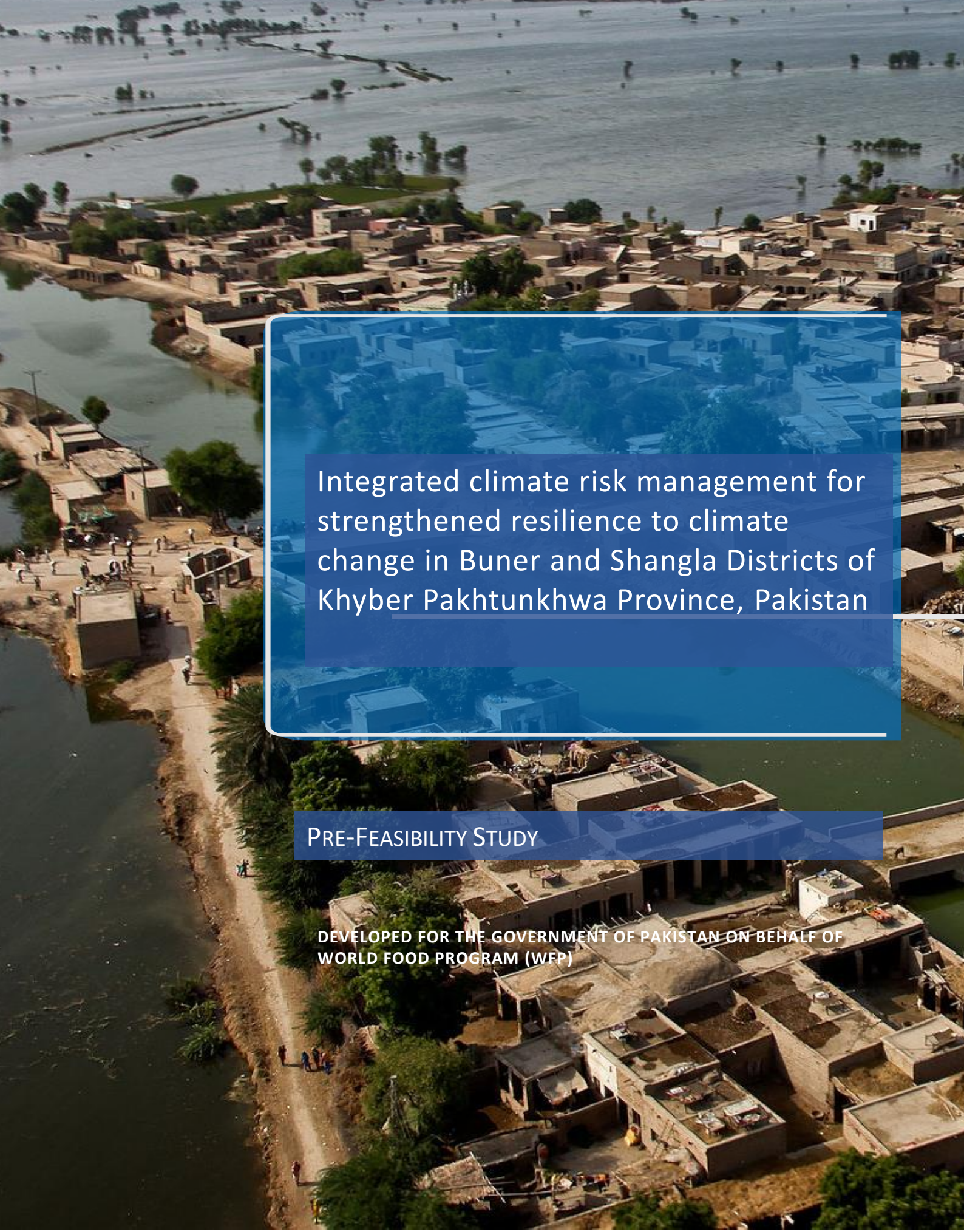


Integrated climate risk management for strengthened resilience to climate change in Buner and Shangla Districts of Khyber Pakhtunkhwa Province, Pakistan

PRE-FEASIBILITY STUDY

DEVELOPED FOR THE GOVERNMENT OF PAKISTAN ON BEHALF OF WORLD FOOD PROGRAM (WFP)

GREEN CLIMATE FUND

WFP

Table of contents

EXECUTIVE SUMMARY

Climate change is adversely impacting the vulnerable communities in Pakistan, and presents a direct threat to enabling the socio-economic growth of the most vulnerable people in the country[1]. Under future climate conditions, these impacts are projected to worsen, and the country's natural and human capital are expected to be severely affected[2]. Climate change already threatens the progress Pakistan has made towards poverty reduction and in the absence of adequate interventions, the increasing risks from climate hazards (particularly floods) will likely compromise the country's development ambitions[3].

The country requires significant support for climate change adaptation, particularly to overcome its technical, financial, and policy barriers (see the section below on barriers to adaptation). This includes a need for greater technical capacity for forecasting and multi-hazard vulnerability risk assessments, particularly at a local level. In Khyber Pakhtunkhwa Province there is a need to enhance protective measures against floods, as there is currently inadequate early warning systems in place to enable communities to adequately respond to floods, particularly in Buner and Shangla Districts. Water storage facilities are also insufficient, having reduced due to silting, while deforestation has worsened soil erosion near major rivers. Financially, local governments require more resources to fund the development, operation, and maintenance of water storage and early warning systems, and donor-led initiatives must address concerns of discontinuity. Lastly, there is a lack of comprehensive policies and plans for addressing climate change adaptation needs, with a rise in low-quality infrastructure that is not built to sustain climate change risks.

1. CONTEXT AND BACKGROUND

1.1. National socio-economic context

1.1.1. Geography

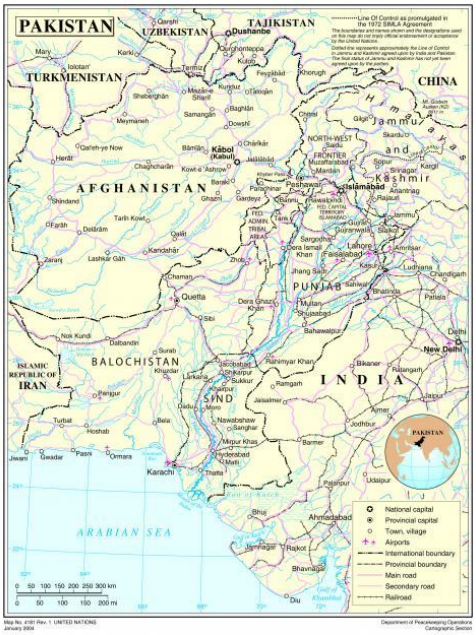


Figure 1. Map of Pakistan.

[1] https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability
[2] World Bank. 2022. Country Climate and Development Report.
[3] World Bank. 2022. Country Climate and Development Report.

Pakistan is located in the South Asian subcontinent and covers a land area of over 880,000 km^2 (as shown in Figure 1). It shares borders with India to the east, China to the northeast, and Iran and Afghanistan to the west. The country's diverse topography encompasses alpine regions with permafrost, as well as temperate, tropical, and sub-tropical ecosystems, along with coastal areas. Pakistan is categorized into ten agro-ecological and nine major ecological zones, showcasing its environmental and biological richness.

The majority of Pakistan's land area, about 75%, is classified as arid, while only a small portion of the country has a humid climate. The agricultural plains are situated at different altitudes, ranging from a few meters above sea level in the south to over 3,000m above sea level in the north. The lowland plains are situated along the Indus River, while high mountain ranges in the north and west - including the Hindu Kush, Himalaya, and Karakoram ranges - contribute to precipitation on the windward side, while the leeward side remains barren, depending on the season. The topographical diversity has an impact on temperature, with cooler temperatures at higher altitudes and warmer temperatures in the lowlands. During the summer monsoon season, rainfall follows the trajectory from east to west, originating in India, and passing through the eastern region of Pakistan. Meanwhile, in winter, a western depression enters northwest Pakistan from Afghanistan[4]. Pakistan boasts a wealth of natural resources, including fertile agricultural lands, natural gas reserves, and mineral deposits. However, the country faces a difficult balancing act in reconciling the competing objectives of economic development and environmental preservation[5]. Pakistan is divided into four provinces: Punjab, the North West Frontier Province (NWFP), Sindh, and Balochistan, as well as two federally administered territories: The Federally Administered Tribal Areas (FATA) and the Northern Areas. Furthermore, the territory of Azad Jammu and Kashmir (AJK) is directly administered by the Pakistani government. Each province or territory is further subdivided into administrative units referred to as districts and Unit Councils.

1.1.2. Population and demographics

As of 2020, Pakistan's population totalled 220.9 million people, with an annual growth rate of 2%[6]. However, a large proportion of the population remains in poverty. In 2015, approximately a quarter of the population (24.3%) still lived below the national poverty line, although this number has slowly decreased in recent years[7]. The percentage of the population living in poverty decline slightly in 2018 to approximately 21.9%[8]. In addition to the high national poverty rate, wealth distribution in Pakistan is highly unequal. In 2015, for example, the bottom 20% of the population held only 8.9% of the wealth, highlighting the dire circumstances of Pakistan's poorest and most vulnerable people. Between 2017 and 2019, 12.3% of the general population suffered from undernourishment, a statistic that persisted into 2018[9]. While the poverty rate in Pakistan has declined slowly in past decades, the impacts of climate change are posing a severe threat to this trend and threaten to reverse the gains that have been made in socio-economic development (more detail is presented in section 2.3).

1.1.3. Economic context and importance of the agriculture sector

Pakistan is a semi-industrialized developing country that has transitioned from an agriculture-based to a mostly service-based economy, with services contributing 49.4% to the GDP in 2019[10]. Despite this shift, agriculture remains the backbone of Pakistan's economy, employing 42.3% of the workforce and contributing 22% to the GDP in 2019[11,12]. Given the high proportion of people relying on agriculture for their livelihoods,

[4] World Food Programme (2018) Climate Risks and Food Security Analysis: A Special Report for Pakistan.
[5] World Bank (2021) Pakistan Overview – Economy.
[6] United Nations Population Division (2020) World Population Prospects 2019 Revision.
[7] Asian Development Bank (2021) Poverty Data: Pakistan.
[8] World Bank. 2023. Poverty and equity brief: Pakistan. Available at: https://databankfiles.worldbank.org/public/ddpext_download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/current/Global_POVEQ_PAK.pdf
[9] FAO (2020)
[10] World Bank (2021) Pakistan Overview – Economy.
[11] World Bank (2021) Pakistan Overview – Economy.
[12] World Bank (2021) Pakistan Overview – Economy..

climate impacts and adaptation needs in this sector are a high priority[13,14]. Pakistan's population depends heavily on climate-sensitive land, water, and forest resources for food security and livelihoods. The majority of Pakistan's population lives along the Indus River, an area prone to severe flooding in July and August, while major earthquakes are frequent in the mountainous northern and western regions[15]. 60% of the population holds "vulnerable employment," which means low job security and limited access to social protection programs[16].

The five most important crops in the country – wheat, rice, cotton, sugarcane, and maize – are grown predominantly by subsistence farmers, and a large proportion of the nation's agricultural land is degraded, increasing the impact of climate change. Damage to key cash crop yields, including cotton, is a particular concern for low-income communities. Pakistan is the fifth largest producer of cotton in the world – the industry contributes 10% of the country's GDP and employs approximately 30% of the country's farmers, many of whom are rural women. Crop production and livestock rearing are the two main agricultural sub-sectors, accounting for 34.9% and 58.3% of agriculture value-added, respectively[17]. The fishing and forestry sub-sectors represent minor contributions at 2.1% and 2.3% respectively[18]. Figure 2 below shows key agroecological zones for Pakistan. Table 1 below shows the cultivated surface area and production volumes for key agricultural crops, for the 2019-2020 and 2020-2021 agricultural seasons. Figure 3 below shows the crop calendar for key staple and cash crops.

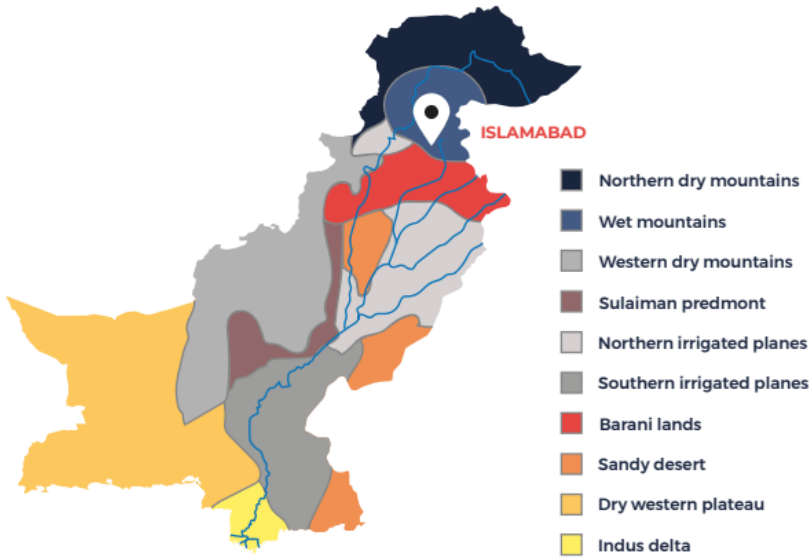


Figure 2. Agroecological zones of Pakistan[19]

Table 1. Production surface areas and volumes, key crops, in thousands of hectares and tons[20]

Crop/Year	Wheat		Maize		Rice		Sugarcane		Cotton	
	Area [ha]	Production [t]	Area	Production	Area	Production	Area	Production	Area	Production
2019-2020	8,804	25,247	1,404	7,883	3,034	7,413	1,039	66,379	2,517.3	9,148

[13] World Bank (2021) Climate Change Knowledge Portal - Climate Change Profile Pakistan. Available online: https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-historical
[14] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[15] World Bank (2021) Climate Risk Country Profile Pakistan.
[16] ILO 2018
[17] World Food Programme (2018) Climate Risks and Food Security Analysis: A Special Report for Pakistan.
[18] Ibid.
[19] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[20] Pakistan Bureau of Statistics (2021) Area and production of important crops.

2020-2021	9,177	27,293	1,417	8,464	3,335	8,419	1,165	81,009	2,078	7,063

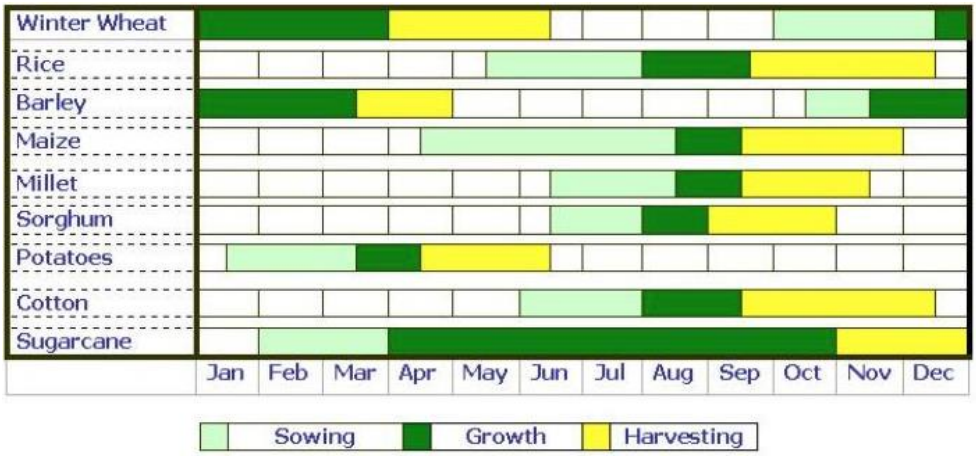


Figure 3. Crop calendar for key food and cash crops[21].

As agriculture in Pakistan depends largely on the availability of water for irrigation, production is concentrated in in the Indus River Basin, which covers 65% of the country's total area, including the provinces of Punjab, most parts of the Sindh territory, the eastern region of Baluchistan, and Khyber Pakhtunkhwa. Around 80% of Pakistan's agricultural production area is irrigated. Pakistan relies on the Indus Basin Irrigation System (IBIS), the largest contiguous irrigation system in the world, for basic food security and water supply for all sectors of the economy. The IBIS is the backbone of Pakistan's agricultural economy[22]. About 20% (approximately 3.24 million ha) of Pakistan's cultivable area is outside IBIS, where farming is in *barani* (rain-fed) areas, resulting in low agricultural productivity. Punjab accounts for 56.8% of the nation's cultivable area. Although Punjab accounts for 77.7% of the nation's irrigated area, about 13.3% of cultivable land in Punjab is still rain fed. Some of the country's poorest populations also reside in these *barani* areas and are dependent on agriculture for most of their income. Without a secure source of water for irrigation, however, farming in *barani* areas is both a low-productivity and a high-risk venture[23].

In terms of land use, two-third of farms are small farms that cover less than five acres, while one-third of farms are fragmented[24]. These small farms are characterised by inefficient water management and irrigation practices. Further, there are notable disparities in food production from one region to another. Punjab and Sindh are self-sufficient in the production of key staples and cereals, however, local production in other parts of the country are insufficient to meet the population's dietary needs. These disparities are illustrated with inadequate food availability in local markets reported by households in the FATA (39%), Gilgit-Baltistan (13%) and Khyber Pakhtunkhwa (15%)[25]. Pakistan's economy has been growing slowly over the past two decades, with annual per capita growth averaging only 2%, less than half of other comparable South Asian countries. This is partly due to inconsistent macroeconomic policies and an under-reliance on investment and exports to drive economic growth. Consumption-fuelled growth has led to recurrent boom-bust cycles with sizable current account and fiscal deficits that ultimately required policy tightening.

[21] National Agromet Centre. Crop Calendar of Pakistan.
[22] Yu, Winston, Yi-Chen Yang, Andre Savitsky, Donald Alford, Casey Brown, James Wescoat, Dario Debowicz, and Sherman Robinson (2013) The Indus Basin of Pakistan: The Impacts of Climate Risks on Water and Agriculture. Washington, DC: World Bank.
[23] Jalalpur Irrigation Project (2017) Sector Assessment Summary: Agriculture, Natural Resources, and Rural Development.
[24] Khan, M.J (2017) Agriculture and Textile Sector: Challenged and Way Froward. Punjab Economic Research Institute Policy Brief.
[25] World Food Programme (2018) Climate Risks and Food Security Analysis: A Special Report for Pakistan.

21% of households in Pakistan have reported being affected by a shock[26] between 2013 and 2016, which has affected their ability to access and/or purchase food. The proportion of affected households is highest in FATA (59%) and Khyber Pakhtunkhwa (36%), where floods are the predominant shocks recorded. There are significant disparities in food security between Pakistan's provinces and administrative areas. Households are comparatively more food insecure in the Federally Administered Tribal Areas (FATA) (6%), Gilgit-Baltistan (68%), Khyber Pakhtunkhwa (49%), Balochistan (63%) and Sindh (52%) than those in Punjab (37%) and Islamabad Capital Territory (ICT) (32%)[27].

1.1.4. The impact of Covid-19 on Pakistan's economy

The coronavirus disease (COVID-19) pandemic has had unprecedented adverse social and economic impacts. The pandemic has compounded the challenges vulnerable populations already face in their day-to-day lives. Adding yet another shock on top of these challenges has the potential to create devastating health, social, economic, and environmental crises, leaving a deep and long-lasting mark[28]. In response to the COVID-19 pandemic, containment measures were adopted, resulting in a severe contraction of economic activity during the final quarter of FY20. As a result, GDP growth is estimated to have contracted by 1.5% over FY2020. Half of the working population experienced either job or income losses, with informal and low-skilled workers employed in elementary occupations being the hardest hit. This has led to an estimated increase in poverty incidence in FY20 from 4.4 to 5.4%, using the international poverty line of $1.90 PPP 2011 per day, with more than two million people falling below this poverty line. Additionally, 40% of households experienced moderate to severe food insecurity. To mitigate the adverse socioeconomic effects of the pandemic, the government focused on a stimulus package equivalent to approximately 2.9 percent of GDP and a deferment of some fiscal adjustment measures.

1.2. Overview of project target Areas

1.2.1. Overview

The project is set to be implemented in the northern mountainous area of Khyber Pakhtunkhwa province, specifically in the districts of Shangla and Buner. The selection of these districts was made in consultation with the Ministry of Climate Change (MoCC) and the Provincial Government. The reason for selecting these districts is that they have been particularly vulnerable to floods and landslides triggered by episodes of intense rainfall over the past few decades[29]. These intense rainfall episodes have been linked to changing rainfall patterns and irregular onset of rainfall in the season. Moreover, increasing temperatures have worsened the situation, making communities more vulnerable to flood risks, particularly in Shangla district. The entire Northern Pakistan has recorded increasing temperatures and changing rainfall patterns in terms of intensity and timeliness[30]. The targeted districts of the project are located in one of the wettest parts of the country, as shown in Annex 2, Figure 1, which makes them prone to floods, especially with the combination of increasing temperatures and decreasing snow cover. More information on floods can be found in Section 2.2. Figure 4 below shows the exact location of the targeted districts.

[26] Such as a natural disaster, price hikes, insecurity, the death of a breadwinner, or crime.
[27] Ministry of National Food Security and Research, WFP, FAO & UNICEF, 2016.
[28] Ibid.
[29] NDMA 2007 to 2018 (information present in several reports), http://cms.ndma.gov.pk/publications#
[30] Chaudry and Qamar UZ, 2017. Climate Change Profile of Pakistan, Asian Development Bank https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf; Hussain MS, Lee S. The regional and the seasonal variability of extreme precipitation trends in Pakistan. Asia-Pacific Journal of Atmospheric Sciences. 2013 Aug 1;49(4):421-41.

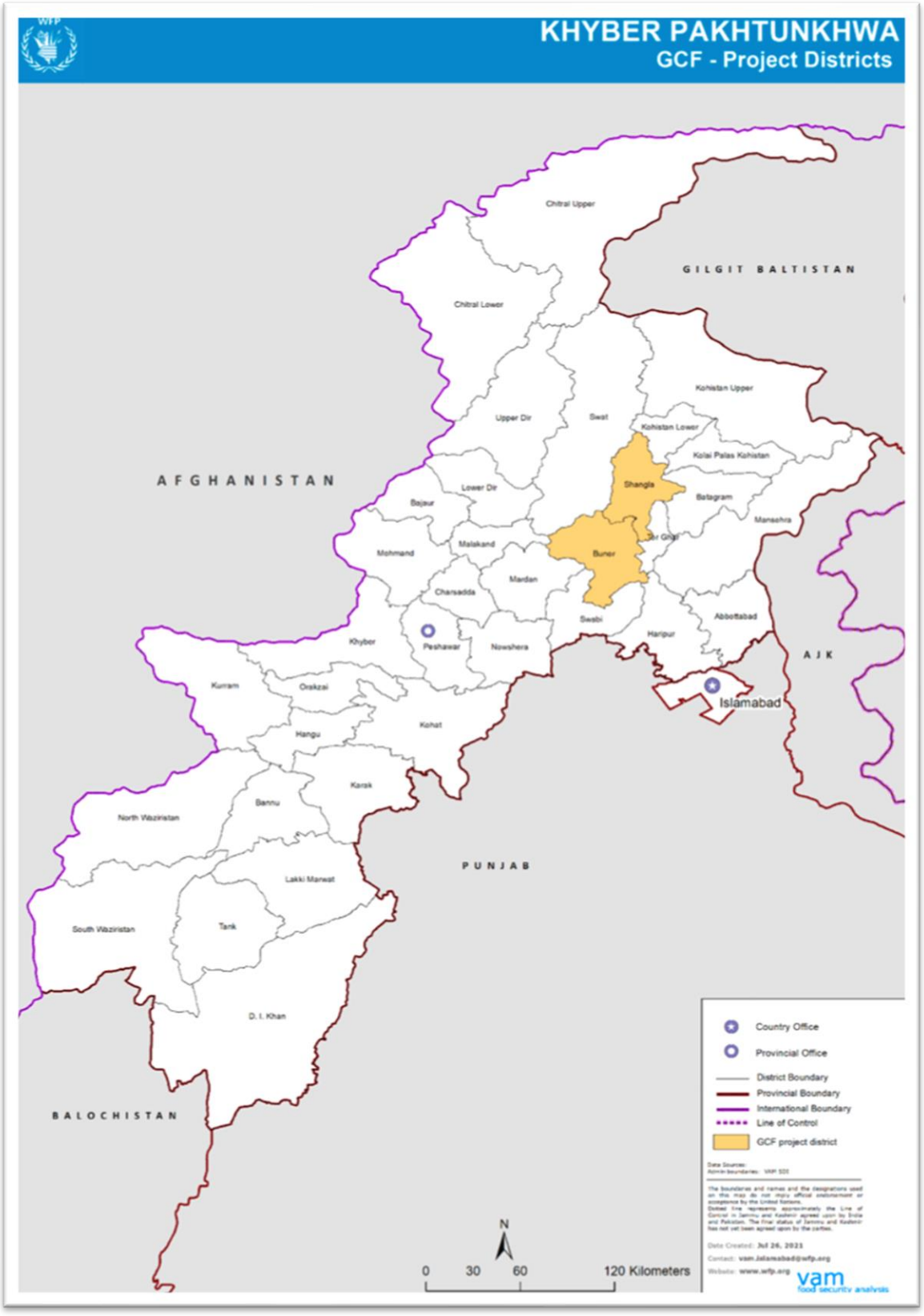


Figure 4. Project target districts in Khyber Pakhtunkhwa province.

