastructure exacerbates the situation (Wasim, Tanvir & Mukhtar 2022).

Many areas in Valley lack proper sewage and waste disposal infrastructure and systems. This lack of sanitation facilities, especially in rural areas, leads to many waterborne diseases, particularly during the monsoon season (Malik et al. 2010; Waseem, Tanvir & Mukhtar 2022). This inadequate sanitation infrastructure has been posing a significant health risk to the public.

In Swat, hydropower is the main source of energy, many small power plants are operating in the region and providing continuous electricity supply to the community. As the valley is highly susceptible to climate vulnerabilities, energy infrastructure is also at risk of power plants and transmission line damage, particularly from floods and landslides. This damage can cause a disruption in electricity supply that may affect both residential areas and critical infrastructure, including hospitals and schools, exacerbating the region's vulnerabilities (Ahmad, 2011).

Although Swat has significant potential for renewable energy including hydropower and solar, the infrastructure to harness this potential is underdeveloped. Therefore, regions existing small-scale hydropower projects are vulnerable to natural disasters which lead to disruption in power supply (Zofeen, 2018). The investment in modern renewable energy infrastructure in the region can help improve energy infrastructure resilience to climate-related risks (Aslam et al. 2022).

3.3 Economy and livelihood

Socioeconomic and natural adversities have significantly impacted the rural economy and livelihood of HKH residents (Khan, 2010). As mentioned in the above section, the region has experienced a series of man-made and natural disasters that have impacted almost all the economic activities of the region (Ullah et al. 2018). Additionally, law and order situation in the region amid militant groups has led to a significant decline in economic activities, especially tourism (Shah, 2010).

The impacts of climate change on the livelihoods of local communities in Swat district are becoming critical mainly because of two vulnerable livelihood options (agriculture and livestock), which are directly linked to variation in temperature and precipitation. Moreover, droughts, unseasoned and heavy rains, and pest attacks have resulted in significant crop failures. All these drivers have led to reduction in income and poverty (Ullah et al. 2018). Floods, earthquakes, and landslides have posed significant risks to the agriculture sector of Swat. The loss of land and damage to crops because of disaster not only affects the availability of food items but also causes income loss to farmers. The damage to infrastructure such as roads and bridges because of disasters disrupts market access which further worsens the situation (Christoph and Pascal, 2023).

Chitral's unique geographical location makes it particularly susceptible to climatic risks such as floods, landslides, and glacial lake outburst floods (GLOFs). The vulnerabilities related to agriculture, livestock, and forestry, which have been discussed in the above section have severe consequences for local livelihoods. For example, GLOFs and flash floods caused extensive damage to infrastructure, irrigation canals, farmlands, and livestock. The higher temperatures, unpredictable rainfall patterns, and shrinking glaciers lead to water scarcity, affecting crop yields and intensifying competition for water resources. Land degradation due to deforestation and unsustainable practices further diminish agricultural productivity.

The history of socio-political unrest and Taliban insurgence poses another layer of risk complexity to the socio-economic fabric of Swat Valley. The valley has experienced periods of conflicts that led to Internally Displaced Persons (IDPs), infrastructure damage, and disrupted economic activities (Amir-uddin and Malik, 2016). Even after the conflict phase is over, a sense of insecurity and fear prevails among the community, which affects investment slowing down economic recovery. Conflicts have also severely damaged the social fabric of the community as many families are still struggling to rebuild their lives in the Valley (Khalid et al. 2022).

In the mountainous areas of KP, women are largely responsible for managing the household chores, fetching water, collecting firewood, and raising livestock. However, they are customarily limited in mobility within the public sphere (Shahbaz et al. 2014). Additionally, Swat has a strong tribal and patriarchal social structure, therefore, women face significant barriers not only to their economic participation but also to their access to education and healthcare. This gender inequality has far-reaching impacts on valley's overall well-being and economic potential (Khan, 2020). It is often argued that disasters usually make prevailing inequalities even worse, particularly for women who are subject to inhumane and unsafe conditions. Gender sensitive approach to adaptation is therefore inevitable in a patriarchal society like KP.