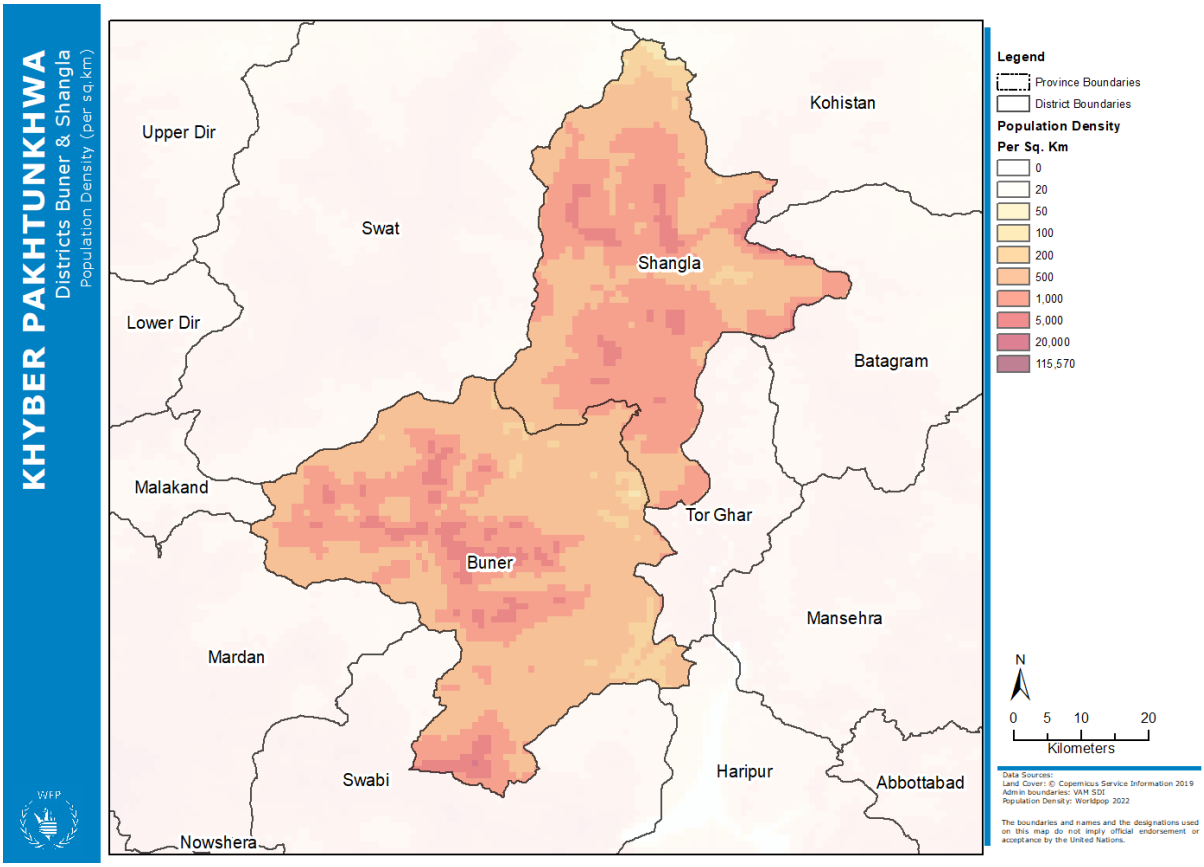


Figure 5. Population Density: Buner and Shangla Districts

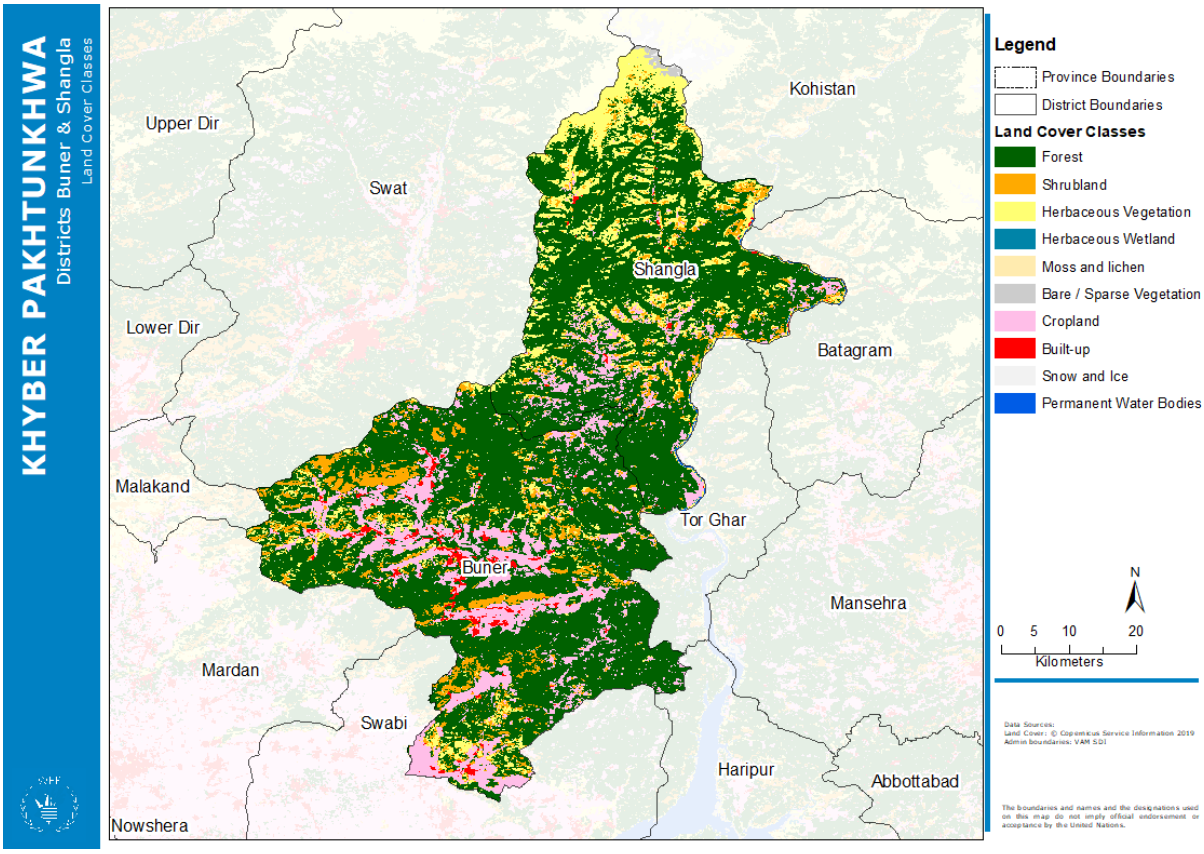


Figure 6. Land Cover Classes: Buner and Shangla Districts

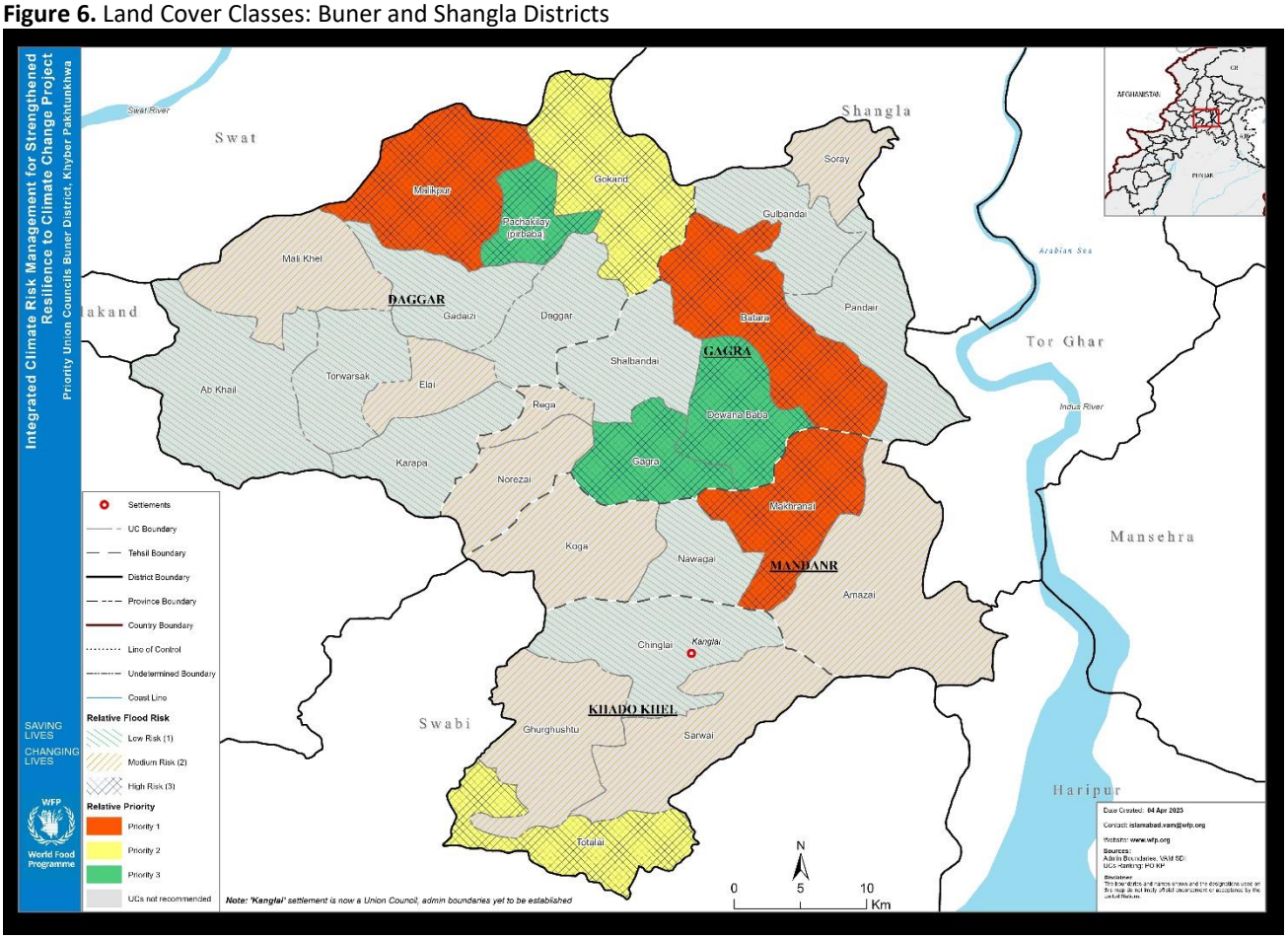


Figure 7. Priority Union Councils: Buner District

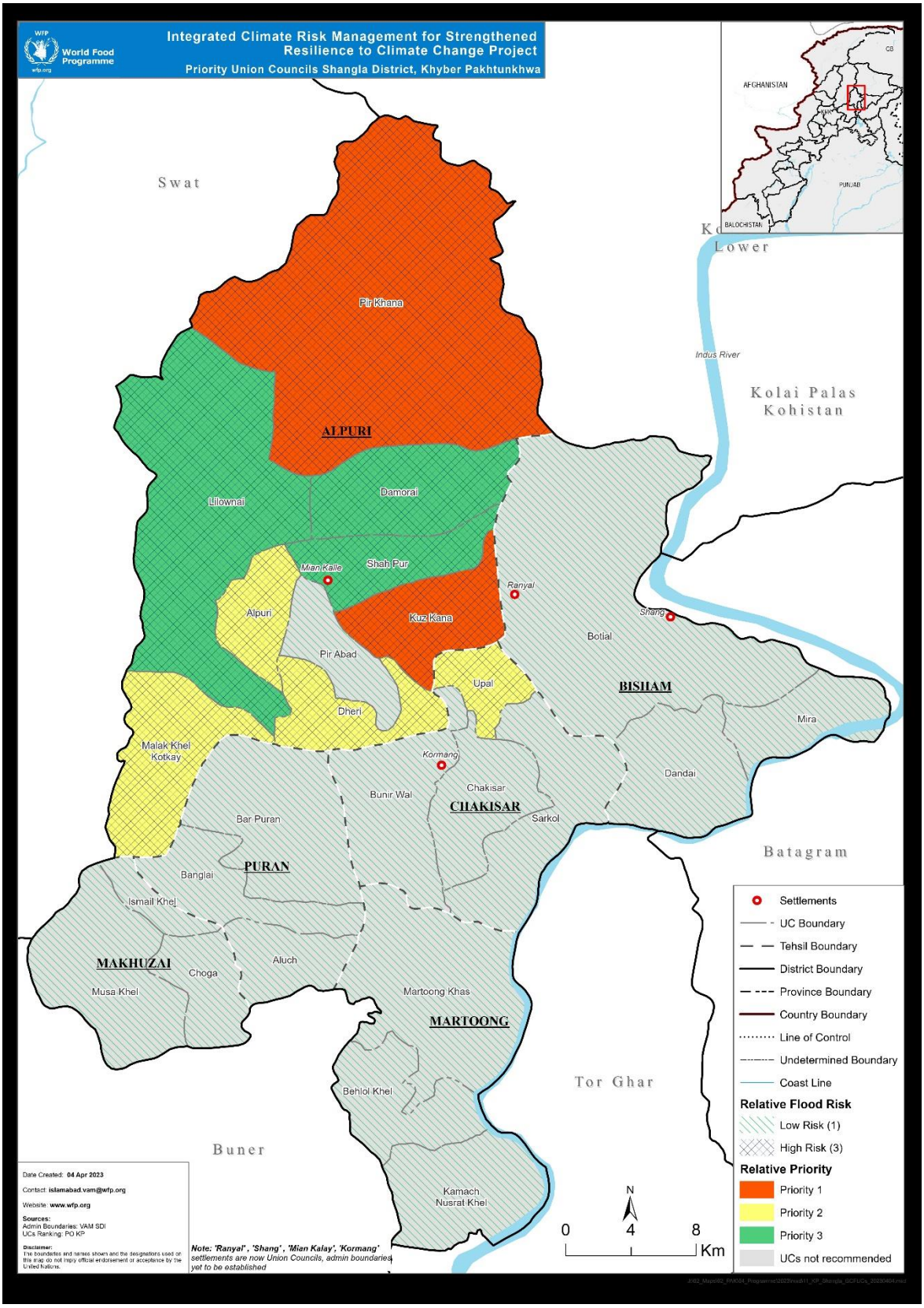


Figure 8. Priority Union Councils: Shangla District

1.2.2. Selection of the Project Area

A site selection analysis was undertaken to identify the most appropriate areas in the Khyber Pakhtunkhwa province for the implementation of the proposed project. This was done by identifying areas that are relatively more prone to natural hazards (floods) which overlap with areas of high vulnerability to food insecurity.

Methodology

The geographical targeting and prioritization comprised two phases, where in the phase vulnerable districts were selected, while in the second phase vulnerable areas (union councils in this case) were prioritised. For both phases, a set of vulnerability criteria was defined and applied.

First Phase (District Targeting)

In this phase, all districts of Khyber Pakhtunkhwa were relatively analysed. For the selection of district, the prime criterion was 'relative proneness to floods' of the respective districts. For this, information from the Provincial Disaster Management Authority (PDMA) Khyber Pakhtunkhwa was used. In this process, a total of 17 districts were identified as 'high or very high' vulnerable to floods, based on the historical trends. This was further triangulated with the available secondary data on the prevalence of food insecurity[31] and malnutrition[32] in the respective districts. Thus, a total of 9 districts were identified as priority one in Khyber Pakhtunkhwa. The findings of this exercise were discussed with the concerned provincial line department (PDMA, PMD, EPA, P&DD) and finally two districts namely 'Buner and Shangla', where no climate change related intervention has been implemented in the past several years especially GCF funded, were proposed for the project implementation.

Second Phase (Union Council-level prioritisation)

The methodology for the prioritisation of the union council in Shangla and Buner Districts involved stakeholders' consultation meeting at the district level. All key stakeholders including officials of all key line departments (Revenue, P&D, Agriculture, Livestock, Education, Health, Irrigation etc.) including office of the Deputy Commissioners, representative from the developmental partners (NGOs) working in the districts and community members having good knowledge of the context of the areas were consulted. For prioritisation of union councils, the vulnerability criteria used is shown in Table 2 below.

Table 2. Vulnerability criteria was used for prioritisation of union councils.

Core Lens		Disaster types, mainly floods
		Relative disaster risk the area is prone to)
Additional Lenses	**Availability**	Type of irrigation; Overall production; Livestock situation; Food supply/availability in markets;
	Utilisation	Drinking water availability, Sanitation system Education/literacy situation, Access to functioning health facility
	Accessibility	Remoteness (Terrain)/access from city HQ, Major sources of livelihood
		Relative income
		Socio-economic impact of COVID-19
Operational feasibility		Relative security risk the area is prone to

[31] WFP's Integrated Context Analysis 2017
[32] National Nutrition Survey 2019

A simple checklist consisting relevant indicators, corresponding to the above vulnerability criteria, was designed and administered during the stakeholders' consultation. Based on local knowledge and expertise of the participants and available secondary information. Union Councils which are 'highly or moderately' vulnerable to floods of the districts only were relatively analysed. Thus, a total of 8 UCs in District Buner and 11 UCs in District Shangla were considered for periodisation. Each indicator in the checklist was assigned a relative vulnerability scale/weight, ultimately a composite index/score was calculated for each UC. The highest the score the highest the vulnerability, thereafter a relative priority was assigned to each UC (Priority One, Priority two and Priority three).

Findings

Using the above-mentioned methodology, the following are the findings of the UCs Prioritisation exercise:

S. No.	District	Tehsil	Union Council	Relative Priority
1	Shangla	Alpuri	Mian Kalay	1
2	Shangla	Alpuri	Ranyal	1
3	Shangla	Alpuri	Pir Khana	1
4	Shangla	Alpuri	Kuz Kana	1
5	Shangla	Alpuri	Dehrai	2
6	Shangla	Alpuri	Malak Khel	2
7	Shangla	Chakisar	Opal	2
8	Shangla	Alpuri	Alpuri	2
9	Shangla	Alpuri	Damorai	3
10	Shangla	Alpuri	Shahpur	3
11	Shangla	Alpuri	Lilownai	3

S. No.	District	Tehsil	Union Council	Relative Priority
6	Buner	Gadezai	Malakpur	1
7	Buner	Chagharzai	Batara	1
8	Buner	Mandanr	Makhranai	1
4	Buner	Daggar	Gokand	2
5	Buner	Khadokhel	Totalai	2
1	Buner	Gadezai	Pacha Kalay	3
2	Buner	Gagara	Gagra	3
3	Buner	Gagara	Dewana Baba	3

Conclusion

The findings of the union councils were presented to the respective Deputy Commissioners, and after a detailed discussion and considering the security situation, two Union councils from District Buner and two Union Councils from District Shangla, classified as priority one, were finalized for the proposed project implementation. Similarly, one union council from each district was proposed as a backup/alternative area. The following is a summary of the union council proposed/approved by the respective Deputy Commissioners:

District	Tehsil	Union Council	Overall Priority
Shangla	Alpuri	Mian Kalay	Primary
Shangla	Alpuri	Pir Khana	Primary
Shangla	Alpuri	Kuz Kana	Alternative
Buner	Chagharzai	Batara	Primary
Buner	Mandanr	Makhranai	Primary
Buner	Gadezai	Malakpur	Alternative

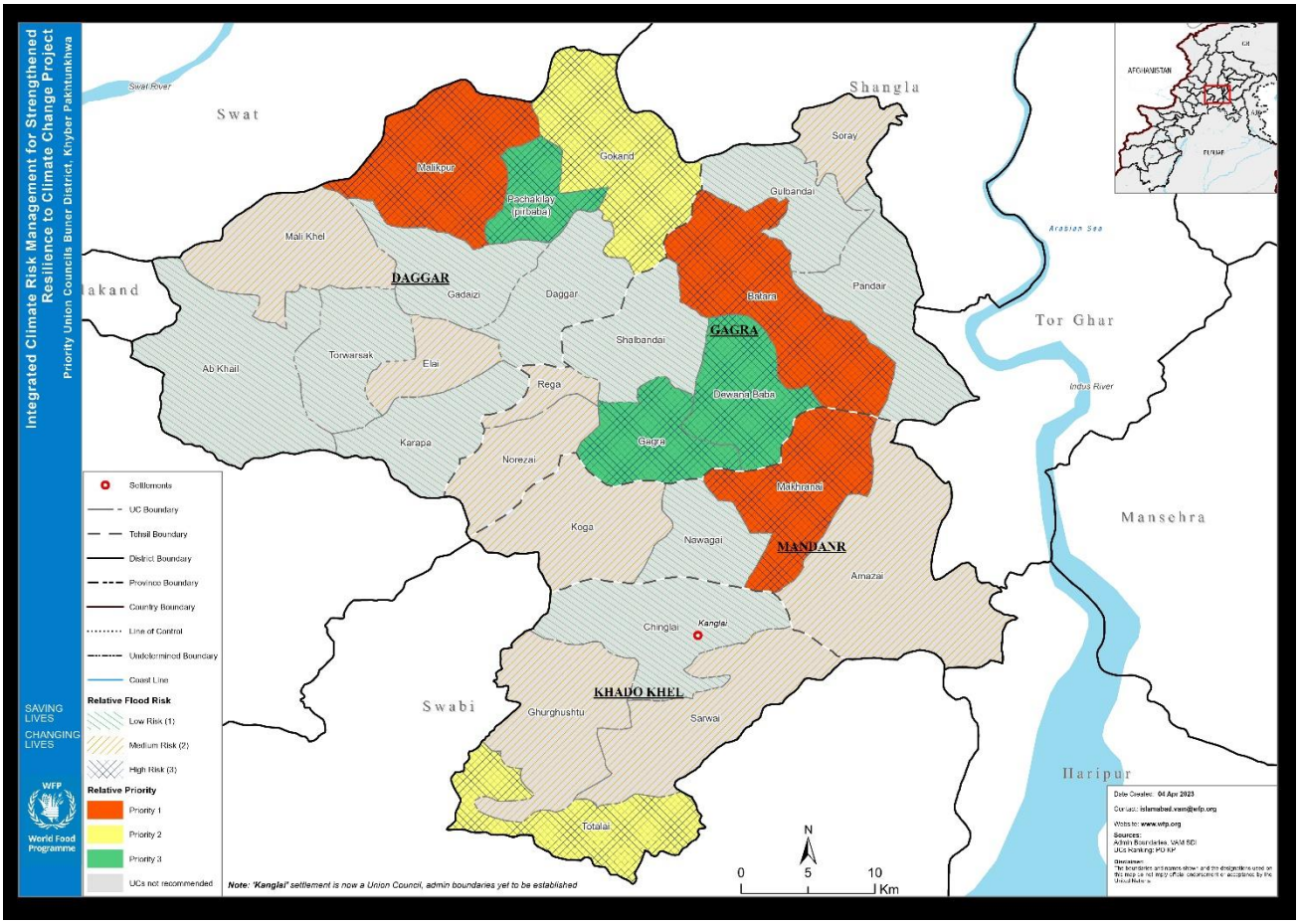


Figure 9. Priority Union Councils: Buner District

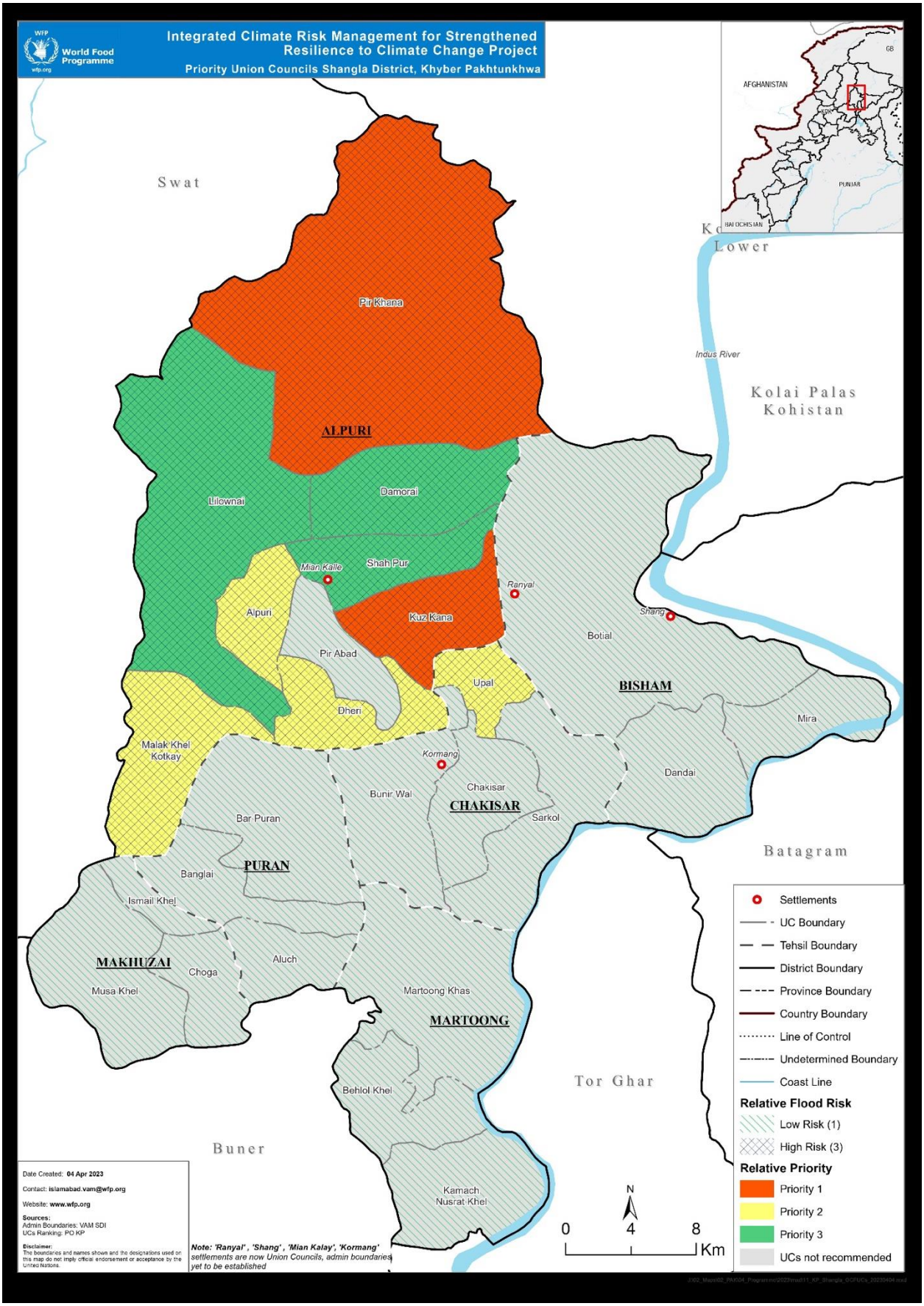

Integrated Climate Risk Management for Strengthened Resilience to Climate Change Project
Priority Union Councils Shangla District, Khyber Pakhtunkhwa
World Food Programme
wfp.org
AFGHANISTAN
GB
PUNJAB
BALOCHISTAN
Swat
Lower
Indus River
Kolai Palas
Kohistan
Pir Khana
ALPURI
Damorai
Lilownai
Mian Kalle
Shah Pur
Ranyal
Shang
Alpuri
Kuz Kana
Botial
Pir Abad
Upal
BISHAM
Dheri
Mira
Malak Khel
Kotkay
Kormang
Dandai
Chakisar
Bunir Wal
CHAKISAR
Sarkol
Bar Puran
Batagram
PURAN
Banglai
Ismail Khel
MAKHUZAI
Aluch
Choga
Musa Khel
Martoong Khas
MARTOONG
Tor Ghar
Behlol Khel
Buner
Kamach
Nusrat Khel
Settlements
UC Boundary
Tehsil Boundary
District Boundary
Province Boundary
Country Boundary
Line of Control
Undetermined Boundary
Coast Line
Relative Flood Risk
Low Risk (1)
High Risk (3)
Relative Priority
Priority 1
Priority 2
Priority 3
UCs not recommended
N
0
4
8
Km
Date Created: 04 Apr 2023
Contact: islamabad.vam@wfp.org
Website: www.wfp.org
Sources:
Admin Boundaries: VAM SDI
UCs Ranking: PO KP
Disclaimer:
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
Note: 'Ranyal' , 'Shang' , 'Mian Kalay', 'Kormang' settlements are now Union Councils, admin boundaries yet to be established

Figure 10. Priority Union Councils: Shangla District

1.2.3 Characteristics of the project area

Khyber Pakhtunkhwa is a topographically diverse province of Pakistan, is situated in the northwest region of the country. The land of KP is an abode to Hindukush, Himalayan and Karakoram Mountain ranges predominantly in the northern, northwestern and eastern parts of the province. In contrast, southern parts of KP are dominated by central valley plains comprising agricultural land and rangelands[33]. The province—Pakistan's third-largest region, by population—has over the past eight years made progress in transitioning out of vulnerability and crises, leading to substantial poverty reduction. KP's incidence of poverty fell from 73.8% in 2002 to 27% in 2014, the largest decrease in any province in Pakistan[34]. The great majority of the population (81.3%) live in rural areas and depend heavily on agriculture and extractive industries for their livelihoods[35]. As illustrated in Figure 11 below, the target districts of Buner and Shangla are located in the northern mountainous agro-ecological zone according to the zonal classification.

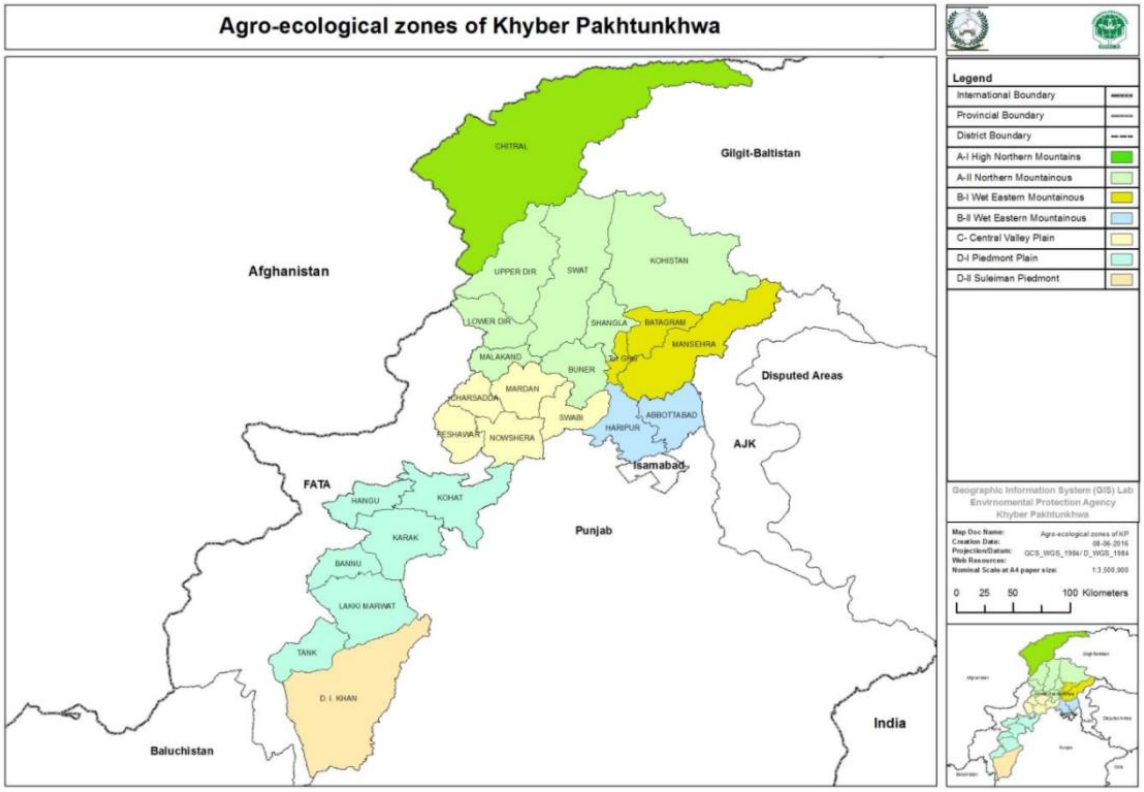


Figure 11. Agro-ecological zones of Khyber Pakhtunkhwa.

The integration of the former Federally Administered Tribal Areas (FATA) with KP in 2018 created new challenges and opportunities for the province. The merge added approximately 5 million people, bringing the province's total population to an estimated 32.3 million, adding 2.72 million hectares of mostly mountainous and remote terrain, bringing the province's total land area to 10.17 million hectares[36].

The challenge for KP will be to expand its development expenditures to cover the needs of both KP and FATA. Given that FATA is one of the poorest regions of Pakistan and is expected to retain its tax-exempt status for the next five years, this merger will affect KP's fiscal situation and increase the need for development

[33] Government of Khyber Pakhtunkhwa (2016) KP Climate Change Policy.
[34] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project.
[35] CGIAR (2021) Climate Smart Agriculture in Khyber Pakhtunkhwa. Available here.
[36] Ibid.

financing. The Khyber Pakhtunkhwa Tribal Districts Transition Framework, estimated to cost US$1.38 billion over three years (2018-2020), has a funding gap of US$726 million or nearly three-quarters of its financing requirement[37].

Socio-economic characteristics

KP province is home to about 32.3 million people, including several of Pakistan's indigenous tribal communities such as the Koochis, Reari, Bakarwal, Kehal, Jogi, Kabootra, Sanyasi, and Kalash. According to the 2017 national demographic survey, 81% of the population reside in rural areas, increasing to 97% in the Merged Areas, with 27% falling below the national poverty line of US $3.10/day[38]. In the former FATA, the economy is based on subsistence agriculture, livestock, fisheries and forestry, which provide some 97% of employment and livelihoods but have been seriously affected by conflict in recent years[39].

The poverty headcount is 18% in Khyber Pakhtunkhwa[40], reflecting several years of substantial progress in reducing poverty. However, the World Bank highlights that "these gains are likely to be reversed due to the COVID-19 pandemic and its associated containment measures". The challenges of poverty reduction are likely to be further affected by climate change and disaster risk-related vulnerabilities[41]. The UNDP National Human Development Report[42] ranks KP as having a medium level of human development, calculated at 0.628 against a national average of 0.681. The Merged Areas, however, had an extremely low level of human development, scoring just 0.216[43]. This is further demonstrated by the UNDP's Multi-Dimensional Poverty Index (MDPI), which classified 73.7% population of the KP's Merged Areas as living in multi-dimensional poverty in 2016, while the comparable figure for the whole KP Province stood at 51.2% in 2015[44]. The Merged Areas are thus considered one of the most underdeveloped regions of Pakistan due to decades of marginalization, economic deprivation, and political instability.

Youth unemployment continues to be a growing challenge in the country, increasing from 6.5% in 2007 to 9.1% in 2015[45]. This is especially significant for the rural agriculture-based economy that employs more than half (around 53%) of Pakistan's young adults. The informal nature of this sector offers low prospects for upward social and economic mobility, with most workers either self-employed or receiving low pay. The youth's minimal participation in agricultural studies at higher education level coupled with few structured programs, reflects this expectation gap and is a serious concern for KP's agriculture-based economy.

#	District	Tehsil	Union Council	Project Priority	Pop 2017	Growth rate	Pop 2023	HH size (average)	Number of households	Male	Female	Disaster types (Floods)	Disaster risk (High)	
1	Buner	Chagharzai	Batara	Primary	30689	3.05	35663.4	9.536	3740	17763.94	17899.46	1	3	
2	Buner	Mandanr	Makhranai	Primary	29353	3.05	34110.84	9.536	3577	16990.61	17120.23	1	3	
3	Shangla	Alpuri	Mian Kalay	Primary	29906	2.98	34635.6	9	3848	17615.67	17019.94	1	3	
4	Shangla	Alpuri	Pir Khana	Primary	36547	2.98	42326.87	9	4703	21527.45	20799.42	1	3	

[37] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project.
[38] GoPBOS (2017) Provisional Summary Results of the 6th Population and Housing Census. Available here.
[39] KPTDSP (2020) Khyber Pakhtunkhwa Tribal District Support Programme – UN Pakistan Proposal. UNDP, UK/DFID. Available here.
[40] World Bank (2019) Poverty & Equality Brief, Pakistan
[41] World Bank (2019) Khyber Pakhtunkhwa Human Capital Investment Project, p.3
[42] UNDP (2017) National Human Development Report, Unleashing the Potential of a Young Pakistan. Available here.
[43] Ibid.
[44] KPTDSP (2020) Khyber Pakhtunkhwa Tribal District Support Programme – UN Pakistan Proposal. UNDP, UK/DFID. Available here.
[45] UNICEF (2019) Final Key Findings Report, National Nutrition Survey Pakistan 2018. Available here.

#	District	Tehsil	Union Council	Project Priority	Pop 2017	Growth rate	Pop 2023	HH size (average)	Number of households	Male	Female	Disaster types (Floods)	Disaster risk (High)	
5	Buner	Gadezai	Malakpur	Alternative	29353	3.05	34110.84	9.536	3577	16990.61	17120.23	1	3	
6	Shangla	Alpuri	Kuz Kana	Alternative	21616	2.98	25034.55	9	2782	12732.57	12301.98	1	3	
		Male	Female	Total	Hh									
	Direct	73 898	72 839	146 737	22 227									

Land use

Land used for agricultural production accounts for 55.4% of the total land area. Due to the rugged, mountainous terrain in KP province, only 1.87 million hectares, which constitute less than 22% of the province's total 8.35 million hectares, are under cultivation[46]. An estimated 1.32 million additional hectares are considered apt for cultivation but not currently developed[47]. Of the cultivated land in the province 930,000 hectares (50%) are irrigated, mostly through a network of government and privately-owned canals. When looking only at the Merged Districts the cultivated area drops to 9%, of which only 39% is irrigated[48]. Forests occupy approximately 1.23 million ha in the province, constituting a significant portion of Pakistan's 4.47 million ha of forested land[49]. Despite the importance of the forestry sector to the provincial and national economy, deforestation and degradation has resulted in the loss of an estimated 170,684 ha from 1990 to 2010[50].

In terms of agricultural land use, KP is dominated by smallholder farmers with some of the smallest average landholdings nationally. According to the most recent census data, 81% of landholdings are under 5 ha, with the average farm size of 1.4 ha, of which 1.2 ha is cultivated, compared to a national average farm size of 2.6 ha with 2.1 ha cultivated[51]. In the Merged Areas, the average plot size is much smaller, averaging only 0.85 ha[52]. Moreover, a 2019 livelihoods survey by the GoKP and World Food Programme in the Merged Areas found that overall, 59% of households do not currently cultivate their lands, while about 34% practice subsistence farming, and about 7% farm to generate income from selling the produce[53]. Throughout the district, the portion of arable land per plot is often limited by the prevalence of steep rangeland, shallow soil, slate, and salinization. This puts intense pressure on existing farmland to support an average of 18 people per hectare, or more than 40 people per irrigated hectare[54]. Figure 12 below illustrates the share of arable land area cultivated for each key staple and cash crops.

[46] GoKP (2020) Development Statistics of Khyber Pakhtunkhwa. Bureau of Statistics, Planning and Development Department. Available here.
[47] Ibid.
[48] Ibid.
[49] Ibid.
[50] Khan et al (2019) Socioeconomic Impacts of the Billion Trees Afforestation Programme in KPK, Pakistan. Available here.
[51] GoKP (2020) Development Statistics of Khyber Pakhtunkhwa. Bureau of Statistics, Planning and Development Department. Available here.
[52] FAO (2019) Agricultural Action Plan for the Tribal Districts of Khyber Pakhtunkhwa 2020-2025.
[53] WFP (2020) Comprehensive Food Security and Livelihood Assessment (CFSLA), Merged Districts and Tribal Sub-Divisions, Khyber Pakhtunkhwa.
[54] In former FATA. GoFATA (2013) Land use indicators. Available here.

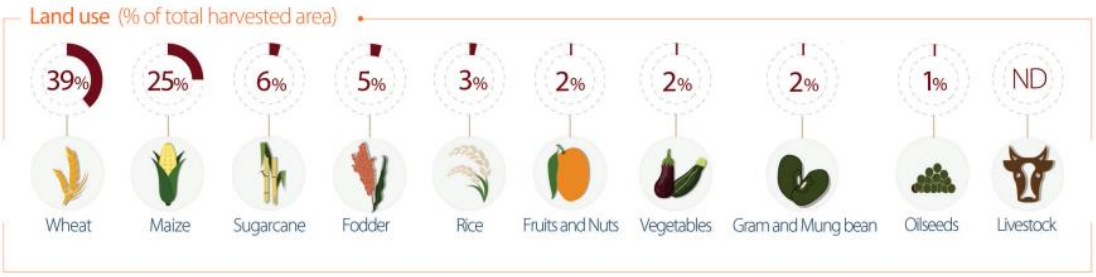


Figure 12. Cultivated land area per crop (in %)[55]

Contribution of agriculture to livelihoods

Agricultural development is of critical importance for both the food security of KP's residents and the province's economic self-sufficiency. Agriculture employs the largest portion of the labour force of KP at 44% and contributes about 24% of the GDP of the province, behind forestry and mining, and ahead of construction and manufacturing[5657]. Women are heavily involved in the agriculture sector, conducting about 70% of on-farm work in KP, concentrated in husking and preserving agricultural produce in addition to caring for and rearing domesticated livestock[58]. KP produces about 75% of the country's tobacco, 17% of maize, 16% of barley, and 8% of sugarcane. However, the province is a net importer of agricultural produce and depends heavily on production from other provinces – especially from Punjab – for important food staples such as wheat (64% import share), rice (7%), citrus (7%) and vegetables (90%)[59].

The two main cropping seasons in KP-and Pakistan more generally- are kharif, the first sowing season starting from April-June with harvest during October-December, and rabi, the second sowing season, beginning in October-December with harvesting in April-May. In KP, the kharif season is suitable for the warm weather cultivation of maize, sugarcane, rice and mung bean, whereas the rabi season produces wheat, gram, barley, rape and mustard, while fruits, nuts and vegetables are grown year-round. By- products of these staple crops, including wheat straw, maize thinning, and stover, play a crucial role as fodder for livestock feed. Sugarcane, tobacco, and fruit are the region's primary cash crops. Agro-climatic conditions in KP provide substantial opportunities for high-value crops, especially horticulture. However, yields of horticulture crops in KP are low – national average yields exceed that of KP's by 78%, 52% and 45% for cabbage, cauliflower and citrus, respectively. Value addition through processing is still at its infant stage in KP. Less than 10% of the total production of fruits and vegetables is processed and post-harvest losses are significant[60].

In addition to crop production, livestock rearing and dairy production are central to livelihoods in KP province, including poultry, goats, sheep, cattle, and buffalo. Approximately 16% of Pakistan's goats and 12% of its sheep are reared in KP[61]. Goats are typically raised by KP's poorer households in arid areas, while buffalo are imported for dairy and held as financial assets, as they maintain value and can quickly be converted to cash in times of need[62]. Both are valuable as many of their parts are in high demand for a variety of uses, including their meat, milk, wool, bones, horns, hair, fat, hides, and skin. Approximately 20% of the net income of farming households and landless families in KP is generated by animal husbandry, and a significant portion of households in Swat, Malakand, and D.I. Khan districts depend primarily on livestock for their livelihoods[63].

[55] CGIAR (2021) Climate Smart Agriculture in Khyber Pakhtunkhwa. Available here.
[5656] GoPBOS (2017) Provisional Summary Results of the 6th Population and Housing Census. Available here.
[57] KPMALC (2015) Agricultural Policy, Khyber Pakhtunkhwa – A Ten Year Perspective (2015-2025). Available here.
[58] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project.
[59] Ibid.
[60] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project.
[61] Shah et al (2019) An empirical analysis of livestock activities of the model farm service centre in Khyber Pakhtunkhwa. Available here.
[62] Ibid.
[63] Ibid.

Food security and Nutrition

Food insecurity and malnutrition pose serious challenges to public health in KP, and their incidence and intensity have been exacerbated by recurring climate hazards in recent decades. Food insecurity is of particular concern in the newly merged territories (former FATA) in Khyber Pakhtunkhwa. According to the latest food security and livelihood assessment by the World Food Programme[64], approximately 1.4 million people are food insecure across the seven merged districts, representing over 31% of the population. The highest numbers are in the two most populated districts – Bajaur (338,213) and Khyber (271,256). The highest percentage of food insecure households among the seven merged districts is in Orakzai (62%). In the remaining six districts, 26–33% of households are considered moderately or severely food insecure[65]. Stunting is extremely concerning in Pakistan, where 12 million children have low height for age. The annual reduction rates estimated at 0.5% are too slow to significantly reduce the national under-five stunting rate of 40.2%. In the Merged Areas, stunting rates are even more concerning with almost half of children stunted (48.3%)[66].

Water scarcity is the major limiting factor for crop production – especially in Kohat and D.I. Khan and Bajaur districts. Less than half of cultivated land is irrigated, falling to around a third in tribal sub-divisions. Well over half of landowners lack water for crops while lack of high-yielding seeds and fertiliser are also major challenges. Around two in five farming households face problems accessing agricultural markets to buy inputs such as fertilizer and tools mainly because of damaged roads or long distances. For 25% of households, it takes more than an hour to reach a market. In the new tribal sub-divisions, agricultural markets are often non-existent, so smallholders must travel to neighbouring districts. For the 41% of landowners that do cultivate crops their production generally sustains them for four months of the year. Most households are net buyers of food, making them vulnerable to fluctuations in market prices.

Food production in KP and particularly in the Merged Areas is far below demand, which means that most households depend on food purchased at market and are more susceptible to price volatility and market disruptions, both of which occur in the aftermath of disasters[67]. Alongside the climate's effects on economic access to food, climate-related disasters affect physical access and make food access a critical issue. For instance, following the monsoon rains of 2010, a rapid assessment of affected communities in Swat district found that 54% of the households in surveyed communities had only 1-3 days' worth of food stock, mainly rice and wheat[68]. Poor food stocks are linked to access and affordability constraints: food prices have been increasing steadily since 2008, furthermore, between 2013 and 2016 most households in the Merged Areas (59%) and KP (36%) report being affected by a climate-related shock that forced them to limit the quantity and quality of food they purchase at the market[69].

Water resources

As Pakistan's climate ranges from semi-arid to arid, approximately 90% of agricultural production is reliant on irrigation, mostly supplied through the Indus Basin Irrigation System. Many of Pakistan's poorest communities, including those in KP, reside in rain-fed, or barani, areas, where livelihood improvements, especially for small-scale farmers, are highly dependent on agricultural gains. In Buner, there are extensive flat-bottom valleys that draw water from rain, snow, and groundwater irrigation channels[70]. Two thirds of croplands in these areas are irrigated during the summer season, whereas half are irrigated during winter[71]. In Shangla, where agro-climatic conditions are harsher and rainfall can total less than 100mm per year, groundwater plays a more

[64] WFP (2020) Comprehensive Food Security and Livelihood Assessment (CFSLA), Merged Districts and Tribal Sub-Divisions, Khyber Pakhtunkhwa.
[65] Ibid.
[66] Ibid.
[67] Ibid.
[68] Save the Children (2010) Rapid Assessment Report of Flood-affected communities in Swat District, KP, Pakistan. Available here.
[69] WFP (2018) Climate Risk and food security analysis: A special report for Pakistan.
[70] KPMALC (2015) Agricultural Policy, Khyber Pakhtunkhwa – A Ten Year Perspective (2015-2025). Available here.
[71] Ibid.

crucial role[72]. Up to 40% of water transported through communal watercourses is lost due to evaporation, spillage, seepage, and leakage[73].

The above challenges are aggravated by poor resource management. Where irrigated water is available, improper field drainage, over-irrigation, and water leakage often leads to waterlogging and salinization[74]. An estimated 20% of irrigation water applied in KP runs off uneven fields, resulting in excessive water application to low-lying areas and under-irrigation in higher elevations. In a recent survey of the Merged Areas, inaccessibility or limited access to irrigation water was cited by 59% of farmers as the primary constraint that keeps farmers from cultivating their land[75]. While farmer, water-user communities, and other communal resource management organisations have helped smallholder farmers effectively manage critical resources globally, in Pakistan, these associations tend to be weak[76]. Social cohesion has been a stumbling block in the tribal areas, and management training would help scale the capacity of existing organisations[77].

2. CLIMATE RATIONALE

2.1. Climatology

Climate profile and baseline

Pakistan is located in a temperate zone and has a predominantly tropical continental climate that is characterised by diversity in temperature and rainfall. The country's climate varies with its topography; generally dry and hot near the coast and along the lowland plains of the Indus River, and progressively cooler in the northern uplands and Himalaya mountains. The summer season in Pakistan is extremely hot, with maximum temperatures of up to 50-54°C occurring in the south and southwestern areas of the country[78]. Pakistan experiences some of the highest maximum temperatures in the world, with an average monthly maximum of approximately 27°C and an average summer maximum of 36°C [79]. The climate is characterised by four seasons (Figure 13), namely[80]:

- a cool, dry winter from December to February;
- a hot, dry spring from March through May;
- the summer rainy season, also known as the southwest monsoon period, occurring from June to September; and
- the retreating monsoons from October to November.

Figure 13. Seasonal calendar[81]

Most of Pakistan receives very little rainfall and is classified as arid to semi-arid[82]; three quarters of the country receives less than 250 mm of rainfall annually[83]. The exception is the northern regions where monsoons bring

[72] Ibid.
[73] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project.
[74] Ibid.
[75] WFP (2020) Comprehensive Food Security and Livelihood Assessment (CFSLA), Merged Districts and Tribal Sub-Divisions, Khyber Pakhtunkhwa.
[76] World Bank (2019) Khyber Pakhtunkhwa Irrigated Agriculture Improvement project. Safeguards document.
[77] Ibid.
[78] Government of Pakistan. 2018. Second National Communication to the UNFCCC.
[79] World Bank (2021) Climate Change Country Profile Pakistan.
[80] World Bank (2021) Pakistan Climate Country Profile
[81] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[82] Asian Development Bank (2017) Climate Change Profile of Pakistan.
[83] IFRC. 2021. Climate Change Impacts On Health And Livelihoods: Pakistan Assessment

upwards of 200 mm a month from July to September (Figure 14). Approximately 34% of Pakistan's land area is classified as hyper arid, 28% as arid, 30% as semi-arid, 3.6% as sub-humid, and 2.8% as humid to very humid[84]. Average annual precipitation is approximately 280 mm, with the northern mountainous region receiving up to 1600 mm, and the south receiving approximately 100 mm per year[85].

Pakistan is situated at the western end of the Southwest Monsoon, which means that the length of the summer rainy season is relatively short, with a period of only one and half months of active rainfall. Approximately 60% of the total annual rainfall of Pakistan falls during this period[86]. The strongest monsoon effects occur on the southern slopes of the Himalayas and the sub-mountain region in the north, where average annual rainfall is between 760–2,000 mm per year[87]. In addition to the spatial irregularity of rainfall, inter-annual rainfall varies significantly. This variability is strongly influenced by El Niño Southern Oscillation (ENSO) cycle, with anomalies in both temperature and flood frequency and impact correlated with the occurrence of El Niño in the region.

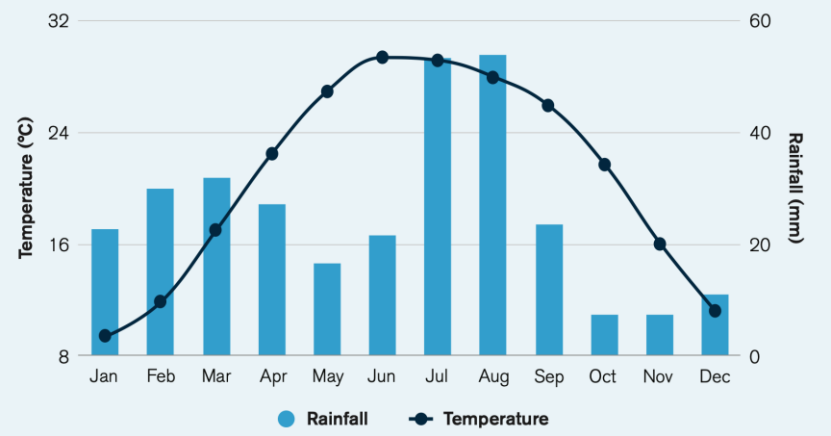


Figure 14. Average monthly temperature and precipitation in Pakistan (1991-2020)[88].

Observed and projected climate trends

Observed temperature changes

Overall, average temperatures in Pakistan have been rising steadily. During the 20th century, annual mean temperature in Pakistan increased by approximately 0.57°C, with the warming trend accelerating since the 1960s. During this period (specifically between 1961 and 2007) average temperatures rose by 0.47°C, which is slightly less than the average increase in the South Asia region as a whole (0.75°C)[89] for the same period. The rise in average temperature has occurred alongside a slightly stronger rise in average daily maximum temperatures (0.87°C between 1961–2007). Overall, an average of 0.6–1.0°C of temperature rise has occurred across Pakistan. This includes a rise in both maximum and minimum temperatures, and has been particularly pronounced during the winter and post-monsoon months (November–February)[90]. Figure 9 below shows the observed temperature changes for Pakistan.

[84] Government of Pakistan. 2018. Second National Communication to the UNFCCC.
[85] Government of Pakistan. 2018. Second National Communication to the UNFCCC.
[86] Ibid.
[87] Ibid.
[88] World Bank (2021) Pakistan Climate Country Profile
[89] World Bank (2021) Pakistan Climate Country Profile
[90] World Bank (2021) Pakistan Climate Country Profile

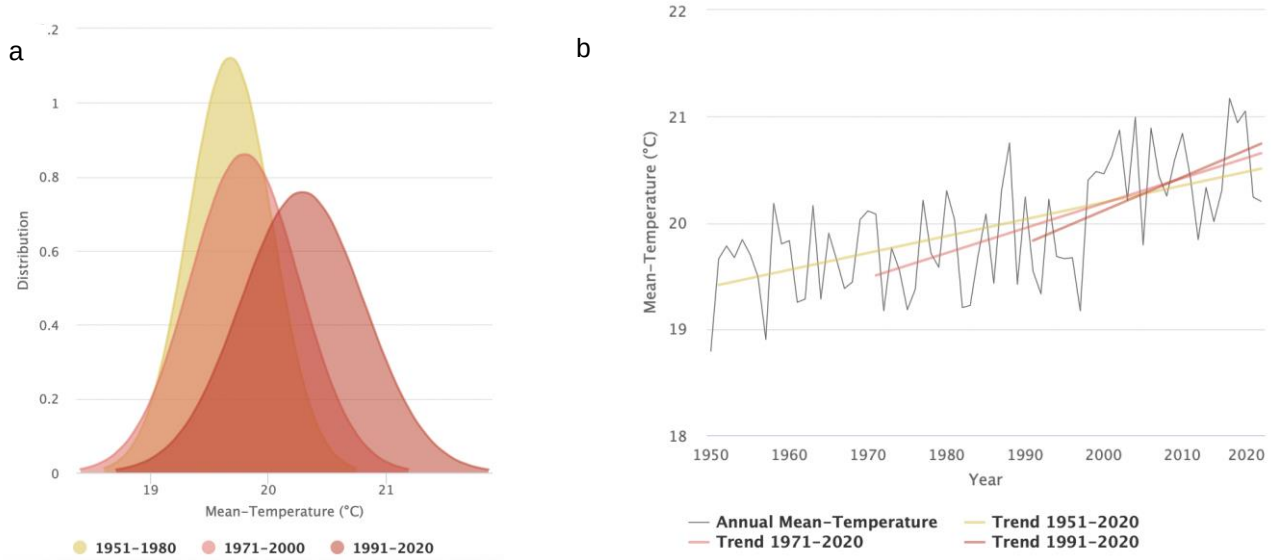


Figure 15. Observed climatology of the period 1901-2020 of a) monthly min-temperature, mean-temperature, max-temperature and average precipitation, b) average annual mean-temperature, c) average annual precipitation.

At sub-national level, historical warming trends have been most significant in the country's southerly regions, with Punjab, Sind, and Balochistan all experiencing winter warming by between 0.91°C–1.12°C since the 1960s. Warming in Khyber Pakhtunkhwa in the north has been less pronounced than other parts of the country (Figure 16 below). The province has experienced increasing mean temperatures of only 0.12°C, and some observations indicate that summer temperatures have decreased. However, the province has still experienced an increase in mean winter temperature of 0.52°C during winter (Figure 16 below). This indicates that winters in Pakistan (which are cool and dry**) (**Figure 13**)** are becoming warmer, with hot and dry conditions that usually occur between March and May becoming more prevalent at the beginning of the year leading to higher rates of evapotranspiration.

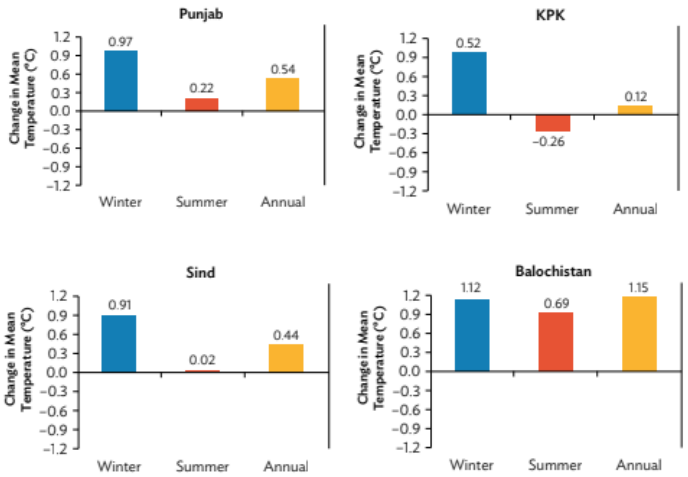


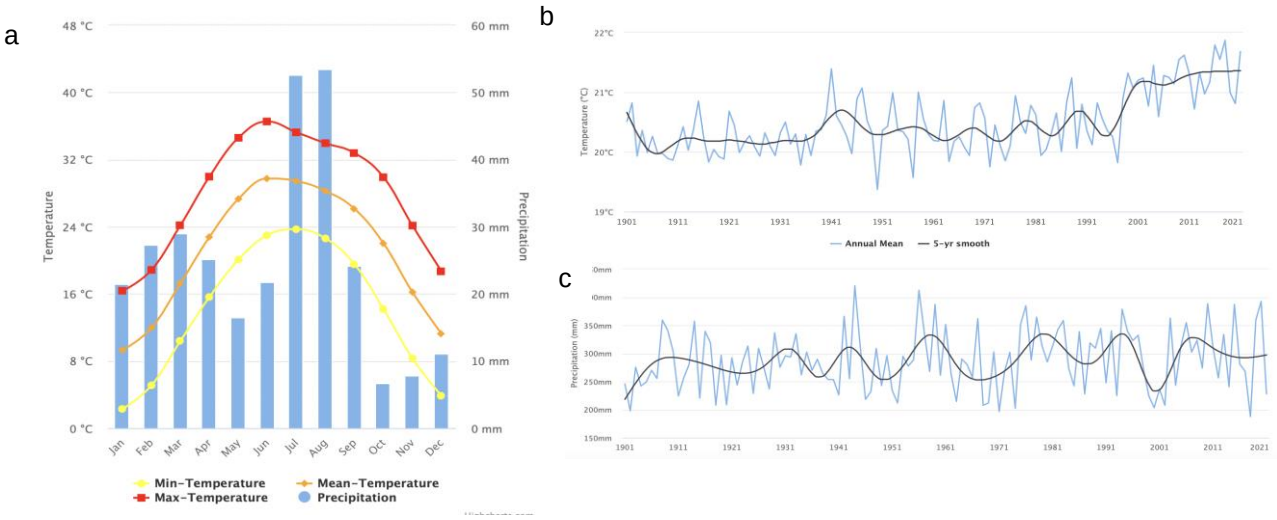
Figure 16. Regional increases in mean temperatures from 1960 to 2007 in winter (blue), summer (red) and annual (yellow)[91]

Observed precipitation changes

In the 20th century, Pakistan experienced significant variation in its overall precipitation. In the first half of the century, a prolonged decline in annual rainfall was observed, but a slight increasing trend has been observed since the 1960s[92]. While this increasing trend is relatively small, it is underpinned by considerable variation across the country's different topographic regions. In the arid plains of Pakistan and the coastal belt, mean rainfall has decreased while other areas have experienced an increase in precipitation, both during the monsoon and dry seasons. This indicates that spatial precipitation variability is increasing, with less precipitation falling over arid and coastal areas, and more over areas of higher elevation[93]. Between 1951–2000, a decrease of 10%–15% in winter and summer rainfall in arid plains and coastal areas was observed while an increase of 18%–32% in summer rainfall was observed in other regions of Pakistan. Recent evidence suggests the glaciers in the headwaters of the Indus Basin may be expanding due to increased winter precipitation over the Himalayan region in the last 40 years[94]. These changing rainfall patterns are strongly influenced by ENSO, and a decrease of 17%–64% in rainfall was observed during the seven strongest El Niño events in the last 100 years[95].

[91] Q, Z. Chaudhry et al (2009) Climate Change Indicators of Pakistan. Technical Report, no. 22. Islamabad: Pakistan Meteorological Department.
[92] World Bank (2021) Pakistan Climate Country Profile
[93] World Bank (2021) Pakistan Climate Country Profile
[94] World Bank (2021) Pakistan Climate Country Profile
[95] Asian Development Bank (2017) Climate Change Profile of Pakistan

Average annual precipitation (Figure 1c) show a considerable variance in particular between 2011 - 2021. Figures 2 and 3 show the observed temperature and precipitation trends for the period 1951 – 2020.



In Khyber Pakhtunkhwa, district-level rainfall data show that average rainfall across the province has increased (Figure 18) more pre-monsoon rainfall has been observed, consistent with shifting and increasing variable rainfall patterns. The districts of Balakot, Kakol and Dir have all received more rainfall comparatively than the rest of the province during the monsoon season.