3.4 Tourism

Tourism is one of the emerging livelihood options in the mountainous area of KP with a considerable contribution to the region's economy. However, various socio-economic and climate factors, including natural disasters, conflicts, and insecurity have significantly impacted the tourism industry. The destruction of tourist infrastructure, such as hotels, roads, and recreational facilities, coupled with the negative perception of the region's safety, has led to a sharp decline in tourist arrivals in Swat (Ali et al. 2020). The decline in tourism revenue has also impacted various associated sectors of economy, including transport, hospitality, and handicraft industries. The above-mentioned factors have forced many families, who are associated with the tourism industry, to seek alternate livelihoods often at lower wages and return (Bhatti and Lim, 2024).

Tourism has traditionally been a vital component of Chitral's economy, particularly the Kalash valleys and Shandur Pass areas that are known for their natural beauty and cultural heritage. However, tourism sector and livelihoods of those who depend on this sector have been severely impacted by climatic events. In 2023, the floods have washed away the roads, bridges, and trekking trails, hindering access to popular tourist spots and disrupting travel plans. Additionally, tourist accommodations, including hotels and guesthouses, suffered damages, further limiting the capacity to host visitors (Secours Islamique France, 2023).

4. STAKEHOLDER MAPPING

Stakeholders may be individuals, social groups, communities, institutions or organizations with a stake (vested interest) in a particular issue or a particular decision, policy or action. In other words, stakeholders include all those who affect, and/or are affected by the decisions, policies and actions of the system. (Worthen et al. 1997; Hemmati, 2002). CSRIO (2009) defined the term "stakeholder" as anyone with an interest in a specific decision. This interest can be the potential to influence the decision, and/or the potential to be influenced by the decision.

Before identifying stakeholders in the milieu of climate change adaptation, it is important to first reflect on:

- **the *issue* in which individuals, institutions or organizations do have their stake,**
- **individuals, groups, institutions and organizations having a stake in this specific issue,**
- **the nature of their *stake*,**

This study focuses on the climate change adaptation in Swat and Chitral districts of KP, Pakistan, with particular emphasis on the agriculture, forestry, infrastructure and livelihoods. Thus, a **first stake** emerges around the utilization of resources, infrastructure and services which are being affected by the consequences of climate change and extreme events. And a **second stake** can be around the interest in 'participating' in the adaptation process. Here, issues of power, influence, conflicts and legitimacy become central.

There is a vast range of stakeholders who on the one hand do have a stake in the climate change adaptation policies, and on the other hand are involved to varying degrees in the decision-making

process. To enter the discussion, we used the definition of Codne and Lonsdale[15], who described stakeholders in the perspective of climate change studies as government officials, policy makers, administrators, scientists, communities, and the private sector. Thus, stakeholders can be brought together from both public and private enterprises to develop a joint understanding of the issues and to effective adaptation. This will, however, be further refined in the discussion that now follows.

4.1 Major stakeholders in climate change adaptation

There is a wide range of stakeholders, who are impacted by the consequences of climate change and related adaptation policies/interventions on the one hand, and on the other they are involved to varying degrees in the decision-making, coordination, and management of these adaptation policies and interventions.

4.1.1 Local community

"Local community" is not a homogenous entity rather there are many groups and sub-groups with different power relations and stakes within a 'community'. In this section, we briefly describe the stakeholder groups within the "local community" who are directly affected by the climate change and adaptation interventions.

i. Farmers

As discussed in the above sections, agriculture and livestock are amongst the major livelihood strategies in both Chitral and Swat districts, and income from agriculture sector (crops and livestock) is one of the major sources of revenue for predominately rural population of KP in general and the districts under consideration in particular. The farming system in the mountainous region of KP is characterized by small landholdings with some of the smallest average landholdings in the country (Millier et al. 2021). Although farming is one of the main livelihood strategies of rural households, more than one-third of the rural population of province is still food insecure. The agriculture sector is highly vulnerable to the impact of climate change and extreme weather events. Farmers of the KHK region are particularly at risk and they often struggle to earn sufficient income to meet their household needs. Farmers of the region largely lack access to agricultural extension services and credit/formal financing options that would help them overcome the constraints and risks associated with farming (ibid).