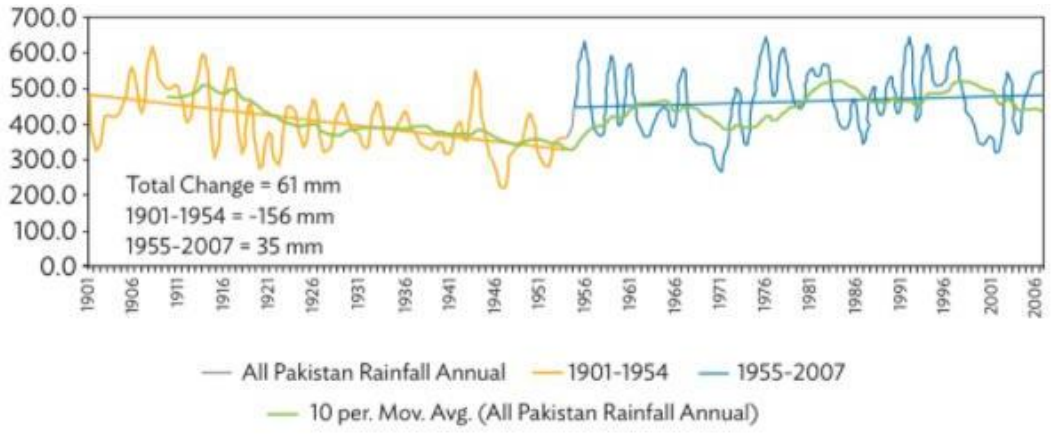


Figure 17. Annual average precipitation, 1901-2007 (in mm)[96]

[96] Ibid.

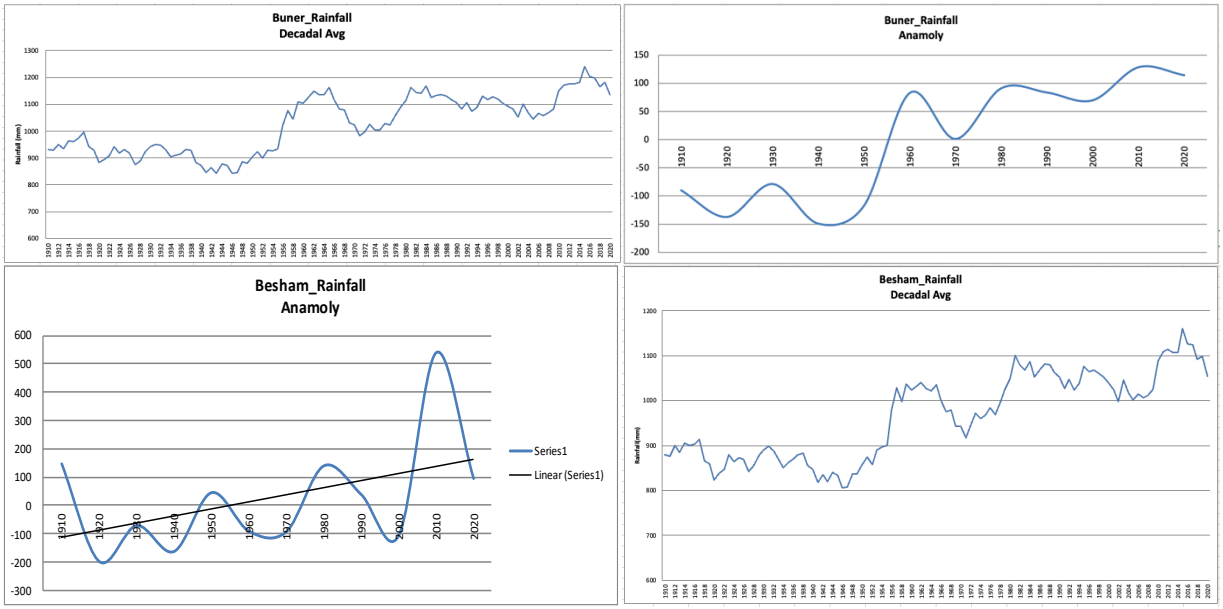


Figure 18. Average decadal rainfall changes and rainfall anomaly in Buner and Besham.

Projected temperature changes

Average temperatures are expected to continue rising in Pakistan. In the medium-term, by 2020–2039, monthly temperatures (average, minimum and maximum) are projected to increase by 0.90–1.31°C under RCP2.6 and up to 1.08–1.55°C per month under RCP8.5[97].

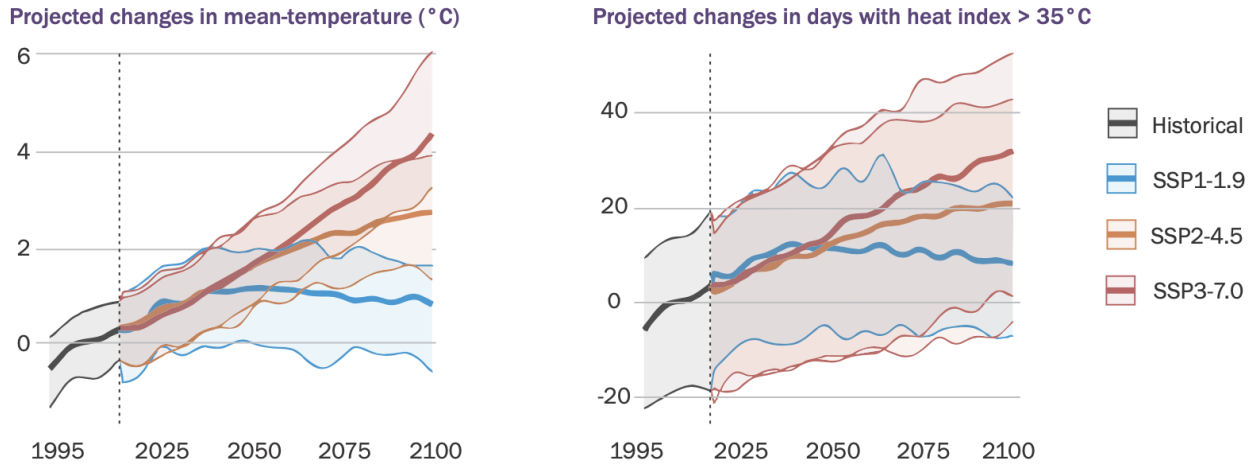


Figure 19. Projected change in annual mean temperature (left and days with heat index >35 C (right). The figure shows the baseline period of 1995-2014 and a multi-model ensemble projection to 2100[98].

Over the longer term, average temperature increases in Pakistan are projected to be higher than the global average. By 2100, mean temperature is projected to rise by approximately 3–6°C, with an accelerated increase expected after 2050. The IPCC projects a global average temperature increase by 2081–2100 of 3.7°C under the highest emissions pathway (RCP8.5) while the model ensemble projects an average increase of 5.3°C for Pakistan under the same scenario. The projected rise in annual maximum temperatures is estimated at 5.3°C. Notably, under the highest emissions pathway (RCP8.5), even the 10th percentile (low) estimate is higher than

[97] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[98] World Bank. 2022. Country Climate and Development Report.

the projected global average temperature rise, at 3.3°C, demonstrating the level of certainty that Pakistan should prepare for above-average increases[99]. Table 3 below shows projected anomaly changes for daily temperatures for the 2040-2059 and 2080-2099 time periods, compared to the reference period of 1986-2005 for all RCPs.

Table 3. Projected anomaly changes (C°) for maximum, minimum, and average daily temperatures in Pakistan for 2040-2059 and 2080-2099, from the reference period of 1986-2005 for all RCPs[100] The table shows the median of the CCKP model ensemble and the 10-90th percentiles in brackets.

Scenario	Average Daily Maximum Temperature		Average Daily Temperature		Average Daily Minimum Temperature	
	2040-2059	2080-2099	2040-2059	2080-2099	2040-2059	2080-2099
RCP2.6	1.4 (-0.5, 3.3)	1.4 (-0.5, 3.4)	1.4 (-0.1, 2.9)	1.3 (-0.2, 3.1)	1.4 (-0.1, 3.1)	1.3 (-0.3, 3.1)
RCP4.5	1.9 (-0.1, 3.7)	2.7 (0.7, 4.7)	1.8 (0.1, 3.4)	2.6 (0.8, 4.4)	1.8 (0.2, 3.6)	2.6 (0.9, 4.5)
RCP6.0	1.6 (-0.3, 3.5)	3.3 (1.2, 5.5)	1.6 (0.1, 3.1)	3.3 (1.5, 5.1)	1.7 (0.1, 3.2)	3.3 (1.6, 5.2)
RCP8.5	2.6 (0.9, 4.2)	5.3 (2.9, 4.2)	2.5 (0.8, 4.1)	5.3 (3.3, 7.2)	2.5 (0.9, 4.2)	5.4 (3.5, 7.5)

Table 4. Projections of average temperature anomaly (C°) for different seasons (3-monthly time slices) over different time horizons and emissions pathways, showing the median estimates of the CMIP5 model ensemble and the 10th and 90th percentiles in brackets.

Scenario	2040-2059		2080-2099	
	Jun-Aug	Dec-Feb	Jun-Aug	Dec-Feb
RCP2.6	1.2 (-0.8, 3.1)	1.5 (0.1, 3.0)	1.2 (-0.8, 3.2)	1.4 (-0.2, 3.0)
RCP4.5	1.7 (-0.6, 3.4)	1.9 (0.3, 3.5)	2.3 (0.1, 4.5)	2.7 (1.2, 4.4)
RCP6.0	1.5 (-0.6, 3.2)	1.7 (0.2, 3.2)	2.9 (0.9, 5.0)	3.4 (1.7, 5.3)
RCP8.5	2.3 (0.2, 4.1)	2.5 (1.0, 4.1)	4.9 (2.2, 7.1)	5.4 (3.5, 7.3)

Figure 20 below shows an illustrative summary of projected temperature and precipitation change by medium- and longer-term horizons compared to the reference baseline.

[99] World Bank (2021) Climate Change Country Profile Pakistan.
[100] World Bank (2021) Climate Change Knowledge Portal (CCKP, 2021) Climate Data Projections. Available here.

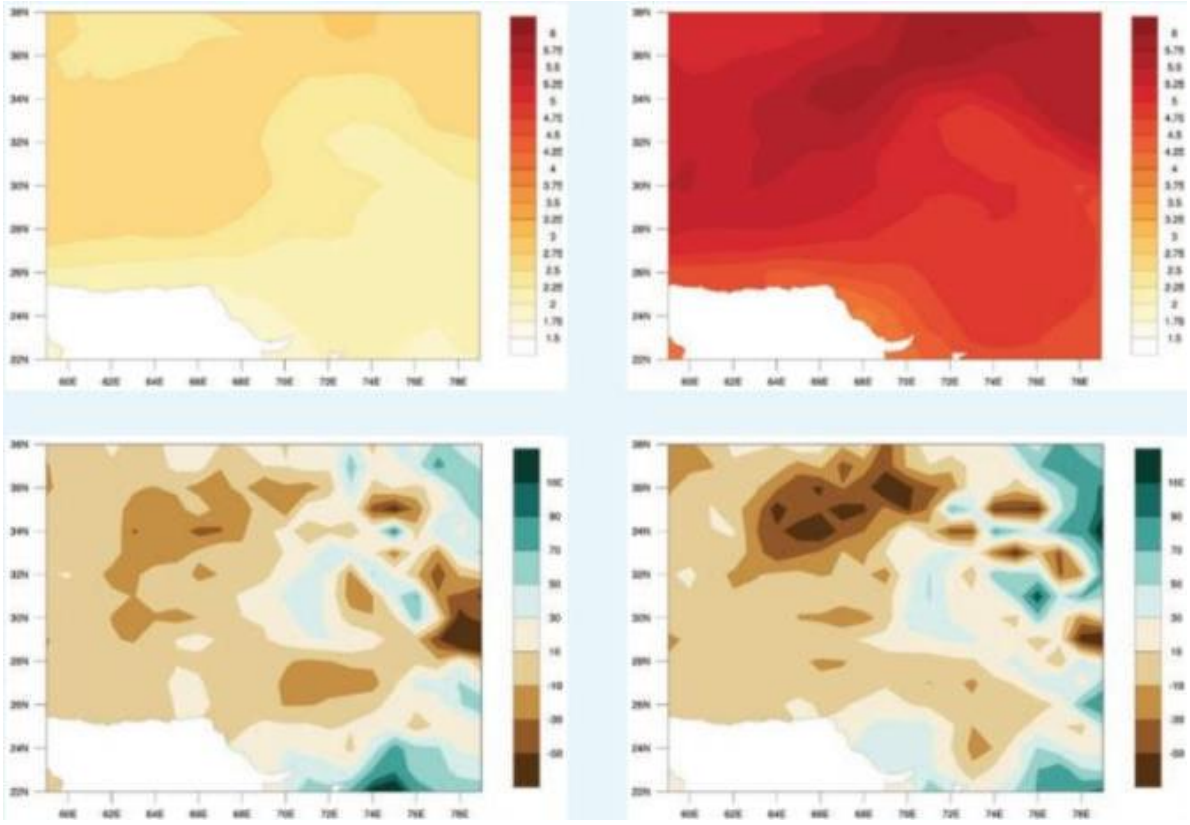


Figure 20. CMIP5 ensemble projected change (32 GCMs) in annual temperature (top) and precipitation (bottom) by 2040-2059 (left) and by 2080-2090 (right) relative to 1986-2005 baseline under RCP8.5.

Projected precipitation changes

During the second half of the 20th century, South Asian summer monsoon precipitation decreased in several parts of Pakistan. However, projections for the 21st century indicate an increase in both annual and summer monsoon precipitation, accompanied by intensifying interannual variability[101]. This trend is in line with the projections for the entire region of Pakistan. Although future changes in monthly and annual rainfall in the South Asian monsoon are challenging to simulate, projections suggest a slight increase in monthly precipitation at the national level, with some regional differences[102,103]. Of the 16 models examined, 12 show an increase in average annual precipitation by the end of the century under RCP8.5[104].

The expected changes in precipitation are likely to vary across different subregions of Pakistan, with particular significance for the Indus basin[105]. Downscaled models suggest that precipitation may increase in the Upper Indus basin, while it may decrease in the Lower Indus basin, although there is still significant uncertainty in these projections. Simulations suggest an increase in the number of rainy days over the northern part of the Indus Basin and a decrease over the southern part, with a projected decrease in rainy days coupled with an increase in rainfall intensity, consistent with the expected increased variability of rainfall[106].

[101] IPCC, 2022: *Climate Change 2022: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

[102] Latif, M., Hannachi, A. and Syed, F.S. (2018). Analysis of rainfall trends over Indo-Pakistan summer monsoon and related dynamics based on CMIP5 climate model simulations. International Journal of Climatology, 38, pp. 577-595

[103] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.

[104] World Bank (2021) Climate Change Country Profile Pakistan.

[105] Rajbhandari, R., Shrestha, A. B., Kulkarni, A., Patwardhan, S. K., & Bajracharya, S. R. (2015). Projected changes in climate over the Indus river basin using a high-resolution regional climate model (PRECIS). Climate Dynamics, 44(1), 339–357.

[106] R. Rajbhandari, A.B. Shrestha, A. Kulkarni, S.K. Patwardhan, S.R. Bajracharya (2015) Projected changes in climate over the Indus river basin using a high resolution regional climate model (PRECIS).

Projections suggest that, until 2050, the mean annual rainfall will likely increase in the range of 2-4 mm per day across all emission scenarios, with the north-eastern part of the country receiving the maximum rainfall. After 2050 and until the end of the century, the rainfall pattern is expected to shift towards the northwest and southern regions[107]. Studies focused on the Southern Punjab region of Pakistan also highlight the seasonality of potential precipitation changes under RCPs 4.5, 6.0, and 8.5, with projected declines in precipitation from January to April and increases from May to December. However, by 2050, the summer rainfall peaks are predicted to shift towards August, while the winter rainfall peaks are predicted to shift towards March, with these trends continuing until 2100[108].

Sea-level rise

In the past century, the average mean sea level rose to 1.1 mm/year for Pakistan. It is difficult to project sea level rise (SLR) by the end of 2100 for Pakistan, since data is limited at the country level. However, the sea level rise projections at the global and regional levels can be helpful in capturing the extent of the risk Pakistan will be exposed to in the future. IPCC AR5 notes a global mean SLR of 0.2–0.6 m by the end of this century, whereas for South Asia, of which Pakistan's coast is a part of due to the shared Arabian Sea border, 0.7 m (with range between 0.42 and 1.12m and a 90% level of confidence) SLR is projected by 2100 on average, relative to the pre-industrial level. Future sea level rise will most likely affect the low-lying coastal areas south of Karachi toward Keti Bander and Indus River delta[109].

2.2. Climate change and natural hazard risk

Pakistan is ranked among the most vulnerable countries to the impacts of numerous natural hazards. While a large proportion of historical mortality attributable to natural hazards has been the result of earthquakes, damage caused by climate-related hazards has increased significantly in recent decades. These climate hazards includes droughts, extreme temperature and heatwaves, as well as storms, floods, landslides and epidemics (Figure 21More information on climate hazards and their impacts on vulnerable communities is presented in the sections below.

[107] IFRC (2021) Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[108] Asian Development Bank (2017) Climate Change Profile of Pakistan
[109] Asian Development Bank (2017) Climate Change Profile of Pakistan

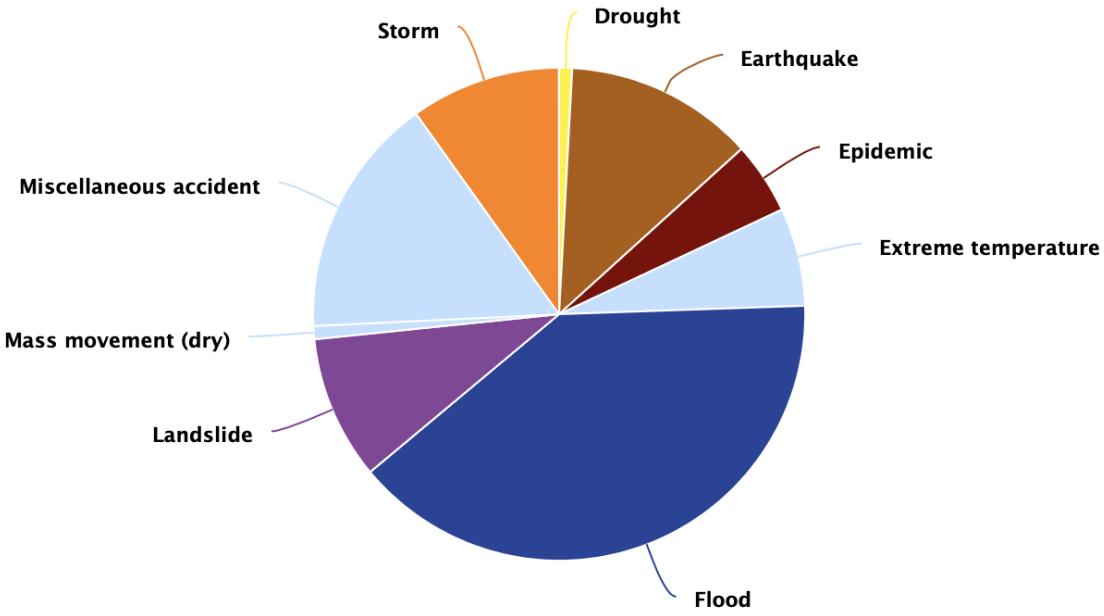


Figure 21. Natural hazards that occurred annually between 1980 and 2020[110].

Floods

In recent decades, flooding in particular has had an increasingly severe impact on communities across Pakistan. Changing precipitation patterns and increasingly variable rainfall across Pakistan, particularly the increase in heavy precipitation events, are causing an increase in the occurrence of riverine and flash floods. This highlights the risk of changes in the seasonality, regularity, and extremes of precipitation, fitting the global trend of increased intensity of sub-daily extreme rainfall events[111]. Temperature rise has also increased the rate of glacier melt, which has caused an increase in the incidence of glacier lake outburst floods (GLOF) and flash floods downstream. Faster glacier melt, shifting seasons and erratic rainfall patterns are all altering the flow of the River Indus which is increasingly affecting agriculture-related activities, food production and livelihoods. In 2020, the country was one of the top 10 countries with the highest exposure to flooding (riverine, coastal and flash floods)[112]. Figure 15 below shows the growing significance of floods in terms of the overall economic impact of natural hazards on Pakistan's GDP.

[110] World Bank. Climate change knowledge portal. 2021.: Country: Pakistan. Available at: https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability

[111] Westra S., Fowler, H. J., Evans, J. P., Alexander, L. V., Berg, P., Johnson, F., Kendon, E. J., Lenderink, G., Roberts, N. (2014) *Future changes to the intensity and frequency of short-duration extreme rainfall*. Reviews of Geophysics, 52, 522–555.

[112] World Bank (2021) Climate Change Country Profile Pakistan.

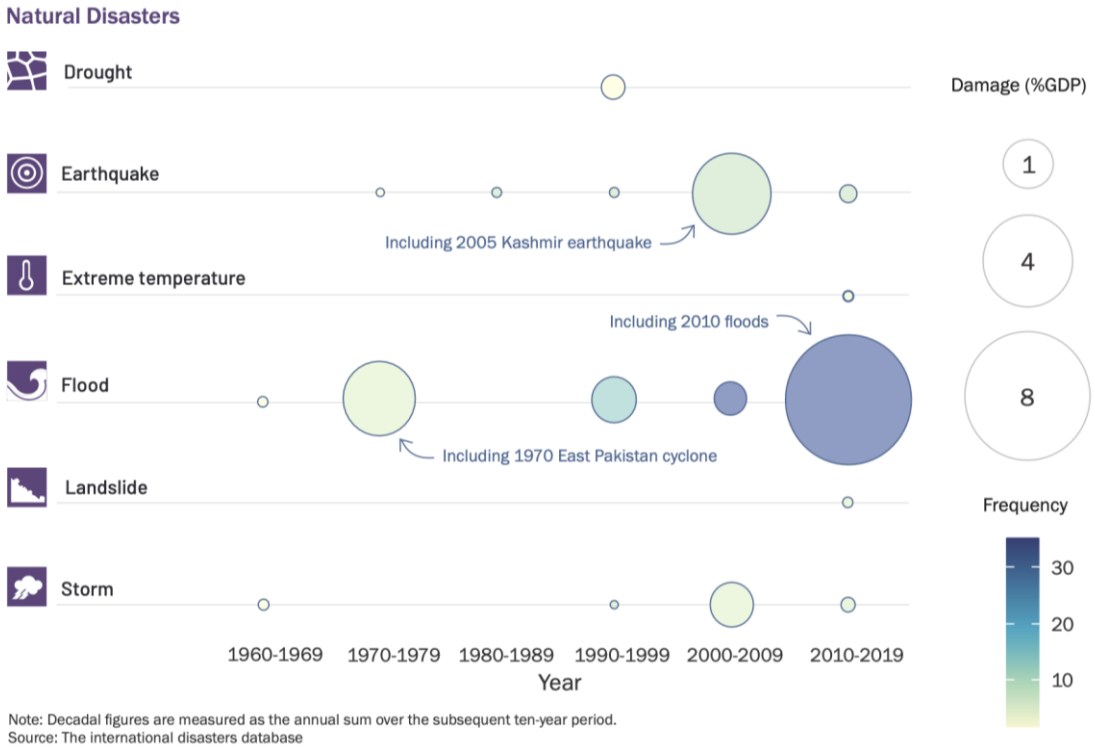


Figure 22. Economic damage (as % of GDP) from natural disasters in Pakistan between 1990 and 2020[113].

Between 1990 and 2020, floods were the natural hazard with the greatest impact in Pakistan[114].. During this period, the most damaging flood occurred in 2010, caused the deaths of approximately 2,000 people, alongside damage to or destruction of 12 million homes and 2.2 million ha of crops[115]. In addition to direct loss of life, these floods impacted livelihoods, infrastructure, settlements and overall economic output. In recent years, climate impacts associated with floods have increased. The floods that occurred in 2022, for example, exceeded the economic impacts of the 2010 floods (see section 3.2 below). These floods further exposed Pakistan's underlying challenges related to its institutions and systems, with poor urban planning and water resource management, inadequate maintenance of infrastructure and limited capacity for disaster risk reduction being some of the key shortcomings that have increased the impacts on vulnerable communities[116]**.** The 2022 floods affected approximately 33 million people, including the loss of 1,700 lives and damage to or destruction of more than 2.2 million houses. In addition, the floods affected water systems, and directly reduced the water security of approximately 5.4 million people (including 2.5 million children)[117].

In Khyber Pakhtunkhwa, climate change has caused an increase in floods, with heavy snowfall in the northern mountains of the province causing a rise in water levels in River Swat and River Kabul, as the snow melts when temperatures rise in the summer. Simultaneously, increasingly erratic monsoon patterns develop, with heavy rainfall disproportionately affecting water flows in the nearby rivers, resulting in flash floods. The concurrent occurrence of riverine and flash floods, melting of snow, heavy precipitation and occasional cloud burst have severely impacted vulnerable communities of Khyber Pakhtunkhwa in recent years[118]. In Buner and Shangla Districts, severe or very severe flash floods have occurred in July and August of each of the three years leading

[113] World Bank. 2022. Country Climate and Development Report.
[114] World Bank. 2022. Country Climate and Development Report.
[115] World Bank (2021) Climate Change Country Profile Pakistan.
[116] World Bank. 2022. Country Climate and Development Report.
[117]UNICEF. 2022. Devastating floods in in Pakistan. Available at: https://www.unicef.org/emergencies/devastating-floods-pakistan-2022
[118] PDMA (2021) Monsoon Contingency Plan.

up to 2020[119]. These floods have been exacerbated by medium or high severity landslides in each year, while secondary impacts, such as water-borne disease outbreaks and loss of crops such as rice and maize have also occurred in both districts. While the Provincial Government does not estimate annual flood damage cost estimates, major flooding in 2010 claimed 158 lives in Shangla and 22 in Buner District. The same floods caused approximately US$10.5 million in damage to roads and bridges alone. While these were the largest floods in recent years, floods that have caused loss of life and damage to homes and infrastructure have occurred in Buner and Shangla in 2006 - 10, 2013, 2015-16 and 2018-20.

Under future climate conditions, an increase in the number of people affected by flooding is projected across Pakistan, with a likely increase of around 5 million people exposed to extreme river floods by 2035–2044, and a potential increase of around 1 million annually exposed to coastal flooding by 2070–2100. The projected changes in extreme events are likely to exacerbate riverine and flash flood hazard, particularly in the northern part of the Indus River basin and in vulnerable semi-mountainous and mountainous areas of Khyber Pakhtunkhwa. The province is expected to witness significant increase in precipitation, consistent with a large increase in annual mean temperatures[120], which would combine with continued, rapid glacial melt and higher snowlines to cause more frequent and more severe flooding[121].

Droughts

The observed increase in average annual and maximum temperatures in Pakistan, alongside the increasing variability of precipitation in the country, has caused a significant increase in the frequency and severity of droughts across the country **[122].** In recent decades, several severe droughts have impacted the country, including one between 1999 and 2001, which resulted in widespread crop failure, livestock mortality and overall damages of approximately US$247**[123].** Droughts not only cause these direct impacts, but the reduction in soil cover and decreased soil moisture content causes the compaction of topsoil which in turn reduces infiltration of rainwater, higher rates of overland flow and consequently contributes to flooding.

Under future climate conditions, under all emissions pathways, the probability of meteorological drought is projected to strongly increase[124]. Drought frequency is projected to increase most strongly in already arid and semi-arid areas[125]. In Pakistan's wetter northern areas, the frequency of what is currently an extreme drought occurring 1 in 100-years is projected to have a return period of 1 in 50-years under 1.5°C of warming or 1 in 20-years under 3°C of warming. Droughts are also projected to intensify with El Niño events. Although projections indicate that an increase in annual rainfall will occur alongside a slight decrease in the duration of dry spells by approximately four days (under RCP 2.6 and RCP8.5), temperature rise is projected to cause an increase in evaporation and an overall drying of the climate. Overall, the annual probability of severe drought will increase by up to 17% across the country**[126].**

Heatwaves

Pakistan is has historically been prone to the occurrence of extremely high temperatures and heatwaves, and regularly experience temperatures of 38°C and above. It is estimated that between 1997–2015, 126 heat waves occurred, at approximately seven per year[127]. Over the period 1980–2007, a significant increase in the

[119] PDMA (2020) Monsoon Contingency Plan District Shangla and Monsoon Contingency Plan District Buner
[120] Shaukat Ali, Hyung-Il Eum, Jaepil Cho, Li Dan, Firdos Khan, K. Dairaku, Madan Lall Shrestha, Syewoon Hwang, Wajid Nasim, Imtiaz Ali Khan, Shah Fahad (2019) *Assessment of climate extremes in future projections downscaled by multiple statistical downscaling methods over Pakistan*. Atmospheric Research, vol. 222, pp. 114-133.
[121] Ministry of Climate Change (2018) Pakistan's Second National Communication to the UNFCCC, p.55
[122] World Bank. 2022. Country Climate and Development Report.
[123] World Bank. 2022. Country Climate and Development Report.
[124] World Bank (2021) Climate Change Country Profile Pakistan.
[125] World Bank (2021) Climate Change Country Profile Pakistan.
[126] World Bank. 2022. Country Climate and Development Report.
[127] Nasim, W., Amin, A., Fahad, S., Awais, M., Khan, N., Mubeen, M., Jamal, Y. (2018). Future risk assessment by estimating historical heat wave trends with projected heat accumulation using SimCLIM climate model in Pakistan. Atmospheric Research: 205: 118–133.

number of heat wave days per year was observed, at a rate of 11 days per decade[128]. Over 1,200 heat-related deaths resulted from a severe heatwave in 2015, primarily focused in Sindh Province. A large proportion of the population is exposed to this risk, as demonstrated by estimates that over 65,000 people were hospitalized with heat stroke during the 2015 heatwave in Pakistan. Karachi and Lahore have been identified as among the most vulnerable cities to heatwaves where, even under lower emissions pathways, temperature currently considered heatwave and associated with high mortality risk are already becoming regular occurrences[129].

Projections indicate that Pakistan, along with the rest of South Asia, will experience a further increase in the occurrence of heatwaves during the 21st century[130]. Under the SSP1-1.9 scenario, the annual number of days with temperatures higher than 35°C will increase by 9-13 days, and by 16–30 days and 21–39 days under SSP2-4.5 and SSP3-7.0, respectively[131]. In KP province, heatwaves that occur alongside extreme rainfall events will increase the intensity and frequency of flooding by contributing to glacial melt that will exacerbate monsoon flooding, increase the incidence of landslides and worsen water stress during times of drought.

2.3. Climate change impacts

As a result of its geographical location, topography and climate, Pakistan is ranked globally in the top countries most affected by climate hazards. Pakistan spends approximately 5.8–7.6% of total federal expenditures on climate change, (or about 11% combined on adaptation and mitigation), according to a multi-country study by UNDP in 2015. Climate change-related natural hazards have already caused severe impacts across Pakistan, including widespread loss of life and a significant risk that the development gains it has made in recent decades are being revered[132]. The sections below provide more information on how climate change is impacting Pakistan's economic growth, its overall water resources and the most vulnerable communities living across the country.

Climate change impacts on Pakistan's economy

Climate change is causing severe impacts on the economy of Pakistan. The country's average annual losses to natural hazards are estimated at approximately US$1.3 billion, with floods accounting for more than 75% of the total[133]. Some estimates of the average losses of Pakistan to natural hazards are even higher, at up to US$3.8 billion annually[134]. Between 1992 and 2021, climate-related disasters caused approximately US$29.3 billion[135] in economic losses[136]. And overall losses from climate-related disasters in 2020 accounted for 11.1% of the country's GDP[137]. Natural hazards, and floods in particular, are having severe impacts on physical assets and infrastructure in Pakistan[138]. Between 1995 and 2013, for example, floods caused damage to or the destruction of approximately 197,230 villages, including 3.45 million houses[139]. The floods that occurred in 2010 alone caused economic losses of nearly US$10.5 billion (including crop losses, infrastructure, livestock and ecosystem services), which was approximately 6% of that year's GDP[140]. In 2022, the total damages caused by flooding amounted to 4.8% of the GDP, with recovery and reconstruction needs projected to be 1.6 times

[128] Asian Development Bank (2017) Climate Change Profile of Pakistan
[129] Matthews, T., Wilby, R.L. and Murphy, C. (2017) Communicating the deadly consequences of global warming for human heat stress. Proceedings of the National Academy of Sciences, 114, 3861–3866.
[130] IPCC, 2022: *Climate Change 2022: Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change
[131] World Bank. 2022. Country Climate and Development Report.
[132] World Bank. 2022. Country Climate and Development Report.
[133] World Bank (2021) Climate Change Country Profile Pakistan.
[134] World Bank (2021) Climate Change Country Profile Pakistan.
[135] Adjusted to 2021 USD value.
[136] World Bank. 2022. Country Climate and Development Report.
[137] World Bank. 2022. Country Climate and Development Report.
[138] ILO (2017) Pakistan Employment and Environmental Sustainability Fact Sheets
[139] GoP (2016) Pakistan's Intended Nationally Determined Contribution.
[140] GoP (2016) Pakistan's Intended Nationally Determined Contribution.

the amount budgeted for national development expenditure in 2023. The 2022 floods are projected to cause a further decline in GDP of approximately 2.2%[141].

Impacts on agriculture, livelihoods and food security

The impacts of climate change on the agriculture sector in Pakistan are varied. Increasing average temperatures and more variable rainfall patterns are causing several notable changes that affect agriculture, including: i) shortening of the growing season, with an increase in temperature shortening the duration between sowing and harvesting, thereby potentially adversely affecting agricultural productivity; ii) changes in river flows, with the Indus River system being most severely affected, and therefore also affecting agriculture through increased flooding and changes in water available for irrigation; iii) increased crop evapotranspiration, which increases water demand in crops; iv) land degradation as a result of water logging, erosion and changes in soil moisture levels; and v) reduced livestock productivity[142]. A summary of the identified climate change impacts in Khyber Pakhtunkhwa is shown below.

Table 5. Summary of identified climate change impacts on livelihoods[143]

Climate change drivers	Impacts	Impacts on rural livelihoods	Impacts on urban livelihoods
Temperature rise	Glacial melt shift – change in river flows	Riverine floods and drought because of the unpredictable timing of meltwaters	Flooding in urban areas; food price shocks as crops are damaged
	Proliferation water-borne diseases	Higher prevalence of water-borne diseases; negatively impacts water storage and sanitation	
Unpredictable monsoon rains	Flash flooding in hilly regions	Damage to crops, infrastructure and basic services	Impact on the transportation of agricultural products affects urban food security and prices; risk of urban flash flooding
	Landslides in mountainous regions	Damage to crops, infrastructure and basic services	Impact on the transportation of agricultural products affects urban food security and prices

In rural areas, including those in Khyber Pakhtunkhwa, the impacts of climate change are most acutely experienced in the agriculture sector since the majority of people living in rural areas are dependent on the sector for their livelihoods. Direct impacts of climate change on agriculture occur through several pathways, including changes in growth processes, as well as the reduced availability of water resources, shifting rainfall regimes and increasingly heavy rainfall events. Moreover, climate change is influencing food production through changes to soils as a result of erosion caused by flooding, changes in pest and disease profiles, the spread of invasive species, and an overall decline in arable areas due to desertification[144]. Floods inundate fertile land, causes an increase in livestock mortality and reduces or destroys crops. The floods that occurred in 2010, for example, resulted in large-scale crop losses, worth more than US$5 billion[145]. This, in turn, also caused food price shocks that affected the most vulnerable community most severely.

[141] World Bank. 2022. Country Climate and Development Report.
[142] Government of Pakistan. 2018. Second National Communication to the UNFCCC.
[143] IFRC, 2021. Climate Change Impacts on Health and Livelihoods: Pakistan Assessment.
[144] World Bank (2021) Climate Change Country Profile Pakistan.
[145] World Bank (2021) Climate Change Country Profile Pakistan.

More variable and erratic rainfall patterns cause flash flooding and landslides in mountainous areas, damaging crops, infrastructure and services, and impacting the transportation of agricultural products. Consequently, climate change is directly impacting food prices, food security and therefore the health and wellbeing of the population. In the livestock sub-sector, climate change is impacting productivity directly through increasing average and maximum temperatures. Higher temperatures have numerous impacts on livestock, including heat stress, decreased productivity, impacts on reproduction, increases in the prevalence of diseases, and increases in water requirements. Moreover, the impacts of climate change on crop production also affect livestock since any decrease in the quality of fodder crops affects the productivity and quality of livestock. Droughts have already had severe impacts on the livestock subsector in many areas of Pakistan. For example, droughts in Sindh and Baluchistan provinces between 1999 and 2002 caused two million livestock to die, necessitating emergency relief to rural communities, including the provision of drinking water and food aid. Another extended drought between 2015–2017 reduced livestock productivity by 48% in some districts[146]. Under future climate conditions, livestock agriculture is expected to continue to be affected, with projections indicating a decline by approximately 30%[147].

The impacts of climate change on food productivity pose a very serious challenge in a country where 60% of the population is food insecure and almost half of the women and children are malnourished[148]. Low-income households living in rural areas are often dependent on small-scale rainfed agriculture and generally have low levels of livelihood diversification. The majority of households in rural Pakistan derive their primary income from informal, insecure, low-earning livelihoods, many of which are related to agriculture[149]. As a result, these communities are most vulnerable to climate risks, particularly in arid and semi-arid areas that are prone to droughts and floods. Communities in the country's mountainous northern regions are also particularly vulnerable to floods – including those living Khyber Pakhtunkhwa (KP)[150].

Under future climate change conditions, flooding and droughts will put increasing pressure on food production and access, and will directly impact food security in KP province[151]. Declining food production will affect food prices in many regions, and lower agricultural output will directly impact those communities who are dependent on rainfed subsistence farming. This will most severely affect the most vulnerable low-income groups in the province, as these people will be compelled to resort to maladaptive coping strategies and use any additional income they generate to meet their nutritional requirements.

Climate change impacts on water

The increasingly erratic and intense rainfall, and the associated increase in flooding, that has been experienced in Pakistan is directly and severely impacting water resources across the country. As previously noted, these uncertain rainfall patterns are particularly notable in arid and hyper-arid areas[152]. Temperature rise and increasingly erratic rainfall causes shifts in the rate of glacial melting, which change the rate of flow in rivers and contributes to riverine floods. Higher temperatures, in combination with flooding, is also associated with an increase in the spread of water- and vector-borne diseases and a decrease in water quality. Moreover, the unpredictable and shifting timing of glacial melt also contributes to droughts, as water supply becomes unpredictable and management thereof increasingly challenging[153]. Changing precipitation patterns are putting increasing pressure on water resources, and thereby also affecting crop agriculture through reduced reliability of irrigation networks[154].

[146] World Bank (2021) Climate Change Country Profile Pakistan.
[147] UNDP 2016
[148] MoPDR (2018) Pakistan Vision 2025: One National – One Vision. Ministry of Planning, Development & Reform.
[149] Ibid.
[150] WFP (2018) Climate Risks and Food Security Analysis: A Special Report for Pakistan.
[151] World Bank. 2022. Country Climate and Development Report.
[152] World Bank (2021) Climate Change Country Profile Pakistan.
[153] *While sea level rise also affects vulnerable communities across Pakistan, the impacts on KP are not direct and therefore not discussed here.*
[154] World Bank (2021) Climate Change Country Profile Pakistan.

Climate change impacts on communities

Vulnerability profile

As of 2021, Pakistan ranked 153nd out of 181 on the ND-GAIN Index, which calculates a country's vulnerability to climate change as well as its readiness to improve resilience. The high vulnerability score and low readiness score of Pakistan places it in the upper-left quadrant of the ND-GAIN Matrix. It has both a great need for investment and innovations to improve readiness and a great urgency for action. Pakistan is the 39th most vulnerable country and the 27th least ready country[155].

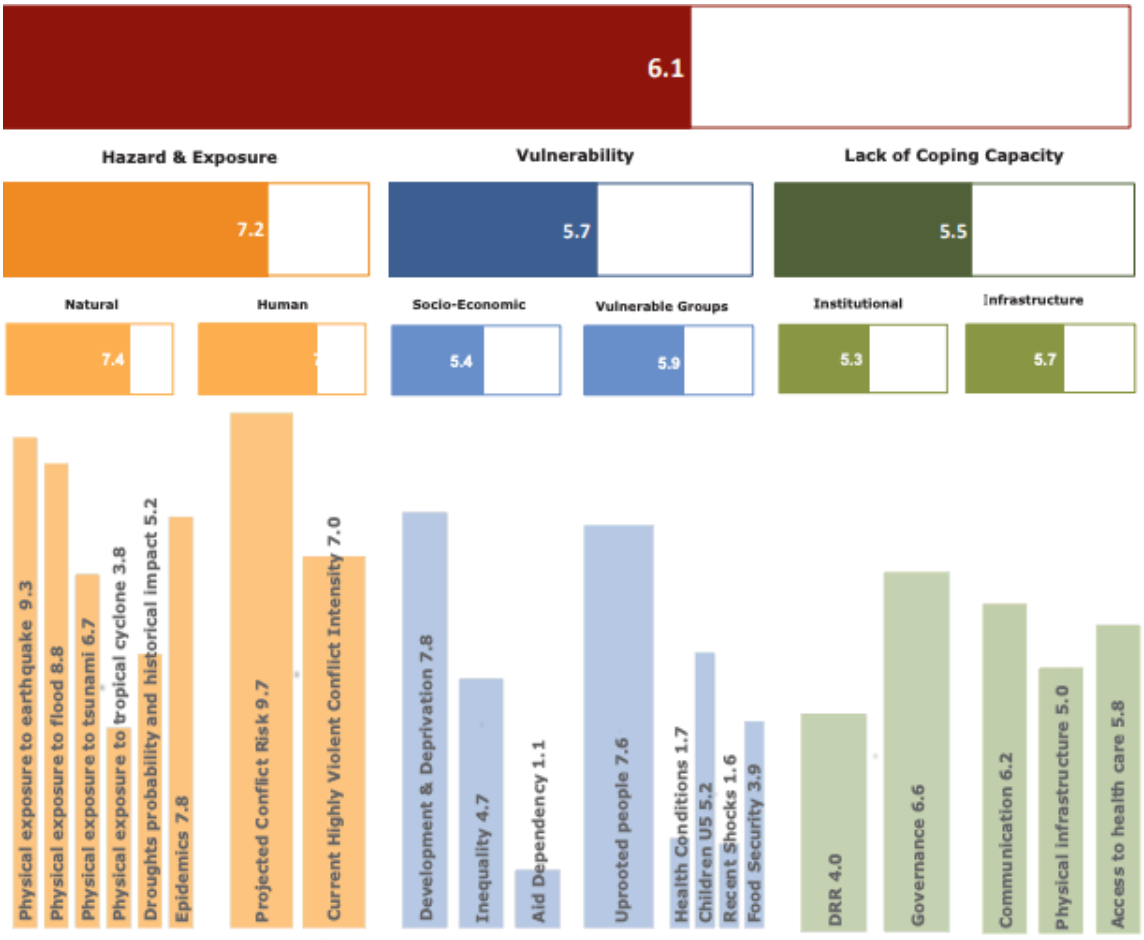


Figure 23. Inform Risk profile of Pakistan

Another indicator used to determine the country's vulnerability to climate change and risk profile is the INFORM GRI (Index for Risk Management Global Risk Index), which measures the risk of humanitarian crises and disasters in 191 countries. The INFORM risk model is based on three dimensions of risk: Hazards & Exposure, Vulnerability, and Lack of Coping Capacity. The Index gives a score of 1-10 (1 being the lowest and 10 the highest) for each risk dimension, as well as an overall risk score. For 2021, Pakistan had an overall risk score of 6.1/10, which INFORM categorizes as "High Level". The Hazard & Exposure dimension, which takes into account a combination of natural and human hazards, scored 7.2/10. The Vulnerability dimension scored 5.7/10, and the Lack of Coping Capacity dimension scored 5.5/10. As illustrated in Figure 23 above, the highest

[155] ND-GAIN Index score for 2021. Available here.

physical exposure was earthquake, with 9.3/10 in the natural hazard category, which was exceeded by the Projected Conflict Risk score of 9.7/10[156].

In the target province of Khyber Pakhtunkhwa, floods are caused by heavy concentrated rainfall in the catchments of Rivers Indus, Swat and Kabul during the monsoon season, which is augmented by snowmelt caused by a rise in temperature. Major floods occur in later summer (July to September) when the region is subjected to heavy monsoonal rains. Major floods in the province have occurred in 1976, 1982, 1988, 1992, 2005, 2006, 2007 and 2010. The unusually large rainfall from the 2010 monsoon caused the most catastrophic flooding in Pakistan's history, flooding one-fifth of the country, affecting 20 million people, and claiming over 2,000 lives. The impact of this event emphasized the nation's vulnerability to flooding also in economic terms. The 2021 PDMA Monsoon Contingency Plan[157] has identified the most vulnerable districts of Khyber Pakhtunkhwa to flood hazards, its results are presented in Table 6 below.

Table 6. Monsoon Hazards Vulnerability Matrix of selected Khyber Pakhtunkhwa districts.

District	Flood Hazard intensity	Riverine flood	Flash flood	Urban flood	Landslide	Avalanche	GLOFs
Charsadda	Very high	Yes	No	No	No	No	No
D. I Khan	Very high	Yes	Yes	Yes	No	No	No
Shangla	Very high	Yes	Yes	No	Yes	Yes	Yes
Dir Upper	Very high	Yes	Yes	Yes	No	Yes	Yes
Nowshera	Very high	Yes	Yes	Yes	No	No	No
Swat	Very high	Yes	Yes	Yes	Yes	Yes	Yes
Chitral (U)	Very high	Yes	Yes	No	Yes	Yes	Yes
Chitral (L)	Very high	Yes	Yes	No	Yes	Yes	Yes
Buner	Medium	No	Yes	No	Yes	Yes	No

The target districts of Shangla and Buner have been categorized as belonging in the medium (600-1,000 mm) and high (< 1,000 mm) rainfall regions respectively, according to the rainfall trends analysis carried out by the PDMA. Table 7 provides a summary of the vulnerability profiles and suggested measures in the three identified agroecological zones of the target province.

Table 7. Climate vulnerability profiles of agro-ecological zones in the target region[158]

Agro-ecological zones	Province	Climate characteristics and risks	Livelihoods and food security	Vulnerability (districts)	Suggested measures
Wet mountains	Khyber Pakhtunkhwa	Both humid and arid, with hot to mild summers and cold winters; 235 mm rainfall in summer and 116mm in winter. The Neelum river area is prone to floods.	Agriculture, poultry, forestry (non-timber forest products), aquaculture and mining-related livelihoods. Seasonal migration is common	Mansehra, Battagram and Abbottabad are highly vulnerable	Flood forecasting and structural measures

[156] Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM) (2021) Pakistan Disaster Management Reference Handbook.
[157] PDMA (2021) Monsoon Contingency Plan.
[158] World Food Programme (2018) Climate Risks and Food Security Analysis: A Special Report for Pakistan.

	Khyber Pakhtunkhwa and Punjab	Rainfall has increased over the years, posing risk of landslide and flood affecting livelihoods. The increasing variability of precipitation and rising average temperatures have also increased the risk of droughts in the province.	Livestock, tourism, horticulture and wage labour-related livelihoods. Remittances are a major source of income.	Attock, Murree and Kohat are moderately vulnerable	Flood control measures, natural resource management and water storage
Northern dry mountains	Khyber Pakhtunkhwa and FATA	Torrential rains and glacial lake outburst floods (GLOFs) are potential climate risks	Forest-based livelihoods, seasonal migration is widespread. High food insecurity	Orakzai, Hangu, Malakand, Upper Dir and lower Dir are highly vulnerable	Community capacity building, flood protection, land use and forest management
Western dry mountains	Khyber Pakhtunkhwa and FATA	Semi-arid highlands with mild short summers, long cold winters; prone to flash floods and drought	Mining, livestock, horticulture and government jobs	Lakki Marwat, Bannu, Karak are the most vulnerable districts	Livelihood support, and the provision of basic services and facilities

Vulnerability factors

Poverty and inequality

Pakistan holds considerable social vulnerability to disaster. High poverty and malnutrition rates prevail and many communities and minority groups are marginalized by socio-economic status, location, and political circumstances. The country's high exposure to multiple natural hazards and its likely exposure to above average climate changes should be seen in the context of its vulnerability. While Pakistan has made great progress towards reducing poverty and reaching middle income status, the impacts of climate change threaten this progress[159]. Many of the climate changes projected are likely to disproportionately affect the poorest groups in society. Heavy manual labour jobs are commonly among the lowest paid whilst also being most at risk of productivity losses due to heat stress. Under future climate conditions, the impacts of floods and droughts will likely exacerbate existing inequalities in the country and will particularly affect vulnerable and marginalised groups such as women, children and people with disabilities, as well as refugees. These groups are likely to be especially severely affected by floods since they lack adequate access to social protection and coping mechanisms[160]. Although household poverty in Pakistan is projected to decline in the future, the impacts of climate change on productivity of the labour force will directly affect the capacity of the

[159] World Bank. 2022. Country Climate and Development Report.
[160] World Bank. 2022. Country Climate and Development Report.

government for poverty alleviation. Even a 9% decrease in GDP by 2050 will directly reduce the government's capacity to meet its poverty reduction targets[161].

Gender

Climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.

In Pakistan, gender equality is enshrined in the Constitution of Pakistan, and the empowerment of women is being promoted through the development of legislative frameworks that protect women and advance gender equality[162]. However, the implementation and enforcement of these frameworks remain a challenge and Pakistan remains one of the most unequal countries in the world. To improve the climate resilience of Pakistan's women, several priority actions have been identified[163]. These include: i) ensuring the participation and representation of women at all levels of climate policy, planning and decision-making; ii) strengthening coordination and promoting institutionalisation to address gender issues and support gender mainstreaming; iii) developing gender responsive climate actions through national and provincial policies and programmes; iv) collecting gender disaggregated data to fill information gaps; v) investing in context specific research to inform policy making and programming; and vi) developing a framework to monitor progress on ccGAP implementation.

Migration

Work by the World Bank Group suggests South Asia will experience an estimated 17–36 million internal climate migrants by 2050 as a result of slow-onset climate changes. The range in this estimate reflects different future development pathways with differing levels of emissions reduction and inequality in development outcomes. Under all scenarios, the poorest and most climate-vulnerable communities are likely to be hardest hit. Without significant mitigation action, beyond 2050 the climate-induced migration rate is likely to accelerate considerably. It is expected that 'hotspots' of in and out-migration are likely to form.

Food insecurity

Climate change is posing a direct threat to food security of the most vulnerable communities in Pakistan. The extensive flooding that has occurred in the country in recent decades as already caused severe crop losses, loss of livestock and other related impacts on food production systems. Rising temperatures, and particularly heatwaves, have also affected food security across the country in recent years[164]. Floods that occurred in recent years destroyed approximately a third of Pakistan's agricultural land and affected approximately 33 million people, with 6.4 million of these people being in urgent need of aid and 5.2 million having lost property and agricultural land. In KP province, these floods caused the loss of approximately 8,767 livestock. The overall impact of the recent floods was that approximately 3.5 million people were food-insecure in different parts of Pakistan[165].

[161] World Bank. 2022. Country Climate and Development Report.
[162] IUCN. 2022. Climate Change Gender Action Plan of the Government and People of Pakistan. Available: here
[163] IUCN. 2022. Climate Change Gender Action Plan of the Government and People of Pakistan. Available: here
[164] Waseem, M., Majeed, Y., Nadeem, T., Naqvi, L.H., Khalid, M.A., Shafiq, M. and Sajjad, M.M., 2022. Climate Change, Flood Disaster, and Food Insecurity in Pakistan.
[165] Waseem, M., Majeed, Y., Nadeem, T., Naqvi, L.H., Khalid, M.A., Shafiq, M. and Sajjad, M.M., 2022. Climate Change, Flood Disaster, and Food Insecurity in Pakistan.

Health

The World Health Organization (WHO) projects that, under a high emissions scenario (RCP8.5), 46 million people in Pakistan will be at risk of contracting malaria by 2070. However, if global emissions are decreased significantly (RCP2.6) this number is projected to be around 12 million by 2070. Diarrheal-related deaths are projected to decrease significantly by 2050, but the proportion of those attributable to climate change is expected to rise, under a high emissions scenario this will be from 11.7% in 2030 to 17% by 2050[166].

Poor water and sanitation still cause over 53,000 deaths among children under five years of age in Pakistan through diarrhoeal diseases[167]. The occurrence of waterborne diseases varies greatly across Pakistan's regions and seasons, yet climate change is expected to increase exposure to these diseases through the pollution of water sources and limiting access to clean drinking water. The proportion of diarrhoeal deaths due to climate change could rise from 11.7% to approximately 17% by 2050[168]. This is projected to lead to an additional 5,639 diarrhoeal-related deaths in children by the year 2030[169]. A disease of particular concern is Cholera, which re-emerged after the extreme floods in 2010 and resulted in 1,218 cases in the 2014 flood. More frequent flooding events may increase the risk of cholera.

3. INSTITUTIONAL, POLICY AND REGULATORY FRAMEWORKS

3.1 National climate change and development policies, strategies and frameworks

Over the past several years, Pakistan has undertaken several policy and planning initiatives with respect to climate change and is preparing a formal climate change strategy. In 2003, it submitted its National Communication to the UNFCCC, and in 2005 it established the Prime Minister's Committee on Climate Change, an overarching body that meets annually to monitor climate change trends and provide policy guidance. In addition, in October 2008, the Planning Commission—the body responsible for preparing the National Plans for the country's main economic sectors—established a Task Force on Climate Change that was given responsibility for preparing the country's climate change policy. The Task Force released its Final Report in 2010, which outlines the country's current approach to addressing climate change from both a mitigation and adaptation perspective, including key recommended adaptation measures in priority socioeconomic areas.

In the international arena, Pakistan has endorsed all of the South Asian Association for Regional Cooperation's declarations on climate change, including the 2010 Thimphu Declaration. The devastating 2010 floods in Pakistan have prompted the Pakistani policy makers to accelerate the process of drafting a national policy and action plan on climate change. Further, various sectoral strategies, including the National Environmental Policy, National Water Policy, and National Forest Policy, also make mention of the potential impacts of climate change.

The Government of Pakistan established the Ministry of Climate Change and issued its Second National Communication on Climate Change in 2019. The National Climate Change Policy recognizes that while Pakistan is working on a strategy that seeks to conserve energy, improve energy efficiency and optimize fuel mix to support global efforts for reduction in greenhouse gas emissions, the more immediate and pressing task is to prepare itself for adaptation to climate change. Pakistan ratified the Paris Agreement on November 10, 2016 and submitted its Nationally Determined Contribution to the UNFCCC in 2016. At the time of writing and according to the updated NDC (2021), Pakistan has commenced the formulation of its National Adaptation Plan (NAP). The project is in full alignment with the Government of Pakistan's commitments as laid out in the updated NDC, notably towards the reduction of flood risk in and around the Indus Basin. Capacity building and

[166] World Bank (2021) Climate Change Country Profile Pakistan.
[167] UNICEF Pakistan (2019) Country Programme of Cooperation between the Government of Pakistan and UNICEF 2018-2022.
[168] WHO (2016) WHO Climate and Health Profile Pakistan.
[169] Ibid.

knowledge transfer are also key priorities for enhancing the resilience of communities to the impacts of climate change, notably flood events.

The proposed project is in line with Pakistan's Strategic Plan "Vision 2025", which has protecting natural resources and addressing climate change as one of its priority areas170, the National Climate Change Policy (2012), and its Framework for Implementation 2014-2030, which, inter alia, calls for ensuring community participation in early warning dissemination and disaster risk reduction activities, particularly in developing evacuation plans, and strengthening flood forecasting, drought monitoring and early warning systems in the country;171,172 It aligns with the Climate Change Act (2017) as it pursues pro-poor and gender-sensitive adaptation, including ensuring food and water security and minimizing the risks from the expected increase in the frequency and intensity of extreme weather events. It is also in line with the national adaptation priorities outlined in Pakistan's Nationally Determined Contribution (NDC), especially the focus on climate-smart agriculture and capacity building and knowledge transfer under the Adaptation Priorities173. Note the project also contributes to the NDC priority around improving the emergency response mechanism for managing extreme events and the near-term actions around strengthening sub-national adaptation planning capacity. The National Disaster Management Act (2010) and its accompanying Action Plan, especially Chapter IV around strengthening the District Disaster Management Authority, the recommendations of the 2016 Technology Needs Assessment (TNA) on agriculture and water, especially section 3.4.1 on early warning system and forecasting technologies. At the time of writing and according to the updated NDC (2021), Pakistan has commenced the formulation of its National Adaptation Plan (NAP).

Pakistan's 18th Constitutional Amendment, passed in 2010, inter alia devolved numerous functions and responsibilities to the Provincial level.174 Khyber Pakhtunkhwa Province has its own Climate Change Policy, for example. This has several broad objectives, including climate resilient food and water security, focusing adaptation on communities especially at risk from climate-prone disasters, enhancing the role of women and leveraging financial, capacity and technological support. Of relevance to this proposal, the policy states that its priorities are to: "Strengthen forecasting, monitoring, early warning systems and evacuation planning for extreme weather events, for both humans and biodiversity (including livestock and fisheries), giving due focus to planning for vulnerable human population: old, children, disabled and women; ensuring community participation in the development process of such plans."175 Related policy initiatives include a disaster risk management plan at the provincial and district levels (though at the district level in Buner and Shangla, these have not been updated for many years) and a Monsoon Contingency Plan at the district level in both target districts.

Table 8. National policies, strategies and frameworks, and their alignment with the proposed project.