ii. Women

Gender disparity prevails across KP and women are not granted the same levels of access to financial services, formal education and agricultural extension services as most of the public, NGOs and private sector led training and capacity building programmes are often targeted towards men (Govt. of KP, 2015; Miller, 2021). This is despite of the fact that women considerably contribute to the productive tasks on the farm particularly in livestock rearing and crops, but most of their work goes unrecognized. They are even more impacted by climate change and extreme events. For instance, a report by SLRC (2012) indicates that due to climate and conflict crisis, women report that their movements are more restricted which often prohibits them from completing daily, on-farm activities.

iii. Indigenous minority tribes

[15] www4.unfccc.int/sites/NAPC/Country%20Documents/General/apf%20technical%20paper02.pdf

In Chitral district, the Kalash is a prominent indigenous minority tribe. They live in the remote Kalash valleys of the Hindu Kush Mountains, which includes the sub-valleys of Birir, Bumborait, and Romboor. The Kalasha people are known for their unique religious beliefs, cultural practices and distinct language, which is considered endangered (Javid, 2024). The Kalash people face multiple challenges, including limited access to healthcare and education, poor economic opportunities, and the impacts of climate change, which is a threat to their agricultural practices and traditional ways of life (Choudhry et. al. 2018)

4.1.2 Government

The government is indeed the primary stakeholder in the realm of climate change adaptation. Given the complexity and scale of the challenges posed by climate change, the government's involvement at various levels is crucial for effective policy development, implementation, and oversight. In this context, the government's role in Pakistan is spread across three layers (i.e. federal, provincial and local government), each with its own set of responsibilities and areas of influence. The multifaceted challenges of climate change can be addressed if these three layers work in close coordination to implement comprehensive and effective adaptation strategy.

Federal government

The Federal government is typically responsible for developing national policies, strategies, and regulations that guide the overall direction of climate adaptation. It creates legal frameworks and coordinates international cooperation on climate issues.

The Federal Ministry of Climate Change and Environmental Coordination is the most important ministry which oversees climate change policies and coordinates the adaption efforts across provinces. The National Adaptation Plan (2023), National Clean Air Policy (2023), National Climate Change Policy (202), Pakistan Update Nationally Determined Contributions (2021) National Forest Policy (2016) are some of the significant policy initiatives undertaken by the Ministry of Climate Change. Pakistan Environmental Protection Agency works under the umbrella of this ministry and responsible for environmental regulations and sustainability initiatives.

The Federal Ministry of Food Security and Research is generally responsible for policy formulation, planning and economic coordination regarding agriculture and food grain. It also focuses on international liaison, procurement of wheat, import price stabilization of agriculture produce and economic studies for framing agricultural policies[16].

In response to the devastating earthquake of October 8, 2005, the National Disaster Management Ordinance was enacted to establish and regulate a comprehensive and progressive disaster management framework at the national, provincial, and local levels, focusing on disaster mitigation, preparedness, and response[17]. The National Disaster Management Authority (NDMA) is federal authority that is responsible to deal with the whole spectrum of disaster management in the country. It

[16] https://mnfsr.gov.pk/Detail/ZGMxZmE5Y2EtN2MwMC00MTliLWIyMDAtZGNiNTQ3NmUyMzE3
[17] https://www.pdma.gov.pk/PDMA

also develops guidelines and standards for national and provincial stakeholders regarding their role in disaster risk management[18].

Provincial government

The provincial government plays a crucial role in bridging the gap between national directives and local implementation. The KP Government is responsible for formulating policies and implementing climate adaptation strategies at the provincial level. The provincial department of Climate Change, Forestry, Environment and Wildlife is responsible for climate change policy formulation, forest management and environmental protection.

The Provincial Disaster Management Authority (PDMA) at KP oversees disaster risk management, including policy formulation, mitigation, preparedness, and hazard risk reduction under the direction of NDMA. It coordinates with all stakeholders at Federal, Provincial and Local levels for disaster preparedness and response, provides relief to affected populations and rehabilitation efforts. PDMA also facilitates donor coordination for relief and reconstruction projects on behalf of the Provincial Government[19].

The Agriculture Department of KP works for the improvement of agriculture sector. Its main goal is to ensure food security, poverty alleviation and to generate employment opportunities through achieving higher growth rate in this vital sector of the economy[20]. The major Directorates of the provincial agriculture department are Agricultural Extension, Agricultural Research, On Farm Water Management and Agricultural Engineering. The livestock sector is administered by the Livestock and Dairy Development Department of KP.