Summary	Description	Alignment of the proposed project to objectives and targets
Pakistan's Vision 2025	Pakistan 2025: One Nation – One Vision (known as Vision 2025) details the country's strategy for reaching its overall national development goals and aspirations. The overarching objective of the strategy is for Pakistan to be one of the 10 largest economies in the world by 2047, in accordance with	The project approach contributes to fulfilling the overall objective of Pakistan's main strategic document, notably those in Pillar IV on water and food security. More specifically, the proposed project will "protect the most food-insecure segments of the population through effective relief measures, including long-term arrangements and adaptation mechanisms", by supporting the provision of

[170] Ministry of Planning, Development and Reform (2018) Pakistan Vision 2025, p.8
[171] Ministry of Climate Change (2012) National Climate Change Policy, p.18
[172] *Ibid*, p.19
[173] As highlighted by NDC Partnership here: https://ndcpartnership.org/climate-tools/ndcs
[174] Rana (2020) Decentralization experience in Pakistan: The 18th Constitutional Amendment
[175] Environmental Protection Agency (2016) Khyber Pakhtunkhwa Climate Change Policy, p.26

<table>
<tr><th>Summary</th><th>Description</th><th>Alignment of the proposed project to objectives and targets</th></tr>
<tr><td></td><td>seven pillars that are based on the imperatives of embracing change and transformation, and to create new opportunities. The pillars of Vision 2025 are: i) People first: developing social and human capital and empowering women; ii) Growth: sustained, indigenous, and inclusive growth iii) Governance: democratic governance – institutional reform and modernisation of the public sector; iv) Security: energy, water and food security; v) Entrepreneurship: private sector and entrepreneurship-led growth; vi) Knowledge economy: developing a competitive knowledge economy through value addition; and vii) Connectivity: modernising transport infrastructure and regional connectivity.</td><td>enhanced hydrometeorological data and implementation community-led adaptation measures to improve the resilience of the most vulnerable populations in Buner and Shangla. Further, the small-scale flood protection structures to be established will protect the livelihoods – which are subsistence agriculture based for the most part – of rural communities in the target districts. Last, the proposed project will nurture interinstitutional collaboration and exchange of data with a view to trigger lasting policy change on the local and national levels.</td></tr>
<tr><td>National Communications to the UNFCCC (two submitted, latest August 2019)</td><td>Pakistan's Second National Communication (SNC) provides an updated overview of Pakistan's efforts in various thematic areas related to climate change mitigation and adaptation, with information up to the year 2015. It briefly discusses the national circumstances since the Initial National Communication (INC), documents the GHG inventory, and models temperature and precipitation changes for 2020, 2050, and 2080. The report also includes measures for disaster preparedness, capacity building, institutional strengthening, and awareness-raising in relevant sectors. Pakistan's response to climate change prioritizes inclusive and equitable measures that focus on the most vulnerable segments of society.</td><td>The latest communication acknowledges the devastating impacts of floods as well as their economic impact, with more than USD 18 billion in losses to the economy in five flood episodes (2010-2014). In this regard, the communication has analysed Pakistan’s needs in terms of upgraded meteorological equipment, as follows in Error! Reference source not found. below:

<table>
<tr><th>No.</th><th>Equipment Required</th><th>Qty</th></tr>
<tr><td>1</td><td>Weather Radars</td><td>18</td></tr>
<tr><td>2</td><td>Establishment of New Observatories
Strengthening/ Up- gradation (Automation- WMO)</td><td>40
97</td></tr>
<tr><td>3</td><td>Automatic Weather Stations (AWS)</td><td>400</td></tr>
<tr><td>4</td><td>FFD- Establishment of Regional Flood Forecasting Centres</td><td>05</td></tr>
<tr><td>5</td><td>Establishment of GLOF Stations</td><td>15</td></tr>
<tr><td>6</td><td>Establishment of Flash Flood Warning Centers</td><td>15</td></tr>
<tr><td>7</td><td>Seismology (Tsunami- 10, Earthquake- 10)</td><td>20</td></tr>
<tr><td>8</td><td>Aviation: Wind Profilers</td><td>8</td></tr>
<tr><td>9</td><td>Awareness/Technology (FM- Radio Channel)</td><td>-</td></tr>
<tr><td>10</td><td>Capacity buildin- Advanced Technology</td><td>-</td></tr>
</table>
Figure 24. Pakistan's needs for upgraded meteorological equipment

Hence, the proposed project will directly contribute to filling the gaps in equipment and capacity by installing additional hydrometeorological equipment.</td></tr>
<tr><td>National Climate Change Policy</td><td>The National Climate Change Policy of Pakistan was drafted in the aftermath</td><td>The proposed project directly contributes to achieving the above strategic objectives by improving early</td></tr>
</table>

Summary	Description	Alignment of the proposed project to objectives and targets
(September 2012)	of the devastating super floods of 2010 and 2011, which resulted in the displacement of over 20 million people, and caused immense economic damage to the livelihoods of communities. The NCCP identifies the "increase in the frequency and intensity of extreme weather events, coupled with erratic monsoon rains causing frequent and intense floods" as the first climate change threat to the country. Therefore, the Policy puts a strong emphasis on mainstreaming climate change at all levels, through the following objectives: 1. "To ensure water security, food security and energy security of the country in the face of the challenges posed by climate change; 2. To minimize the risks arising from the expected increase in frequency and intensity of extreme weather events such as floods; 3. To strengthen inter-ministerial decision making and coordination mechanisms on climate change. 4. To enhance the awareness, skill and institutional capacity of relevant stakeholders;"	warning systems and response times and the capacity of local stakeholders to interpret weather data, which will enhance the resilience of local populations to predict and sustain climate change events. Further, the project will install small-scale engineering structures to mitigate the negative impacts of floods, which will support water and food security in Buner and Shangla. Finally, the project will support interinstitutional coordination mechanisms by creating a platform for knowledge exchange and dissemination, with a view to trigger policy change at the local and national levels.
Framework for Implementation of Climate Change Policy	The creation of the Framework for Implementation of NCCP is a continuation of the National Climate Change Policy (NCCP), which serves as the overarching framework for adapting to the evolving effects of climate change and contributing to its mitigation. The Framework for Implementation of NCCP takes into consideration the current and future projected climate change hazards in Pakistan's different sectors.	The associated NCCP implementation framework calls for ensuring community participation in early warning dissemination and disaster risk reduction activities, particularly in developing evacuation plans, and strengthening flood forecasting, drought monitoring and early warning systems in the country. The proposed project aims to raise the awareness of local communities to the impacts of climate-induced floods, as well as supporting the community-led development of local adaptation actions to enhance the resilience of livelihoods and landscapes.
National Disaster Risk Reduction Policy (February 2013)	In 2015, the National Disaster Risk Reduction Policy was created with input from all stakeholders, including the provinces, the state of AJ&K, and regions. This policy approaches disaster risk reduction in a more comprehensive manner, emphasizing risk assessment, prevention, mitigation, and preparedness through a proactive and anticipatory approach.	The proposed project directly contributes to the achievement of the National DRR Policy, specifically in terms of building the capacity of stakeholders along the chain, raising the awareness of the vulnerable population on the climate change risks to their livelihood, and on installing new hydrometeorological equipment to enhance data collection and dissemination. Further, the project will nurture interinstitutional coordination to increase data and knowledge exchange with a view to enhance early

Summary	Description	Alignment of the proposed project to objectives and targets
	The policy aims to prioritize measures to improve existing vulnerabilities to hazards and ensure that future development initiatives incorporate resilience. It also provides guidelines for timely, dedicated, and sufficient investment in hazard mitigation and preparedness interventions at all levels, which will significantly decrease disaster risk and the associated costs of response, recovery, and rehabilitation.	warning response times in the target area. Lastly, under Component 2 the project will support vulnerable communities to develop local adaptation plans and priority interventions to mitigate the identified climate change impacts of floods, which will directly increase the resilience of vulnerable populations and landscapes.
National Environmental Policy (2005)	The National Environment Policy serves as a comprehensive framework to address environmental concerns in Pakistan, encompassing a range of issues such as air and water pollution, waste management, deforestation, biodiversity loss, desertification, natural disasters, and climate change impacts. Its primary goal is to safeguard, preserve, and revive the country's environment, leading to sustainable development and enhancing the well-being of its citizens.	The proposed project will support the following objectives of the National Environmental Policy: • Integration of environmental considerations in policy making and planning processes • Capacity building of government agencies and other stakeholders at all levels for better environmental management • Creation of a demand for environment through mass awareness and community mobilization
National Water Policy (2018) and National Flood Protection Plans (latest version IV)	The National Water Policy aims to address the problem of an emerging water crisis by establishing a comprehensive policy framework and guidelines for a cohesive plan of action. As Pakistan has a federal system of government with a considerable level of autonomy granted to the provinces via the 18th Amendment to the Constitution, this policy serves as a national framework within which the provinces can devise their own master plans for the sustainable development and management of water resources. While the management of water resources is a national responsibility, the regulation of sub-sectors such as irrigation and agriculture, rural and urban water supply, and the environment fall under the purview of provincial authorities.	One of the key objectives of this policy is to reduce by half the areas affected by floods, and to do so it identifies a number of gaps and lapses, including: • Lack of coordination between federal and provincial departments during floods • Lack of technical data sharing mechanism among departments • Lack of expertise in flood handling departments • Limited real-time data availability • Low density of hydrometeorological gauges as compared to international standards • Limited reaction time for flashy streams • Lack of funds for implementation of flood protection schemes highlighted in the National Flood Protection Plan The proposed project will help addressing each of the above-mentioned barriers and gaps in the province of Khyber Pakhtunkhwa, and therefore support the implementation of the National Water Policy.

Table 9. Alignment with other policies, strategies and frameworks.

Name of climate change and development policy	Alignment with policy objectives and targets
National Monsoon Contingency Plan (2022)	National Monsoon Contingency Plan-2022 has been prepared in coordination with all Disaster Management stakeholders both at federal and provincial levels based on analysis of seasonal forecast by the PMD and likely impacts of climate change. In this Plan, explicit guidelines have been laid down for all Disaster Management (DM) tiers and other relevant stakeholders for mitigation of likely hazards, preparedness against most probable and worst-case scenarios and mounting an effective and timely response to a situation resulting from Monsoon. This plan has been prepared incorporating lessons learnt from Monsoon-2021 mapping available assets, identifying the needs for mobilizing additional resources, clarifying the roles and responsibilities, and establishing coordination mechanism for effective response to likely as well as worst case scenario. In this regard, NDMA engaged all DM stakeholders to identify and map resources and shore up the preparatory /mitigation measures being undertaken for the upcoming Monsoon season in 2022. This also includes meetings of Strategic Coordination Forum, co-chaired by UNRC / HC and Chairman NDMA for enhanced coordination with United Nations and other humanitarian partners. The contingency plan aims to formulate National Response Contingency Plan for all relevant stakeholders for an effective response against the Monsoon-2022 and related emergencies. Responsibility matrix has been laid down, which sequence all of the actions by various stakeholders in line with their tasks and functions for flood management. The activities under the contingency plan trigger as soon as early warnings / alerts are issued by PMD and FFC based on the weather forecast notified by the PMD through daily press releases. Roles and responsibilities of all relevant stakeholders have been clearly laid down in the contingency plan.

National Gender Policy Framework (2022)	Women continue to face serious challenges amid threats to the country's growth and survival due to climate degradation, particularly in occupations that are dependent on natural environments or geographic locations and where climate stress may cause natural hazards. Agriculture, water, and forestry are among the sectors most impacted by climate change and women are heavily engaged in these sectors as full-time labour or secondary workers in addition to their dependence on natural environments for sustenance. Pakistan is among the countries that are most vulnerable to the risks associated with climate change and currently ranks 8th on the Global Climate Risk Index. Droughts and floods produce a precarious survival scenario for communities, especially women. And the latter, are disproportionately impacted by the adverse effects of climate change. Pakistan ratified the Paris Agreement (2015) which mandates gender equity and justice in climate action by the member states. Amongst the policy priority is to mitigate risks by making communities more resilient in face of the looming challenges due to climate change while putting women at the centre of the policy framework on climate change. Furthermore, the establishment of the interlinkages between climate degradation and women's deteriorating plight and creating enabling institutions to develop climate-specific data sets and strengthen analytic capacities to review female vulnerability and resilience in tandem with climate degradation. The policy objectives include: i) establish gender transformative governance structures, lead gender equal institutional transformation, strengthen the Government's capacity to mainstream gender in its policies and programs, and ensure institutionalization of gender equality principles in the government priorities and action plans; ii) create enabling environments for women and girls to learn and become equipped with employable and high-income generating skills; iii) promote equitable access to work opportunities with conducive workplaces, enabling an enterprising environment and necessary business skills; iv) creating avenues for and advancing female leadership, mentorship, and engagement to meaningfully integrate their voices in program design and policy decisions; v) integrate gender-sensitive health elements in cross-cutting services, including health; and vi) end Gender-based violence and mainstream gender protection across systems, policies, processes, and programs.

Table 10. National vulnerability, risk and needs assessments related to climate change adaptation.

Technology Needs Assessment for Climate Change Adaptation (December 2016)	The Pakistan TNA identifies two key sectors for technology prioritization: the water sector and the agriculture sector. For the water sector, the first technology prioritized by the Sectoral Expert Working Group was "flood early warning system". For the agriculture sector, "climate monitoring and forecasting – early warning system" was one of the prioritized technologies, as the accurate and reliable prediction of day-to-day weather and extreme weather events is of vital importance for communities and their livelihoods. Therefore, the project will follow the recommendations of the TNA by improving the collection, dissemination and analysis of weather and climate data through the installation of additional hydrometeorological stations and the provision of capacity building support to stakeholders at the local and national levels.

3.2 International climate change commitments

Nationally Determined Contribution (NDC) to Paris Climate Agreement (Updated 2021)	Pakistan's Intended Nationally Determined Contribution (Pak-INDC) is based on the country's strategic plan, "Vision 2025," and is aligned with policies, plans, and growth targets set by various ministries and government entities. Additionally, the potential impacts of significant development plans and projects, including measures to address energy shortages and contributions to economic growth through the China-Pakistan Economic Corridor	The project is in full alignment with the GoK's commitments as laid out in the updated NDC, notably towards the reduction of flood risk in and around the Indus Basin, including GLOFs. Capacity building and knowledge transfer are also one of the key priorities to enhance the resilience of communities to the impacts of climate change, notably flooding events. The proposed project will support improvements in the "emergency response mechanism for managing extreme events and the near-term

	(CPEC), have been taken into account. Pak-INDC provides an overview of the country's current greenhouse gas (GHG) emissions profile and projects future emissions based on present and future socio-economic parameters, demographic dynamics, and emerging energy needs. The document also outlines current mitigation and adaptation measures being implemented in Pakistan and discusses the challenges and difficulties faced and those that may arise in the coming years. The Pak-INDC identifies the significant challenges facing Pakistan, which are likely to increase in the future due to climate-induced variability and natural disasters, and highlights actions already taken to reduce GHG emissions and build disaster management and resilience capacity. Additionally, it presents a broad range of potential mitigation and adaptation measures, as well as the challenges associated with realizing these measures in both current and future scenarios.	actions around strengthening sub-national adaptation planning capacity".

3.3 Provincial-level climate change policy frameworks

At the provincial level, the Government of Khyber Pakhtunkhwa, as one of the most vulnerable provinces of Pakistan, has showed its commitment to addressing climate change adaptation needs. Most notably through the elaboration of the Khyber Pakhtunkhwa Climate Change Policy (Table 11). The proposed project has been designed in full consideration of the objectives of the GoKP's Climate Change Policy and to complement the objectives of other identified policies, plans and strategies. Overall, the project will contribute to the Provincial Government's objective of minimizing climate change impacts through an integrated approach to disaster risk management and reduction.

Table 11. Provincial policies, strategies and plans and their alignment with the proposed project.

Name of climate change and development policy	Summary	Priority measures identified for adaptation and the contribution of the GCF project to achieving these targets
Khyber Pakhtunkhwa Climate Change Policy (2022)[176]	The Khyber Pakhtunkhwa Climate Change Policy was developed in 2016 and updated in 2022 to ensure its consistency with the updated National Climate Change Policy (2021). The primary objective of the Policy is to ensure that climate action is mainstreamed in development planning, especially for the economically and socially vulnerable sectors of the economy, to steer Khyber Pakhtunkhwa.	Khyber Pakhtunkhwa Climate Change Policy outlines priority measures for mitigation and adaptation in the province in relevant sectors including agriculture, water resources, energy, and health. The Policy identifies a number of objectives for disaster preparedness. These are listed below. • Develop a Provincial Disaster Risk Reduction (DRR) Policy to ensure the implementation of the Sendai Framework and National DRR

[176] Khyber Pakhtunkhwa Climate Change Policy 2022. Available at: https://epakp.gov.pk/wp-content/uploads/2022/09/Khyber-Pakhtunkhwa-Climate-Change-Policy-2022.pdf

	Specifically, the policy aims to: • Enhance awareness of the impacts of climate change among all stakeholders for necessary appropriate measures to combat and minimize these impacts • Facilitate action in Khyber Pakhtunkhwa on climate adaptation and mitigation, while promoting long term sustainability • Enhance interdepartmental coordination and cooperation for effective climate action • Ensure water, food and energy security for Khyber Pakhtunkhwa province in the face of a changing climate • Ensure interests of vulnerable groups and gender aspects are adequately addressed in climate development strategies and planning • Develop bases to secure sufficient financial and technological support, and strengthen institutional and human resource capacities to achieve policy objectives; and to be able to tap financial and technological opportunities available internationally The Policy emphasizes the vulnerability of Khyber Pakhtunkhwa province to the impacts of climate change and is aimed at enhancing the resilience of vulnerable communities, ecosystems, and infrastructure. It is focused on the natural resource-based economy of the province and emphasizes the need to enhance early warning systems and disaster risk reduction measures, reduce the vulnerability of natural and human systems, and capitalize on any potential benefits resulting from anticipated changes in climatic conditions.	Policy (2013), with a focus on climate-induced extreme events and disasters. • Clearly define the roles and responsibilities of each concerned department, emphasizing supervisory roles for public servants and representatives (at the local and provincial levels) during natural disasters to strengthen coordination and build their capacities to adequately plan for and respond to the impacts of extreme weather events. • Develop Nature-based Solutions (NbS) for Disaster Risk Reduction (DRR). • Conduct climate-inclusive Multi-Hazard Vulnerability and Risk Assessment (MHVRA) studies on district-level. • Improve the early warning system inclusive of potential Climate Change hazards. • Update and revise building codes in response to recent disasters and Climate Change. • Create evacuation plans with consideration for women, children, disabled and elder-people. • Carry out hazard and risk mapping of existing infrastructure for telecommunications, power, utilities, transportation, irrigation and agriculture and improve their resilience to climate change, earthquakes, landslides, avalanches, GLOFs and other disasters. • Strengthen forecasting, monitoring, early warning systems and evacuation planning for extreme weather events, for both humans and biodiversity (including livestock and fisheries), giving due focus to planning for vulnerable human population: old, children, disabled and women; ensuring community participation in the development process of such plans. • Maintain accurate records of seasonal patterns, temperature and precipitation for each agro-ecological zone and use this data and information to project Climate Change scenarios. • Develop an 'assessment and compensation mechanism' including insurance of losses and damages in the aftermath of disasters and measures for rehabilitation. • Plan, design, construct and strengthen appropriate flood embankments, dykes, protective bunds to protect flood plains and populations in view of likely floods. • Design, construct and upgrade disaster resilient multi-purpose buildings in relatively safer areas to use as shelter during natural calamities.

		• Ensure storm drainage system in major cities for intense rainfall events. The proposed project supports the recommended policy measures of the KP Climate Change Policy by: • Installing additional hydrometeorological equipment • Increasing the technical capacity of local stakeholders to analyse climate data • Raising the awareness of local communities on the impacts of climate change-induced floods and how they can be addressed • Supporting these communities to develop locally appropriate adaptation measures and plans • Supporting inter-ministerial cooperation and data exchange for mainstreaming climate change adaptation and disaster preparedness into policies and sectoral plans.
Khyber Pakhtunkhwa Climate Change Action Plan (August 2022)	The Khyber Pakhtunkhwa Climate Change Action Plan was released in August 2022, complementary to the Khyber Pakhtunkhwa Climate Change Policy of the Province. The document provides information specific to KP province in the context of climate change, a situation analysis focussed on the impacts of climate change across different sectors, and an Action Plan that details proposed adaptation and mitigation in each sector. In formulation of the Action Plan, special focus was placed on Youth and Women Development, with oversight provided by the Status of Commission of Women Khyber Pakhtunkhwa and other international and national public and private sector organisations	At inception any guidance directly relevant to the target districts will be taken into account. The project will be implemented in a manner that is in line with the Plan and conflict with any regulations laid out in the Plan will be avoided, including within the ESAP.
Provincial Disaster Response Plan Khyber Pakhtunkhwa [177]	The Provincial Disaster Response Plan outlines the GoP's guidelines for managing and responding to disasters/ emergencies in the Province. The Plan is aligned with the National Disaster Response Plan (2019). The Provincial Disaster Response Plan is a "Multi-Hazard" Response Plan developed with a purpose to enhance the Provincial's ability to manage disasters using a comprehensive approach. It outlines the processes and mechanisms to facilitate a coordinated response by the national and/or the provincial/local level departments/agencies.	At inception any guidance directly relevant to the target districts will be taken into account. The project will be implemented in a manner that is in line with the Plan and conflict with any regulations laid out in the Plan will be avoided, including within the ESAP.

[177] https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0CAIQw7AJahcKEwjo29eOuuP_AhUAAAAAHQAAAAAQAw&url=https%3A%2F%2Fapp.adpc.net%2F%3Fjet_download%3D16940&psig=AOvVaw1MlJYWEXVsW9neg-gGdcKV&ust=1687955427062175&opi=89978449

Khyber Pakhtunkhwa Flood Response Plan (2022)[178]	The Khyber Pakhtunkhwa Flood Response Plan (FRP) was developed in 2022 for not pre-emptive and response measures to flooding in KP province. The primary principles of the KP FRP are to: i) reach every affected household with immediate relief support; ii) restoring essential public services and prevent disease breakouts; iii) prioritise restoration over other public expenditures; iv) adopt a data-driven approach to resource allocation to prioritise and identify key adaptation opportunities; and v) develop adaptation and mitigation strategies for a resilient KP.	At inception any guidance directly relevant to the target districts will be taken into account. The project will be implemented in a manner that is in line with the Plan and conflict with any regulations laid out in the Plan will be avoided, including within the ESAP.
The Khyber Pakhtunkhwa Water Act, 2020[179]	The Khyber Pakhtunkhwa Water Act was enacted to enhance the management and regulation of water resources in the Province. In addition, the Act regulates the use of water in the interest of conservation and sustainability.	At inception any guidance directly relevant to the target districts will be taken into account. The project will be implemented in a manner that is in line with the Act and conflict with any regulations laid out in the Act will be avoided, including within the ESAP.
Monsoon Contingency Plan 2022[180]	KP Monsoon Contingency plan 2022 focuses on planning for 2022 hazards to identify and analyse related risks for not just their humanitarian impacts but also the associated adverse effects on private and public infrastructure, and to define roles and responsibilities of diverse stakeholders for preparedness and response. In this context PDMA have shared contingency planning guidelines with District Administration, Line Departments, and other stakeholders for anticipating likely scenarios and perceiving threat levels. After technical review by relevant departments, this plan includes identifying gaps and challenges to effective emergency response and then planning and implementing a series of actions to increase response capacity and reduce potential risks and gaps. DRR/M risks associated with potential hazards is an integral part of development of contingency planning. This plan defines what preparedness mechanism will be used, when and where, and it also offers agencies, both Government and Humanitarian the opportunity to define when, where and why their emergency response resources will be deployed, when emergency funds will be used and what kind of responses, materials and type of human resource will be required.	KP Monsoon Contingency plan 2022 focuses on planning for hazards to identify and analyse related risks for not just their humanitarian impacts but also the associated adverse effects on private and public infrastructure, and to define roles and responsibilities of diverse stakeholders for preparedness and response. In this context PDMA have shared contingency planning guidelines with District Administration, Line Departments, and other stakeholders for anticipating likely scenarios and perceiving threat levels. After technical review by relevant departments, this plan includes identifying gaps and challenges to effective emergency response and then planning and implementing a series of actions to increase response capacity and reduce potential risks and gaps. DRR/M risks associated with potential hazards is an integral part of development of contingency planning. This plan defines what preparedness mechanism will be used, when and where, and it also offers agencies, both Government and Humanitarian the opportunity to define when, where and why their emergency response resources will be deployed, when emergency funds will be used and what kind of responses, materials and type of human resource will be required.

[178] GoKP. 2022. KP Flood Response Plan 2022. Available at: https://pndkp.gov.pk/download/kp-flood-response-plan-2022/
[179] PAKP. 2020. Available: https://www.pakp.gov.pk/acts/the-khyber-pakhtunkhwa-water-act2020/
[180] GoP. 2022. **Monsoon Contingency Plan 2022.** Available at: https://reliefweb.int/report/pakistan/provincial-disaster-management-authority-government-khyber-pakhtunkhwa-monsoon-contingency-plan-2022

3.4 Pakistan's Disaster Risk Management frameworks and strategies[181]

Pakistan has a three-tier disaster response system, consisting of the Federal, Provincial, and District levels. At the Federal level, the National Disaster Management Commission (NDMC) oversees overall policies. The National Disaster Management Authority (NDMA), the lead agency for disaster management at the federal level, provides technical guidance to national authorities, particularly provincial-level ones, on plans, strategies, and programs for disaster management. In 2007, the NDMA was established to serve as the federal government's lead agency for the implementation, coordination, and monitoring of all disaster management activities, including preparedness, prevention, mitigation, response, recovery, rehabilitation, and reconstruction. The government placed the NDMA under the Ministry of Climate Change (MoCC) in 2011, but it was later moved directly under the Prime Minister's Office (PMO) in 2018. According to the National Disaster Management (NDM) Act (2010), the NDMA is headed by a Chair with three Members, each of whom directs one agency wing (operations, disaster risk reduction, and administration/finance). The NDMC is the broader whole-of-government body, chaired by the Prime Minister, of which the NDMA is the Secretariat.

The disaster response system in Pakistan is organized into three levels: Federal, Provincial, and District. The National Disaster Management Commission (NDMC) is responsible for overall policies at the Federal level, headed by the Prime Minister. The National Disaster Management Authority (NDMA) is the lead agency for disaster management at the federal level, providing technical guidance to national, particularly provincial-level authorities. In 2007, NDMA was established as the federal government's lead agency for implementation, coordination, and monitoring of all disaster management activities, including preparedness, prevention, mitigation, response, recovery, rehabilitation, and reconstruction. The Provincial Disaster Management Authority (PDMA) is the lead agency for disaster management at the Provincial level, headed by the Provincial Chief Minister. PDMAs are responsible for coordinating with ministries, departments, and districts for disaster risk management within the province. The PDMA has oversight on implementation, coordination, and assessments of ongoing risk reduction efforts or on-the-ground emergency responses. PDMAs examine provincial vulnerabilities to different disasters and specify prevention or mitigation measures. The PDMA also has the power to examine construction to ensure it meets standards and to ensure that communication systems are in order and disaster management drills are carried out regularly.

At the district level, the District Disaster Management Authorities (DDMA) ensure that areas vulnerable to disasters are identified, and measures for prevention and mitigation are undertaken. DDMA organizes specialized training for government officers and employees, voluntary rescue workers, and community training and awareness programs. The DDMA has the greatest oversight of early warning mechanisms and maintains communication systems via periodic drills. It has the power to identify buildings and places for use in the event of a disaster situation, and it establishes stockpiles of relief and rescue materials. The DDMA encourages the involvement of NGOs and voluntary social-welfare institutions working at the grassroots level in the district for disaster management.

Table 12 below lists and describes the key national-level policies, plans and law overarching the planning and implementation of Pakistan's disaster response system.

Table 12. National guidelines, policies, plans and laws related to DRM and EWS[182]

Policy, plan or law	Description
National Disaster Management Plan (NDMP) (2013-2022)	The National Disaster Management Plan (NDMP) (2013-2022) is the overarching policy addressing Pakistan's planning and policy directions. It comprises the National Disaster Management Plan, Human Resource Development Plan on Disaster Management,

[181] Unless otherwise stated, information source: National Disaster Management Authority (2019) National Disaster Response Plan. Available here.
[182] National Disaster Management Authority (2019) National Disaster Response Plan. Available here.

Policy, plan or law	Description
	National Multi-Hazard Early Warning System Plan, and Instructors' Guidelines on Community Based Disaster Risk Reduction (CBDRM). NDMP was formulated and approved by the National Disaster Management Commission and covers the complete spectrum of disasters as well as the pre-, mid-, and post-disaster phases of a response.
National Disaster Response Plan (2019)	Updated and expanded from its 2010 iteration, the 2019 National Disaster Response Plan (NDRP) is the guiding document that establishes process and structure for the country's delivery of assistance to address the consequences of any major disaster. It outlines the commitments and role of NDMA, other government departments, and humanitarian stakeholders during all phases of response. The Plan is the federal government's "multi-hazard response plan" intended to allow the country to manage disasters in a comprehensive way. It focuses on the existing system, the procedure of declaring disasters, early warning systems, and the information flow among all stakeholders. NDRP delegates to local government institutions the task of developing and improving local response plans based on the underlying risks in their areas.
Human Resource Development Plan (HRDP) on Disaster Management	The Human Resource Development Plan (HRDP or Volume I of the NDMP) is an effort to guide the systematization of education and training for DRM practitioners within Pakistan. According to the HRDP, the National Institute of Disaster Management (NIDM) should become the focal point for disaster management training, research, and capacity building. A library and Disaster Information Resource Centre (DIRC) will be built, and DRM training will be available to all federal, provincial, and district government employees. The plan foresees regular training for SAR, fire brigades, and ministry staff. Finally, the plan is to build community capacity via workshops for community leaders and training for community members and schools.
National Multi-Hazard Early Warning System Plan (NMH-EWS-P) (2012-2022)	The National Multi-Hazard Early Warning System Plan ((NMH-EWS-P) or Volume II of the NDMP) runs 2012-2022. It establishes the early warning communication route for government agencies responsible for monitoring disaster data and how they broadcast that data to susceptible districts, the media, and other government agencies. Once the information from central authorities reaches the District Disaster Management Agency (DDMA) of the affected district, the DDMA is then responsible for verbal, telephonic, and electronic media dissemination to their public. The Plan considers the potential use of mosque loudspeakers, mobile phone SMS/MMS, sirens, and the public address systems held by civil defence, police, or fire brigades. In addition to disseminating information, the current Plan also addresses replacement, repair, and expansion of the radar and sensor networks that feed the Pakistan Meteorological Department (PMD), the lead agency for climate, seismic, and geophysical monitoring.
Instructors' Guidelines on Community Based Disaster Risk Reduction (CBDRM)	The Instructors' Guidelines on Community Based Disaster Risk Reduction (CBDRM) (or Volume III of the NDMP) outlines how Pakistan's leaders will push down to the community level awareness and expertise in managing disasters. It outlines risk assessment, building a CBDRM plan, and establishing a committee to conduct local drills and awareness raising activities.
Host Nation Support Guidelines (2018)	The Host Nation Support Guidelines focus on actions to reduce response time via clearly defined duties and roles for government, assisting countries, and international humanitarian organizations. Included are mandates, responsibilities, processes, clearance requirements, and coordination procedures to provide common operational understandings for all stakeholders.
National Flood Protection Plan IV (NFPP) (2016-2025)	NFPP-IV builds on NFPP-I (1978), NFPPII (1988), and NFPP-III (1998), which built a combination of flood protection structures and institutions, developed flood early warning, and led to floodplain mapping and zoning. NFPP-IV includes non-structural measures with provision for restoration and maintenance of existing flood protection works. The Federal Flood Commission oversees development of each NFPP and supervises the Flood Forecasting and Warning System.
National Policy Guidelines on Vulnerable	The National Policy Guidelines on Vulnerable Groups in Disasters cover major areas to which authorities overseeing disaster management must attend, including data

Policy, plan or law	Description
Groups in Disasters (2014)	collection and policy planning to ensure awareness of communities. Officials involved in rescue, relief, and rehabilitation must be sensitized to the presence of vulnerable communities when implementing a disaster response including officials at the planning level and the ground level staff. The main purposes include meeting the needs of vulnerable groups, ensuring interventions are designed with vulnerable groups in mind, safeguarding equitable access, and encouraging vulnerable groups' active participation in decision-making.
National Disaster Risk Reduction Policy (2013)	The National Disaster Risk Reduction (DRR) Policy introduced a proactive approach to disaster management by emphasizing risk assessments, prevention, mitigation, and preparedness. It calls for Operational Plans to be readied ahead of disasters and that can be implemented by national and provincial governments. The policy promotes measures to ameliorate existing vulnerabilities to hazards and ensure that future development initiatives add resilience. The policy also seeks to provide guidelines for timely, dedicated, and adequate investment on hazard mitigation and preparedness interventions at all levels which will not only substantially reduce the disaster risk but also the consequential damages and economic cost associated with response, recovery, and rehabilitation.
National Disaster Management Act (2010)	The National Disaster Management (NDM) Act applies nationally. It created the National Disaster Management Commission that is responsible for policies, plans, and guidelines for disaster management. Moreover, it created the National Disaster Management Authority and laid out its responsibility for implementation and monitoring of disaster planning and responses. It calls for the National Plan to lay out measures for prevention and mitigation of disaster, preparedness and capacity-building activities, and financing sources for disaster management.
NDMA Guidelines on Stocking, Maintenance and Supply of Relief and Rescue Items	These guidelines are intended to streamline the stocking system and provide a uniform matrix for items used by all relevant authorities in a rescue or relief situation. It divides stocks into Food and Non-Food Items, the latter subcategorized into rescue, relief, or support items. It lays out lines of responsibility for maintenance of the stocks as well as the method for requesting additional or different items.
NDMA Policy Guidelines for Conduct of Multi-Hazard Vulnerability and Risk Assessment	NDMA's national guidelines for Multi-Hazard Vulnerability and Risk Assessment (MHVRA) cover execution, methodology, governing policies, standard operating procedures (SOP), and monitoring, evaluation, and standardization of data. The purpose is to set standards for datasets and tools for assessment to ensure the accuracy of the national picture for DRR planning. In the end, NDMA expects these guidelines to lead to the development of an MHVRA repository and offer a forum for data sharing, data acquisition, synchronization, provision of access to government data, and avoidance of overlap in data.
Guidelines for Multi-Sector Initial Rapid Needs Assessment	Multi-Sector Initial Rapid Needs Assessment (MIRA) guidelines were developed by NDMA with support from UN OCHA. The approach is inclusive, comprehensive, decentralized, and focused on institutionalization. MIRA is the first step of the Assessment and Monitoring Framework and was designed to identify strategic humanitarian priorities after the onset of natural disasters or complex emergencies. After the floods of 2012 and 2014, lessons learned highlighted two major gaps in implementation including a lack of trained enumerators and a lack of validation mechanism. Revisions were incorporated into the latest MIRA up-date.

3.5 Disaster Management and Early Warning Systems[183]

Pakistan Meteorological Department (PMD) falls under the Aviation Division of the Cabinet Secretariat. It is the primary collector, researcher, and disseminator of meteorological information to the country's government and public. In addition to meteorology, it manages hydrological and seismic information. All of this information is intended to increase the safety of transport, mitigate disaster, and impact development

[183] Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM) (2021) Pakistan Disaster Management Reference Handbook.

within the context of climate change adaptation. Within its remit specifically, PMD is responsible for early warning of natural hazards (cyclones, heavy rains or storms, heat waves, floods, and earthquakes) and for monitoring the country's glaciers to issue a warning in case of Glacial Lake Outburst Flood (GLOF). Under PMD are four Chief Meteorologists, three of whom head the following departments: National Drought Monitoring and Early Warning Centre (NDMC), National Seismic Monitoring and Tsunami Warning Centre (NSMC and NTWC), and Flood Forecasting Division (FFD). Each of the departments publishes bulletins, alerts, and other information on its home page.

The NDMC in Islamabad is the hub for drought-related analysis for the country. It issues a monthly drought bulletin and moisture analysis based on indices collected from domestic and international resources. It advises the government on drought-related matters, including the declaration of an emergency. The NSMC and NTWC are based in Islamabad. NSMC runs twenty remote seismic monitoring stations with broadband (120s) sensors throughout the country. Each station uses global positioning system (GPS), and all stations are linked with central recording stations at Karachi and Islamabad via satellite. A parallel program is in place for the installation of short period (1s) sensors for close monitoring of faults and local seismicity, and data is communicated to a central recording station via internet and radio. NSMC/NTWC has links with global monitors, and PMD has developed links with warning centers in Japan and Hawaii. Pakistan is also a member of the Indian Ocean Tsunami Information Centre (IOTIC) and Indian Ocean Tsunami Warning and Mitigation System (IOTWS) that brings together the national seismic and tsunami centers of member states. It primarily uses seismic and tsunami information from Australia, India, and Indonesia for dissemination to member agencies.

Flood Forecasting Division (FFD) and Flood Early Warning System of Pakistan (FEWS-Pakistan)

The Flood Forecasting Division (FFD) brings together data on the country's rivers, rainfall, and water management. Under it, the Flood Early Warning System of Pakistan (FEWS-Pakistan) began operation in 2007. It is based on a mathematical model composed of a hydrological model (SACRAMENTO) and a hydraulic model (SOBEK). Together, they use rainfall-runoff data both from rim stations from the catchments of the Jhelum, Chenab, Ravi, and Sutlej Rivers in India and from hill torrents in Pakistan on main rivers in addition to river geometry. FEWS is now augmented by the Integrated Flood Analysis System (IFAS), which is hydrological modelling software used to calculate river discharge with the help of satellite rainfall data. The current hydro-meteorological network for flood forecasting and communication systems comprises the following:

a) High Frequency (HF) radio-based network,
b) VHF real-time telemetry system,
c) Meteor-burst telemetry system, and
d) Weather Radars at Sialkot, Lahore, and Mangla.

The HF and VHF systems are operated by the Water and Power Development Authority (WAPDA), partly in cooperation with Provincial Irrigation Departments; the HF network transmits data every six hours while the 24 VHF telemetry stations (7 in the Indus Basin, 8 in the Jhelum Basin, 5 in the Chenab Basin, 3 in the Ravi Basin, and 1 in the Sutlej Basin) have mostly been side-lined by the Meteor-burst Based Communication System (MBCS). MBCS consists of 24 Remote Terminal Units (RTU), which transmit hourly rainfall and river levels data.

Institutional capacity needs of FFD

Several institutional capacity gaps exist within the Flood Forecasting Division (FFD) and the Pakistan Meteorological Department (PMD) Khyber Pakhtunkhwa office in relation to the Flood Early Warning System. These are listed below.

The Flood Forecasting Division, as well as the PMD Khyber Pakhtunkhwa office, have limited capacity in providing short-range and seasonal flood-forecasts in support of delivering flood early-warnings days, weeks and months before a flood occurs. While daily 7-day rainfall forecasts are available at the district level, seasonal and sub-seasonal weather forecasts are not, and there is little evidence that these forecasts are communicated effectively to highly vulnerable communities and especially in remote areas. Lack of a centralised communication and coordination mechanism - among different institutions and different layers, national, provincial and district - poses challenges in terms of timely communication and leads to delays in communication and coordination.

At the district level, capacities are very low to interpret and communicate information effectively to highly vulnerable communities so that they can take actions in preparation for a forecasted extreme weather event. During consultations, it has appeared that early warnings may not be accurate or are not communicated effectively, which has resulted in lack of trust among community members. Early warning information is currently communicated through mosque announcements, government officials in the district and social media. However, given the low literacy rates, especially among women and girls, the efficacy of print, digital and social media is likely to be very limited.

Capacities to use the limited available information for planning purposes are also limited. For example, the Shangla District Disaster Risk Management Plan highlights that the existing early-warning system for floods is inadequate and needs to be adapted to the needs of communities, non-government organizations and local government.184 Moreover, Shangla Districts' DRM plan was last updated in 2007, while Buner doesn't have such a plan at all. Both districts have a document called a 'Monsoon Contingency Plan', however, these plans provide an overview of extreme weather events and provide a basic inventory of hardware resources and contact persons. During consultations that took place in the preparation of this Funding Proposal, Khyber Pakhtunkhwa PDMA highlighted that there is a lack of financial and human resource capacity to develop, enhance and update Disaster Risk Management plans at the provincial and district level.

Disaster information sharing

Beyond national assets, Pakistan has access to some of India's hydrological data. Under the Indus Water Treaty (1960), India and Pakistan each send a commissioner to the Permanent Indus Commission, which acts as a bilateral forum for discussing water use and management throughout the greater Indus Basin. An addendum in 1989 saw the parties agree to share river flow data in order to improve flood forecasting in Pakistan. Daily flow data from India is passed via Pakistan's Commissioner for Indus Waters (PCIW) to FFD for issuance of flood information to all other stakeholders. In periods of flood or potential flood, the transmission of the data can be increased to as frequently as necessary, up to once every hour. Within the Office of the PCIW, a flood cell is established each year during the monsoon and runs 24/7 from 1 July through 10 October.

[184] UNDP (2007) Shangla District Disaster Management Plan, p.3

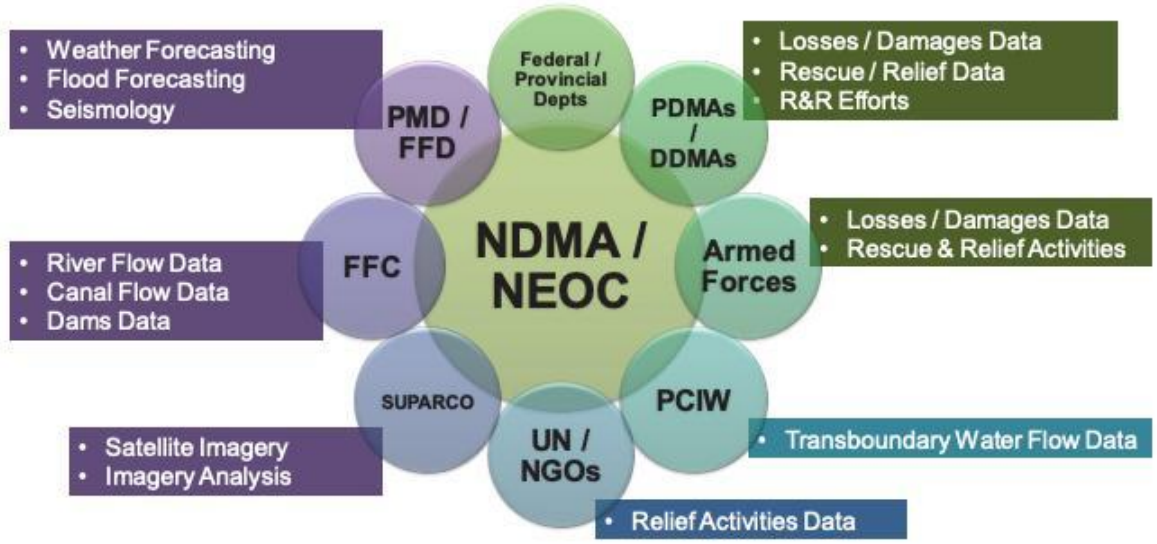


Figure 25. Disaster Information Sharing Ecosystem

3.4.1 Challenges for the early warning system

Despite these institutional improvements, competing interests remain a problem at every level, especially when it comes to the political economy of disaster relief. Mission overlap between policy-making institutions also results in coordination issues and communication gaps. ERRA continues to exist despite NDMA being the federally backed body designated to lead. Recently, a Ministry of Climate Change was formed, but the issue of climate change has many overlaps with disasters and, hence, the relations between these bodies remain contentious. In short, given the frequency and intensity of recent events and the government's institutionalized response, disaster management can certainly be considered a national and local priority. However, when it comes to disaster risk reduction, there remains a strong need for a coherent plan that would delineate the division of functions between the national and local level[185].

Thus, the government's ability to identify, assess and monitor risks associated with floods has certainly improved considerably over the last decade. However, the understanding and ability to act on other disasters like heat waves that can potentially affect a much larger segment of the population is still primitive. Moreover, it is often lack of coordination and friction in information flow among different organizations that causes delays in government response. The government regularly uses mainstream media to raise awareness about disasters like floods and heatwaves and steps that citizens can take to mitigate risks. However, most of those awareness campaigns are reactive in their timing and limited in content. There is also very limited content about disaster preparedness and risk reduction in educational material taught in public and private schools.

The National Disaster Management Act of 2010 mandates that NDMA elaborate guidelines and give direction to all concerned Ministries, Department, and Authorities at all levels of government regarding measures to be taken in response to any disaster situation. Despite this legal authority, many smaller-scale disasters remain within the remit of their respective district or provincial authorities as they do not rise to the level of requiring federal or international attention. International assistance can be requested by national authorities in case the scale of the disaster overwhelms national capacities. On one hand, provinces' ability to set aside funds for potential emergency responses is uneven meaning that PDMAs often immediately require financial assistance from the federal level. On the other hand, as political creations, the Provincial administrations' willingness to devote resources to prevention and mitigation may be related to their relationships with the federal and district levels. It has been noted that when a party that is in the federal opposition controls a provincial administration, they may be more likely to prioritize the good publicity they can gain from disaster response than the less publicity attractive work of risk reduction.

Provincial disaster management bodies are allocated large sums of funds every year by their respective governments, an indication of the government's commitment. In addition, the National Disaster Management Plan has been formulated and it broadly outlines how the government, donors, and NGOs should work together for disaster management and risk reduction. However, in order to reduce the underlying risk factors, existing funds need to be diverted towards risk reduction and more funds need to be raised.

The capacity for disaster preparedness and response at the national and, after the 18th Amendment to the constitution, at the provincial level, has been consistently improving. In principle, there is also agreement that in addition to the national and provincial level, capacity for disaster preparedness and response needs to be built at the local level. Elected or appointed representatives of the government at the local level are best placed to identify, assess and manage risks as well as respond to disasters. However, despite the explicit devolution of disaster management to the local level, de facto control is still centralized at the provincial level. In order to have effective disaster preparedness for response at all levels, capacity for disaster management has to be built at the local level so that the function and its accountability can be effectively devolved.

[185] A. Fayaz & J. Bussell (2017) Disaster Preparedness in Pakistan, research brief no. 8.

As far as flash floods in the mountainous regions of the province, there is no early warning system to provide them with basic facilities and services in a timely manner. Currently, the available early warning and forecasting of floods is based on telemetry, which is installed by WAPDA and the Irrigation Department. The existing setup of the Irrigation Department can provide a response time of 24-48 hours in river Swat, 5-7 hours in Kabul River, and 36-48 hours in Indus River at DI Khan, which is insufficient time to enable the evacuation of vulnerable communities in the area. Further, the province has witnessed little or no improvement in water storage capacity due to unavailable funding, which would have the potential to reduce the province's vulnerability to floods.

4. PAST AND ONGOING PROJECTS

The Government of Pakistan has demonstrated its commitment to addressing the impacts of climate change in the country. A summary of relevant past, ongoing and planned initiatives related to climate change adaptation with which the proposed GCF project is aligned is provided below.

Project title	Key performance assessment	Synergies with proposed GCF investment	Upscaling potential
Recharge Pakistan: Building Pakistan's resilience to climate change through Ecosystem-based Adaptation (EbA) and Green Infrastructure for integrated flood risk management[186] (2023-2030) Implemented by WWF Pakistan with GCF funds	The primary objective of the Recharge Pakistan initiative is to transform the country's approach to flood and water resource management in local watershed sites in the Indus Basin river system. This will be accomplished by implementing ecosystems-based adaptation (EbA) and green infrastructure interventions, as well as enhancing community-based natural resource management. These activities will address long-term drought and flood resilience, while establishing a paradigm shift for future EbA initiatives in Pakistan. There is no geographical overlap of the two projects in KP province, and the WWF project addresses fluvial (river) floods, while the WFP project is focused on pluvial (flash-floods). There are nonetheless several entry points for replication, upscaling, and sharing of good practice and evidence generation between the two projects.	- Small-scale green infrastructure for flood risk reduction - Community-based natural resource management - Climate-resilient agricultural livelihoods - - It complements this by specifically targeting flash flood risks in the target districts through improved early warning systems and community-based anticipatory actions. This focus on	- Alignment with and potential replication of community-level activities related to climate-resilient agricultural livelihoods and flood protection infrastructure. - The WWF-Pakistan and WFP project development teams met during March 2023 to discuss complementarity between their respective projects and ensure that spatial and thematic duplication is avoided. Both organizations presented an overview of their projects and discussed potential entry points for collaboration and shared learning during the implementation phase. - Since implementation has commenced for the WWF project, the WFP

[186] Refer to Section 6 of Annex 2a Pre-feasibility Study for full details of the proposed synergy and alignment with the WWF Recharge Pakistan project.

		localized, rapid-onset flooding fills a niche not covered by WWF's broader approach, ensuring a more comprehensive strategy for managing all types of flood risks across different geographies within Pakistan	project will benefit from early-stage learnings and be able to apply this knowledge to similar activities in the inception phase. - A joint WWF-WFP workshop is planned for project year 3 to create a platform for sharing of good practice and further alignment. - There is no spatial overlap or duplication between the two projects. There is however a common administrative boundary at the provincial level, since the DI Khan project area of the WWF project is within Khyber Pakhtunkhwa (KP) Province (in the south), as is the WFP project (in the northeast). This scenario presents a synergistic opportunity to collaborate and share lessons learned within common governance structures and engagements with government at the provincial level in KP. - ***Level of upscaling potential:[187] Very high***
Transforming the Indus Basin with Climate Resilient Agriculture and Water	This project develops the country's capacity to use the information it needs to adapt to the impacts of climate change on agriculture and water management by putting in place state-of-the art technology.	- Climate resilient agricultural (CRA) practices - M&E framework and	- Replication and scaling up of best practices on CRA within the selected communities in Buner and Shangla, in particular practices with

[187] Level of upscaling potential is determined based on two criteria: (1) Appropriateness of the technology/practice for the context of the project; (2) Ease of tailoring and replication of the technology /practice in the project target area

Management (2019 – 2026) Implemented by FAO with funds from GCF	The project has passed its midpoint and delivered technical results in particular on strengthened M&E framework and implementation of climate resilient agriculture (CRA) in Sindh and Punjab provinces. The proposal addresses flood risks indirectly by improving the capacity of the agriculture sector to withstand and recover from flood events, thereby ensuring food and water security in vulnerable communities	implementation of CRA practices It builds on this by integrating specific flood management strategies with a focus on food security and livelihood diversification, ensuring that communities have the tools to not only survive but thrive in the aftermath of floods. This synergy ensures that while FAO improves the agricultural sector's resilience to floods, WFP enhances the capacity of individual communities to anticipate, respond to, and recover from flood events	gender-inclusive lens. Preparation of a catalogue of best practices CRA to be integrated in decision making processes at local level. ***Level of upscaling potential:[188] Very high***
Scaling-up of Glacial Lake Outburst Flood (GLOF) risk reduction in Northern Pakistan (2015 – 2022) Implemented by UNDP with funds from GCF	The project focuses on GLOF risk reduction and will build 250 engineering structures including damns, ponds, spill ways, tree plantation and drainage to reduce risk. At the same time, the development of disaster management policies and the introduction of weather monitoring stations, flood gauges, hydrological modelling and early warning systems will increase the ability to respond rapidly to flood scenarios.	- Capacity building of government agencies and general public on disaster risk reduction practices. - Small-scale infrastructure for flood reduction - - It complements	- Replication and upscaling of best practices and technologies for small-scale flood reduction infrastructure suitable for river flooding in Buner and Shangla. ***Level of upscaling potential: high***

[188] Level of upscaling potential is determined based on two criteria: (1) Appropriateness of the technology/practice for the context of the project; (2) Ease of tailoring and replication of the technology /practice in the project target area

	This approach is crucial for regions prone to GLOFs, where the melting of glaciers due to climate change increases the risk of sudden and catastrophic floods. By enhancing early detection and community preparedness, the proposal seeks to reduce the vulnerability of high-risk areas to these climate-induced disasters	by addressing flash floods' immediate and localized impacts, which require different preparedness and response strategies than GLOFs. This ensures that the broader landscape of flood risk management in Pakistan includes both the catastrophic potential of GLOFs and the sudden devastation of flash floods	
Pakistan Hydromet and Climate Services Project (PHCSP) (2018 – 2024) Implemented by The World Bank	The project will strengthen Pakistan's public sector delivery of reliable and timely hydro-meteorological and disaster risk management services. The project focuses on (i) Institutional Strengthening and Capacity Building; (ii) Modernization of the Observation Infrastructure, Data Management, and Forecasting Systems; (iii) Enhancing Pakistan Meteorological Department (PMD) Service Delivery and Building Partnerships with the Private Sector; and (iv) Project Management, Systems Integration, and Monitoring and Implementation Support of PMD. By improving the delivery of climate and hydro-meteorological services, the PHCSP addresses the need for robust early warning systems and climate information services, thereby complementing the efforts of other proposals in building an	- Delivery models of early warnings to remote areas - Installation of Hydrometeorological stations - - While the PHCSP focuses on improving the institutional and technical capacity for climate service delivery, the WFP's proposal augments this by directly targeting community-level resilience and response mechanisms, especially in	Replication of the delivery models for early warnings in the selected communities in Buner and Shangla. *Level of upscaling potential: Medium*

	integrated approach to climate resilience and flood management.	relation to food security and livelihoods in the face of flash floods. The WFP's emphasis on actionable early warning systems and local adaptation plans ensures that the infrastructure and services enhanced by the PHCSP are effectively utilized at the community level, closing the loop on a comprehensive climate resilience strategy for Pakistan	

5. PROJECT DESIGN AND RATIONALE

Summary of climate change problem

Pakistan has experienced an overall increase in temperature of 0.57°C in the 20th century, with an acceleration since the 1960s. Average daily maximum temperatures have also increased by 0.87°C in the same period, with an average of 0.6-1.0°C temperature rise across the country, more pronounced in winter and post-monsoon months. Pakistan has witnessed significant variation in precipitation, with a prolonged decline in annual rainfall during the first half of the 20th century and a slight increasing trend since the 1960s. However, the spatial variability of precipitation is increasing, with less rainfall in arid and coastal areas and more in areas of higher elevation. In the future, Pakistan is expected to experience higher than global average temperature increases, with a projected rise of 3-6°C by 2100. Precipitation is also expected to increase in both annual and summer monsoon, with variations across different subregions of the country.

Local communities across Pakistan are highly vulnerable to climate hazards, particularly floods. Changing precipitation spatiotemporal patterns and increasingly variable rainfall across Pakistan are causing an increase in the occurrence of riverine and flash floods. Temperature rise has also increased the rate of glacier melt, causing an increase in the incidence of glacier lake outburst floods (GLOF) and flash floods downstream. Vulnerable communities in Pakistan are severely impacted by these climate hazards, which have resulted in loss of life, impacted livelihoods, infrastructure, settlements and overall economic output. Under future climate conditions, an increase in the number of people affected by flooding is projected across Pakistan, with a likely increase of around 5 million people exposed to extreme river floods by 2035–2044.

Summary of adaptation needs

Climate change is adversely impacting disaster management efforts in Pakistan, and presents a direct threat to enabling the socio-economic growth of the most vulnerable people in the country[189]. Under future climate conditions, these impacts are projected to worsen, and the country's natural and human capital are expected to be severely affected[190]. Climate change already threatens the progress Pakistan has made towards poverty reduction and in the absence of adequate interventions, the increasing risks from climate hazards (particularly floods) will likely compromise the country's development ambitions[191].

The country requires significant support for climate change adaptation, particularly to overcome its technical, financial, and policy barriers (see the section below on barriers to adaptation). This includes a need for greater technical capacity for forecasting and multi-hazard vulnerability risk assessments, particularly at a local level. In Khyber Pakhtunkhwa Province there is a need to enhance protective measures against floods, as there is currently inadequate early warning systems in place to enable communities to adequately respond to floods, particularly in Buner and Shangla Districts. Water storage facilities are also insufficient, having reduced due to silting, while deforestation has worsened soil erosion near major rivers. Financially, local governments require more resources to fund the development, operation, and maintenance of water storage and early warning systems, and donor-led initiatives must address concerns of discontinuity. Lastly, there is a lack of comprehensive policies and plans for addressing climate change adaptation needs, with a rise in low-quality infrastructure that is not built to sustain climate change risks.

Barriers to adaptation

Information barriers

Insufficient technical capacity in advanced forecasting and MHVRAs at district level: District Disaster Management Units (DDMUs) are the first responders to any disaster event in the area. However, their capacity to conduct Multi-Hazard Vulnerability Risk Assessments (MHVRAs), which are a commonly used tool for the climate-aware construction of buildings and infrastructure, is limited. Further, there is insufficient capacity in the collection and management of vulnerability data to inform future planning. With regards to urban settings, adequate town planning, hazard mapping, de-watering pumps and the implementation of a sewerage water disposal system are all deficient or lacking at the local level, which poses a serious flood risk caused by intense rain episodes coupled with encroachment issues. Lastly, there is a limited expertise in the development and operation of advanced numerical forecasting models at local level, and in the interpretation of high-resolution imagery and forecast model outputs.

Absent or outdated local-level DRM plans: Flood preparedness is initiated at the provincial and district levels to identify vulnerable areas and devise a response plan in line with identified vulnerabilities. However, the institutions responsible for disaster management response lack sufficient technical capacity and equipment. Moreover, Shangla Districts' DRM plan was last updated in 2007, while Buner doesn't have such a plan at all. Both districts have a document called a 'Monsoon Contingency Plan', however, in reality these plans provide an overview of extreme weather events and provide a basic inventory of hardware resources and contact persons.

Inadequate dissemination of warnings: Early warning information is currently communicated through mosque announcements, government officials in the district and social media. However, given the low literacy rates, especially among women and girls, the efficacy of print, digital and social media is likely to be very limited.

[189] World Bank. Climate change knowledge portal. 2021.: Country: Pakistan. Available at: https://climateknowledgeportal.worldbank.org/country/pakistan/vulnerability
[190] World Bank. 2022. Country Climate and Development Report.
[191] World Bank. 2022. Country Climate and Development Report.

Technical barriers

Limited flood protection arrangements: The majority of the Khyber Pakhtunkhwa Province lacks protective arrangements to safeguard the vulnerable population against flood disasters.

Insufficient, outdated and sparse meteorological grid cover: There are 16 MET stations in the Province, which require a technology upgrade. Some longer-range radars located in higher elevations would cover the majority of the land area of the Province, while automatic weather stations in hilly areas would be sufficient to enhance the weather forecasting capacity of Pak Met Department[192]. The PMD has no hydrometeorological monitoring-stations in Buner and Shangla Districts, and only 13 automated weather-stations throughout Khyber Pakhtunkhwa Province – an area of over 100,000km, with a population of 35 million - which limits the ability to monitor real time weather-variables and provide emergency flood-warnings to communities downstream.[193]

Insufficient and outdated Early Warning System arrangements: Existing arrangement rely on river gauges through WAPDA's telemetry system and the Irrigation Department of Khyber Pakhtunkhwa. Due to the limited forecasting capacity, existing arrangements do not enable sufficient time to prepare for floods. Although real time telemetric devices and automatic hydrometeorological telemetric devices have been deployed at existing irrigation gauging points by PDMA, these only cover 7 out of more than 100 sites required for the provision of real-time, accurate weather information to adequately respond to flood risk in the Province.