Local Government

Local governments must be at the forefront of climate change adaptation efforts because they are directly involved in implementing policies on the ground and engaging with communities. The local government institutions in KP are mandated to carry out development activities at local levels to provide basic civic amenities to the citizens. There are three tiers of local governments in the province viz. the district, tehsil and Union Council. At the district level the functions are further devolved to Tehsil (sub-district), Town and Union Council (UC) levels. Each district has an elected *Zilla* (District) Council, elected Tehsil Council, Town and Union Councils. These councils look after various activities at their respective levels.

Civil Society Organizations (CSOs) and NGOs

The CSOs and NGOs are considered as intermediaries between the government and local communities, facilitating awareness, education, advocacy and capacity-building initiatives that empower vulnerable populations to adapt to climate impacts.

Table 4: Stakeholder mapping in the context of climate change adaptation in HKH region of KP

[18] http://www.ndma.gov.pk/about
[19] https://www.pdma.gov.pk/PDMA#Functions
[20] https://agriculture.kp.gov.pk/page/goal_objective_of_agriculture

Stakeholders	Role in System	Current Concerns	Longer-Term Interests	Power & Influence
Federal Ministry of Climate Change and Environmental Coordination	Policy formulation on climate change adaptation Coordination with international actors and provinces	Lack of ownership of climate change policy by provinces and local governments Funding constraints	Sustainable climate change adaptation policies with ownership at provincial and local levels Effective international collaboration	Medium to High influence Regulatory power and access to funding
Federal Ministry of Food Security and Research	Development and implementation of food security policies	Food security risks due to climate change impacts and disasters on agriculture	Ensuring food security amidst climate change challenges	Low to Medium influence
National Disaster Management Authority (NDMA)	Disaster risk management and coordination with Provincial Disaster Management Authorities (PDMAs)	Increasing incidences of climate-related disasters in HKH region	Better disaster response and resilience strategies Effective coordination between federal, provincial and local levels	High influence Emergency management, relief operations Resource mobilization
Provincial Department of Climate Change, Forestry, Environment and Wildlife, KP	Provincial policy on climate change, forest management, and environmental protection	Deforestation and loss of biodiversity exacerbated by climate change	Sustainable management of forests. Biodiversity conservation. Effective adaptation at provincial level	Low to Moderate influence
Provincial Disaster Management Authority (PDMA)	Disaster risk management, mitigation, preparedness, and hazard risk reduction at KP province	Increasing frequency of disasters in HKH. Disaster preparedness and community resilience	Long-term effective strategies for disaster risk reduction and community engagement	High influence in disaster management at the provincial level

KP Agriculture Department	Agricultural development, productivity enhancement	Crop failures and reduced yields due to climate variability and disasters	Adoption of climate smart agricultural practices. Enhanced income of smallholder farmers	High influence Implementation of Agricultural policy and farmer support programs
KP Livestock and Dairy Development Department	Development policies for better productivity in livestock and dairy sectors	Impact of climate change on livestock health and productivity	Sustainable livestock management and food security	Moderate influence in livestock policy and support programmes
Local Government	Implementatio n of local policies and community engagement	Limited resources and capacity to address climate change related issues at the local level	Strengthening local governance and community resilience. Financial sustainability	Medium influence at local level in policy implementation and community mobilization
NGOs and CSOs	Advocacy, awareness-raising, and community engagement on climate issues	Need for greater community involvement in adaptation efforts	Empowerment and mobilization of local communities and sustainable development initiatives	Moderate influence through grassroots mobilization and advocacy
Farmers	Primary stakeholders in agricultural adaptation practices	Vulnerability to climate impacts, decreasing resources, limited livelihood options	Adoption of sustainable and climate-resilient farming practices	Low influence
Women	Carrying out agricultural and livestock activities. Household food security	Gender disparities Restricted access to basic services	Women empowerment	Low influence in decision-making processes
Indigenous Minority Tribes and Groups	Traditional knowledge holders and stewards of local ecosystems	Marginalization Low participation in decision making Diminishing culture and identity	Recognition of indigenous rights and integration of traditional knowledge in adaptation Equal rights	Low influence

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