Insufficient water storage and regulation capacity: Water storage facilities have drastically reduced in Khyber Pakhtunkhwa over the years, ranging from 30% to 70% in different storage reservoirs, mainly due to silting. This has reduced the flood mitigation capacity of these structures, where upstream catchment areas are found insufficient to regulate the flow of water into and from dams. Damming authorities have not been able to address the issue of silting of water reservoirs so far.

Financial barriers

Limited financial allocation to local governments and perception of water storage structure as public goods: The development, operation and maintenance of water storage structure remain in the public sector domain. However, it has been proven difficult to access finance due to insufficient resources and low program budgets compared to the high costs of feasibility studies, cost-benefit analysis, and environmental assessment for a sound decision-making process. Additionally, reconstruction of water conveyance structures after each flood also adds to the challenge of keeping the management budget low.

Policy and institutional barriers

Lack of sound comprehensive cross-sectoral policies for resource protection, development and management: due to the limited interinstitutional collaboration and lack of integrated approach to DRM and EWS, there is a lack of comprehensive policies and plans to address climate change adaptation needs encompassing food security, agriculture, and water storage and management.

Limited cooperation and data exchange among relevant government agencies: such as meteorology department, disaster management, agriculture, irrigation and water management authorities at federal and provincial level. As Early Warning is considered a multidisciplinary sector, information and responsibilities are currently split among different departments such as PDMA, Rescue 1122, Civil Defence, District

[192] PDMA (2021) Monsoon Contingency Plan. Available here.

[193] Note that there is no optimal number of hydrometeorological monitoring stations *per se,* but considering the highly varied geography of Khyber Pakhtunkhwa Province, which varies from high mountains with valleys, glaciers to fertile river areas and extreme dry areas, clearly 13 is insufficient. Temperature can show substantial variation across a distance of 30km, for example. As a minimum, automated weather stations should monitor temperature (max and min), precipitation, wind speed and direction, humidity, sunlight hours. Other local parameters may be necessary, depending on the location.

administration, Irrigation, WAPDA, Communication &Works, Tehsil administration, Metrological Department/Office etc. The emergency response mechanism is activated on need basis and there is no regular resource or core group of experts allocated to this. Lack of a centralised communication and coordination mechanism - among different institutions and different layers, national, provincial and district - poses challenges in terms of timely communication and leads to delays in communication and coordination.

Social barriers

Insufficient awareness of severity of flood risk by the general population: The PDMA's Monsoon Contingency Plan has repeatedly identified the perception of flood early warnings by the general population, which can be dismissed or resisted by the public until it is too late to evacuate. Identified measures to address this risk are the issuance of warnings through SMS and adequate awareness raising campaigns.

Variation in land tenure structures at the community level: There is a limited understanding of land tenure structures specificities by technology developers and practitioners, which results in challenges to secure land for the construction of water storage structures and reservoirs, and to distribute the benefits of these structure equally among users.

Table 13. Identified barriers to adaptation and proposed interventions

Barriers to adaptation	How the GCF project will address the barriers
Information barriers	
Insufficient technical capacity in advanced forecasting and MHVRAs at district level	Under Output 1.1, the project will provide capacity building support to the PDMA, PMD, FFD and the Ministry of Climate Change to enhance their flood forecasting capability. To ensure that the proposed capacity building activities are in adequation with the existing baseline, a full gap assessment will be carried out through the analysis of institutional and human resource capacity in those local and national departments, along with a mapping of hydrometeorological station needs.
Absent or outdated local-level DRM plans	Under Output 1.2, the proposed project will support the DDMA to constitute disaster management committees as well as developing procedures and protocols to enhance EWS implementation. This new formal mandate and operational guidelines will contribute to the development of sound DRM plans at the local level for the districts of Shangla and Buner. Further, Output 2.1 will support the development of local adaptation plans encompassing livelihoods, food security, nutrition and agriculture in light of expected climate change impacts.
Inadequate dissemination of warnings	Under Output 1.1, based on the review conducted in the first activity, a communication strategy and dissemination protocol will be developed to enhance the dissemination of early warnings to vulnerable communities. Further, as part of Output 2.1, communities will be presented with information on the expected climate change impacts on their livelihoods prior to initiating the development of local adaptation plans. During the workshops, communities will be asked to share their preferences in terms of warning dissemination tools (SMS, Mosque, local officials, other). This information will be shared with local and national authorities to be taken into account in the revision or development of DRM plans and procedures.
Technical barriers	
Limited flood protection arrangements	Output 2.2 will support the implementation of prioritized adaptation interventions such flood protection infrastructure like dams and / or walls.
Insufficient, outdated and sparse meteorological grid cover	Under Output 1.1 and based on the assessment of hydrometeorological station needs, the proposed project will procure and install a number of

	hydrometeorological stations in Buner and Shangla. The locations and number of stations will be examined during FP development.
Insufficient and outdated Early Warning System arrangements	Output 1.1 will pertain to the identification of hydrometeorological needs and procurement and installation of stations in the target districts. Under Outputs 1.1 and 1.2, the project will carry out a review of the EWS baseline in Shangla and Buner districts to define areas for strengthening and improving the capacity of local government authorities to implement improvements to the EWS and develop a communication strategy and dissemination protocol for the adequate dissemination of early warning messages.
Insufficient water storage and regulation capacity	Indicative adaptation interventions to be supported under Output 2.2 will pertain to the establishment of small-scale water storage structures and flood protection infrastructure such as dams or walls.
Financial barriers	
Limited financial allocation to local governments and perception of water storage structure as public goods	Under Output 2.3 the project will support the identification of provincial and national funding mechanisms that could be tapped for the implementation of adaptation actions including water storage, flood protection and EWS. Further, the project will support capacity building efforts at the provincial and local levels to plan and develop community savings, revolving funds or micro-finance products to enable investment in small-scale adaptation actions and potentially attract private sector finance.
Policy and institutional barriers	
Lack of sound comprehensive cross-sectoral policies for climate change adaptation	Under Component 1, the proposed project will work with district, provincial and national authorities and institutions to improve their capacity to effectively plan, implement and maintain DRM and EWS mechanisms and assets. Further, under Output 3.1, the project will disseminate and transfer knowledge through provincial and national level workshops, as well as developing a set of policy recommendations for consideration by government authorities.
Non-compliance of building codes and land use plans	Under Component 2, the project will ensure that land planning and building codes are acknowledged and respected in the implementation of selected adaptation interventions.
Limited cooperation and data exchange among relevant government agencies	Output 3.1 will pertain to the collection and dissemination of data and case studies by creating linkages back into national level policy and decision-making to facilitate the replication of project results in other flood-prone areas.
Social barriers	
Insufficient awareness of severity of flood risk by the general population	Through the development of community-led local adaptation plans under Output 2.1, vulnerable communities will be sensitized to the risks associated with climate change and floods and the benefits of implementing early actions. Improvements to the dissemination of early warning messages will also contribute to addressing this barrier.

6. THEORY OF CHANGE AND PARADIGM SHIFT

Project objective and goal statement

Goal Statement

IF institutional capacity is strengthened in national and subnational government entities to forecast floods and improve early warning, and they have established anticipatory action protocols, and local adaptation plans are implemented, and systems are developed for knowledge management including lessons learned towards climate resilient initiatives

THEN people in the beneficiary areas will be able to cope with flood risks in the short term and adapt to more frequent and more severe flooding in the long term

BECAUSE they'll be able to develop and adopt short-term responses through anticipatory action and long-term adaptation strategies that strengthens the resilience of local livelihoods and communal infrastructure, and improved knowledge management to guide informed decision making/programming under climate resilient initiatives

Project objective

The project's ***overarching objective*** is to : i) to improve flood early-warning systems (EWSs) by strengthening technical capacity and governance within the climate information services (CIS) sector; and ii) to support vulnerable communities to prepare for and adapt to the impact of flash-floods through improved flood risk information and strengthened local adaptation planning for climate-resilient livelihoods and infrastructure. The project will achieve this objective through the implementation of three interrelated components, namely:

- improved capacity for flood early warning systems and anticipatory action (Component 1);
- increased climate resilience through local adaptation plans and diversified livelihoods (Component 2); and
- improved knowledge management and learning (Component 3).

Project scalability and potential for transformation

The project's value-add is the promotion of flood CIS and EWS that are grounded in impact-based forecasting and anticipatory action to estimate potential impacts at local level. This is coupled with an improved communication strategy to alert local communities well in advance of potential flash-floods to catalyse anticipatory actions. Investments in preparedness will result in reduced amounts requested for potential humanitarian response post-disaster and will drastically reduce costs for recovery and re-construction of climate-impacted livelihoods. The project will focus on several aspects including systems, processes, technologies and capacities of institutions and beneficiary communities.

These investments can be easily scaled up and expanded to other flood-prone areas in other contexts with similar challenges and hazards. In particular, the project will result in improvements in: i) timing of alerts (earlier dissemination of alerts to prolong the time for preparedness actions); ii) quality of alerts and move towards impact-based forecasting; iii) dissemination of alerts to make sure these reach flood-prone communities, which have a very low literacy rate, and that these communities can understand and interpret the information; iv) development of operating procedures for preparedness and anticipatory actions that are linked to pre-identified indicators and thresholds. In addition to the strengthened CIS and EWS aspects described above, the project will address the interface between climate change, agriculture, and food security. This will include disaster risk reduction and support for climate-resilient agricultural (CRA) practices and community-level flood protection, to address current climate risks and build capacity for longer-term adaptation of vulnerable communities in the beneficiary districts. The project will emphasize the role of knowledge management and learning (KML) and adaptive co-learning for replication and upscaling of good practice and lessons learned. The concrete adaptation activities will be gender responsive, by working to identify and address the underlying drivers of food security and vulnerability related to livelihoods, knowledge and practices and gender inequality.

Overview of Outcomes and Components

Components 1 and 2 take a short and long-term approach to meeting the project's overall objective. **Component 1** focuses on national and subnational technical capacity to generate short-range flood forecasts, as well as the procurement and installation of a flood early-warning system (EWS) for the beneficiary districts of Buner and Shangla. This component of the project will improve the availability of observed hydrometeorological (hydromet) and flood early-warning information, sharing this information through enhanced vertical and horizontal coordination to design and implement anticipatory action (AA) that minimizes the impacts of floods in the beneficiary districts.

Component 1 also lays important foundations for **Component 2.** The improved flow and accuracy of climate information services (CIS), a strengthened EWS, and improved AA protocols are important enablers of adaptation in the long-term, because they Increase the lead time and information available to efficiently reduce the impact of a potential disasters.

Component 2 focuses on adaptation in the longer term. It will support beneficiary communities to develop local adaptation plans that guide adaptation action, while building on the anticipatory actions and other capacities built in Component 1. It will then implement priority adaptation actions where these concern livelihoods or small or micro-scale flood protection infrastructure in a way that is compatible with the environmental and social safeguard requirements of a GCF Simplified Approval Process project and the WFP Environmental and Social Safeguards Framework.

Component 3 captures knowledge from activities implemented under Components 1 and 2 to develop a framework that leverages the project's potential for replicability and upscaling. To that end, a knowledge management and learning (KML) approach will be used to build the evidence-base for replication and behaviour change for beneficiary communities and institutions through: i) strengthened capacity and upskilling for knowledge-sharing and evidence-base development; ii) the development of multi-purpose knowledge products that can contribute to future climate change interventions/projects, climate change policy, awareness-raising, and research outcomes; and iii) an end-to-end project communication strategy to promote consistent messaging and high visibility of good practices and lessons learned throughout the project implementation process.

Interlinkages between components

The project is structured in three components. Under ***Component 1***, the project will improve forecasting and early warning capacity and implement prioritized anticipatory actions that are designed to mitigate the impacts of flooding. Under ***Component 2***, the project will support communities to develop adaptation plans and implement priority adaptation actions, as well as have access to sustainable sources of financial and technical support. Activities under Component 1 will deliver benefits in terms of reduced impacts from floods in the shorter term, while activities under Component 2 will support vulnerable people to adapt to projected changes in flooding frequency and severity in the longer term. ***Component 3*** will then bring together knowledge and co-learning from the project to support replication and integration with financing mechanisms at the provincial and national level.

Proposed adaptation measures

A key component of the project, and the LCCAP process in particular will be to implement priority adaptation actions related to strengthening the resilience of climate-sensitive livelihoods, as well as offsetting the risk of flood damage by establishing small or micro-scale flood protection infrastructure within beneficviary communities. As part of the participatory LCCAP process, a menu of potential adaptation interventions will be used as the starting point to select the interventions most suited to the respective local contexts of th beneficiary communities. The menu was developed during the project development phase and is summarised in Table 14 and will be supplemented by appropriate action plan for implementation, as well as an operation and maintenance plan.

Table 14. Menu of potential adaptation practices

Adaptation practices	Adaptation benefits	Level of implementation
Climate resilient agricultural practices (CRA)		

Conservation Agriculture Techniques	- Increases in soil moisture reserves during unseasonal drought periods, associated with increased organic matter content - Reduction of soil disturbance and maintenance of cover reduces runoff and erosive losses during increasingly intense extreme rainfall events	Farm/community level
Field dredging[194]	- Removes excess water during plant growth, reduces soil erosion and prevents the development of fungal diseases. - Efficient drainage systems control excess soil water and accumulation of excess salts in the crop's root zone. - Decreases the prevalence of important water-related diseases that affect human, plant and animal health. - Organic matter applications improve soil structure and avoid soil compaction.	Farm level
Crop rotation[195]	- Increase soil fertility as each crop has different nutrient requirements and plant-soil dynamics. - Increase crop yields with the diverse nutrient availability. - Reduce soil erosion and prevent nutrients from being washed away by wind or water (through an increase in crop cover).	Farm level
Water and Soil Conservation measures		
	- Water conservation - Soil conservation - Reforestation of sloped watersheds - Minimal soil disturbance - Weed management	Community level
Micro-scale flood protection infrastructure[196]		
Rehabilitation and transformation of gullies	- Decrease soil erosion and prevent nutrients from being washed away by wind or water - Conservation and reforestation measures	Community level
Stone pitching and improvement of water reservoirs	- Enhance the water retention capacity to ensure continuous access to clean water - Mitigate flood flow in event of excess rain	Community level
Eyebrow basins, trench bunds and small herring-bone basins	- Enhance soil-water retention capacity needed as a preparatory action for tree planting.	Community level
Alternative livelihood activities		
Creation of additional vegetable gardens/orchards at household / community levels	- Enhance community and household livelihoods via the generation of additional income and the supply of local produce at lower costs.	Farm/community level

[194] Alvar-Beltrán, J., Elbaroudi, I., Gialletti, A., Heureux, A., Neretin, L. Soldan, R. 2021. *Climate Resilient Practices: typology and guiding material for climate risk screening*. Rome, FAO.
[195] *Ibid.*
[196] Refer to the following section for further detail and examples of potential flood protection infrastructure.

Examples of small-scale flood protection infrastructure

Small-scale community-based interventions will be selected following the assessment and prioritization of community-level hazards and risks, as well as their ability to cope and withstand the effects of those hazards. When prioritizing the activities, WFP will conduct a preliminary environmental and social review of the project activities by using the WFP Environmental & Social Risk Screening Tool. The screening results will determine the risk category of the project interventions and only those interventions categorised as Low Risk will be considered for implementation. Should any residual risk be identified, this will be captured by a project specific Environmental and Social Action Plan (ESAP) and managed accordingly during the project implementation. Below are some of the thematic areas which may be considered during selection/prioritization of project activities:

1. Soil and water conservation without altering the land cover of forests, wetlands, farming land, grazing land, or other landscapes of ecological or economic importance **– Category-C- low risk)**
2. Land clearing (restoring agricultural potential for below than 10 ha of land)-**Category-C- low risk.**
3. Irrigation schemes (that cover below 20ha and water development the rehabilitation or construction of weirs, reservoirs, or ponds having less than 3m hight/depth OR have a storage capacity of less than $400m^{3-}$ **Category-C- low risk**.
4. Forestry and agroforestry development carefully considering any negative affect on natural habitats, ecosystems, or biodiversity **Category-C- low risk.**
5. Flood control (restoration of embankment, check dams of less than 3m high- **Category-C- low risk**).

Below are some examples of the activities that have been implemented by WFP with focus on restoring natural resources in degraded and food-insecure areas. These interventions were established through proper adherence to planning and design norms, environmental and social reviews as well as technical follow-up on environmental and social aspects during implementation, monitoring and evaluation which contributed to improve the environment at local level:

Figure 26. The rehabilitation and transformation of a gully land into productive units by building soil sedimentation and overflow structure, gabions and weirs are possible across large gullies- having less than 3m hight/depth OR have a storage capacity of less than $400m^3$

Figure 27. Stone Pitching/improvement of water reservoir with a hight of less than 3m and a storage capacity of less than 400m$^{3.}$

Figure 28. ***Eyebrow basins, trench bunds and small herring-bone basins for tree planting (same area a few years later).***

Figure 29. Improvement of Physical access/gully control by stone pitching/other ingenious techniques without cutting and altering the natural land as well as land cover of forests

Paradigm shift and impact potential

The project will enhance the adaptive capacity of vulnerable communities in Buner and Shangla Districts and the capacity of authorities to implement forecast-based actions anticipate and mitigate expected impacts of forecasted floods. This will result in a paradigm-shift from the present baseline situation, which focuses on traditional response to disasters (usually occurring both during and after a flood). In the current baseline scenario, there are no structures in place to act before an extreme weather event happens: vulnerable

communities do not receive sufficient information in advance, there are no plans or standard operating procedures pre-defined, nor funds earmarked to allow action before the event hits. The most vulnerable only receive limited support after the flood has happened. The social protection system is not designed to expand when a flood happens to support those who were hit by it. Livelihoods are extremely vulnerable to climate change and - due to little awareness and capacity at the local level - resilience and long-term adaptation option are prone to local level political interest, often not prioritized in the local planning and therefore lacking adequate funding and sustainability. The project will promote a paradigm shift to anticipatory actions that reduce the expected impact of floods before they occur by strengthening resilience of vulnerable communities, thus leading to reduced recovery times and overall costs of response. Specifically, the project's paradigm shift potential lies in:

i) the innovative component of forecast-based anticipatory actions for flood events, which, based on tailored forecasts that contain pre-agreed thresholds and triggers linked to operating procedures, aims to complete the link from early warning systems to early actions;
ii) the knowledge and capacity building activities that will enhance the understanding of climate change impacts and guide the climate proofing of livelihoods and the integration into local plans of adaptation measures over the long-term;
iii) the gender-transformative approach, with a strong focus on women's empowerment and income-generating activities, also working with men's community organizations and mixed community organizations where decisions, planning and implementation of projects are carried out jointly by men and women;
iv) a systemized knowledge management mechanism that will lead to increased potential for upscaling and replication through the activities proposed under Component 3.

Component 3 has been specifically designed to drive the scalability and replicability elements the proposal, capturing knowledge and best practices from both Components of the project with the aim of enhancing knowledge and potential for replication at the provincial and national level. The project aims to develop case studies, foster transfer of knowledge to other flood prone areas and creating linkages back to national level policy and decision-making to facilitate dissemination and replication throughout the country. Where possible, the project will also collaborate with UNDP's GLOF-2 project to develop collaborative knowledge products, where appropriate. There is high potential for scalability in some aspects of the project; BISP, for example, is a national programme, so actions taken in the target areas to make it or other social protection schemes more responsive to the potential for climate change-related impacts. Similarly, community-level adaptation actions and financial sustainability at the community level have high national replication potential, given Pakistan's overall vulnerability to climate change, and the general lack of finance for adaptation action.

Detailed description of project components, outputs and activities

Component 1. Improved capacity for flood forecasting, early warning systems, and anticipatory actions

Under Component 1, the project will strengthen the technical and governance performance of the EWS at the district level in Shangla and Buner in close collaboration with national and provincial level government partners and institutes. The primary stakeholders will be the Planning and Development Department, as Executing Entity, Khyber Pakhtunkhwa Provincial Disaster Management Agency (PDMA) and its counterparts at the National and District Levels, the PMD, and the Flood Forecasting Division (FFD).[197] The project will improve both the weather information sharing environment through enhanced vertical and horizontal coordination and information flows, and the flood early-warning system, which will be used to design and implement anticipatory actions against a potential flood in the target districts. The project will set up the Forecast-based Finance mechanism, improving forecast capacity identifying triggers and thresholds and the most suited anticipatory actions. In parallel, WFP will pilot the implementation of such actions with GCF proceeds (should these be triggered by the forecast). While the GCF proceeds will be used to pilot and test

[197] Note that FFD is a division under the Pakistan Meteorological Department

the mechanisms, showcase its potential, provide evidence and draw lessons learned to improve its implementation, the project will also identify and engage government funds for the implementation of anticipatory action, to ensure sustainability after project completion. In particular, the activities of this component will result in the (i) improvement of the timing of alerts (earlier dissemination of alerts to prolong the time for preparedness actions), (ii) increased quality of alerts and move towards impact-based forecasting for communities to take respective actions, (iii) effective dissemination of alerts to make sure these reach flood-prone communities which often have a low literacy rate and that these communities are able to understand and interpret the information, and (iv) development of Standard Operation Procedures (SOPs) for preparedness and anticipatory actions that are linked to identified indicators and thresholds. Component 1 consists of three outputs:

Output 1.1 – Early warning system strengthened including installation of AWS, dissemination of early warning and associated technical assistance to Govt Staff.

This output addresses the identified barriers and challenges defined by PMD and FFC with regard to early-warning system infrastructure and technical capacity to undertake flood forecasting. Specifically, the three activities under this output will address the following issues in the beneficiary districts: i) inadequate coverage in terms of weather stations, rain gauges, and discharge measuring stations as per the World Meteorological Organisation (WMO) guidance; ii) the lack of access to detailed observed and projected flood risk modelling, as well as the limited technical capacity to undertake quantitative flood modelling; iii) gaps in the flood early-warning system; and iii) the lack of climate-sensitive anticipatory action.

The specific design of the capacity strengthening activities is informed by the identified knowledge gaps and capacity needs at local and provincial level via a capacity assessment, which focused on: (a) Review the PMD/FFD flood forecasting institutional and human resource capacity and services provided to Shangla and Buner Districts; (b) Assess hydro-meteorological station needs in Shangla and Buner districts. The detailed results from this assessment are included in Annex 2. Pre-feasibility analysis section 1.3.4. The assessment highlighted the need to strengthen flood forecasting capacities, including 1) build short-range and seasonal flood-forecasting capacity at PMD/FFD and at the Regional Meteorological Centre, Peshawar; and 2) procure and install hydro-meteorological stations in the target districts.

- **Activity 1.1.1** Hydromet monitoring, forecasting, and early-warning capability strengthened
- **Activity 1.1.2** Early-warning system strengthened

Output 1.2 – Anticipatory Actions triggers and protocols developed and institutionalized by respective Govt departments.

Under output 1.2, a comprehensive feasibility study will be carried to assess potential hazards, forecasting availability, risk and impact data, potential early actions, financing, and communication channels. At the community level, risk analysis will focus on flooding, evaluating past occurrences, vulnerability, and exposure. Development of triggers will involve analyzing forecasts and historical data to define impact levels and create triggering models. When selecting early actions, consideration would be given to the capacity of relevant organizations and government departments, lead times, available resources, and community readiness. Possibilities would be explored to integrate anticipatory finance with automatic funding streams for activation. The last but very crucial step would be the simulation through drills to generate proof of evidence, testing the model within the forecasted timeframe, collecting and analyzing data, assessing early actions, and evaluating the trigger system's efficacy.

- **Activity 1.2.1** Anticipatory action system developed at provincial level

Component 2: Increased climate resilience through local adaptation plans and diversified livelihoods

Increasing temperatures and changing weather systems are impacting the water and agriculture sectors. Agriculture and livestock, as the main sources of livelihood in the target districts, are being directly affected. As crop yield suffers due to different stressors, particularly floods, food insecurity increases, and livelihoods

are threatened. There is a need to support the local communities in developing their capacity to adapt and become more resilient to the changing climate. As previously highlighted, low levels of literacy – especially among women – and limited, non-climate responsive social protection has further increased community vulnerability. Most families in Buner and Shangla rely on a single livelihood source, which leaves them vulnerable to a total loss of income.

Component 2 will strengthen adaptation planning and livelihoods at the community level in Buner and Shangla Districts by increasing and diversifying incomes and reducing dependency on flood-affected crops. Under Component 2, community level climate change action plans will be developed, and their priority actions implemented. Project interventions will ensure that locally adapted measures for sustainability are in place and the communities are in a position to be able to independently manage their livelihoods in the future. Communities targeted by Component 2 will have benefitted from the improved EWS, forecasting capabilities and anticipatory action SOPs developed in Component 1. However, to adapt to the risk of increasingly frequent flooding in the longer term, communities also require support to plan and implement actions that make their livelihoods more diversified and climate resilient in the longer term.

Under Component 2, the project will plan and implement adaptation and resilience building assets, through a facilitated and inclusive community-based process. These measures will improve the natural resource base upon which the livelihoods of vulnerable communities depend, target the underlying drivers of malnutrition and food security, and increase their capacity to absorb weather shocks such as drought and flooding, as well as adapt to longer-term changes such as increased average temperatures and increasingly erratic rainfall.

The assets will be selected through a participatory local climate change action planning process, which will be informed and enabled by the evidence generated and the awareness and capacity developed under Component 1. Individuals in the targeted communities will be enabled to select the assets from a menu of potential options that has been developed to meet the needs of women, men, youth (female and male), and other groups within the target communities, as expressed during the two rounds of community consultations. The asset creation activities will be accompanied by capacity development and technical support for sustainable and climate-resilient agricultural practices. As production is enhanced and diversified, the project will support the development of climate-resilient, nutritious value chains, including support to reduce post-harvest losses (PHL), to enhance processing, and to increase access to markets. The project activities will be designed to improve dietary diversity of the target populations.

Component 2 will **integrate gender issues systematically**, including responding to the need raised by women during the consultations to enable diversification beyond rice to more nutritious food (e.g. homestead gardening, pulses, poultry, and production, value addition and marketing of neglected nutritious crops such as *findi)*. Assets will be supported that reduce the time women must spend on unpaid care and domestic work where possible.

Output 2. Local adaptation plans co-developed and prioritized community adaptation actions implemented

Activities under this output will address the lack of grassroots climate change adaptation planning and will strengthen local governance at the beneficiary union and village council level within Buner and Shangla districts. A community-based participatory planning (CBPP) approach will be employed to ensure that activities and interventions under this output are suited to the local context and needs (especially those of disproportionately vulnerable and/or underrepresented groups) of the respective beneficiary communities, and to promote buy-in and ownership of the adaptation plans at community level. WFP's approach to CBPP forms part of the organisation's three-pronged approach (3PA[198]) which is used to strengthen the design,

[198] WFP. 2017. 3PA Factsheet. [Online]. Available: https://www.wfp.org/publications/2017-three-pronged-approach-3pa-factsheet

planning and implementation of programmes in resilience building, safety nets, disaster-risk reduction, and preparedness.

The objectives of the activity under this output is to proactively strengthen the capacity of existing community structures on the use of planning instruments to manage climate risks and to co-develop local climate change adaptation plans for each prioritised beneficiary union council (four in total). The local climate change adaptation plans (LCCAPs) will be aligned with the relevant climate policy at national and subnational level and will incorporate outputs from the observed and projected flood risk modelling under Component 1. Lessons learned for upscaling and replication of the activities under this output will form part of the consolidated communications strategy for the project under Component 3.

- **Activity 2.1.** Local adaptation plans co-developed for beneficiary union councils

Component 3. Improved knowledge management and learning

Project funds will be used under this component to develop a framework that leverages the project's potential for replicability and upscaling at the regional, national, and subnational levels. To that end, a knowledge management and learning (KML) approach will be used to build the evidence-base for replication and behaviour change for beneficiary communities and institutions through: i) strengthened capacity and upskilling for knowledge-sharing and evidence-base development; ii) the development of multi-purpose knowledge products that can contribute to future climate change interventions/projects, climate change policy, awareness-raising, and research outcomes; and iii) an end-to-end project communication strategy to promote consistent messaging and high visibility of good practices and lessons learned throughout the project implementation process.

An inclusive approach to KML will be adopted throughout the project, ensuring that local ecological or indigenous knowledge is adequately incorporated and integrated with more 'formal/scientific' knowledge types, and that no groups are marginalised in the knowledge generation process. Concerning knowledge transfer, the project will emphasise bi-directional learning through co-creation of knowledge products and capacity development exercises. The capacity strengthening and training exercise under Activity 3.1 is an example of this, where institutional and community project beneficiaries will be trained in the co-design, creation, and dissemination of project knowledge products.

Part of WFP Pakistan's in-kind co-finance contribution to the project is to provide KML services through its in-house communications department. The in-house WFP communications team will work closely with national and subnational government counterparts as well as WFP colleagues at the Regional Bureau Bangkok and Headquarters in Rome to ensure that the project communication strategy is aligned with WFP's internal protocols and policies (including but not limited to social safeguards). Access to an existing international communication system will ensure that learnings from the project can be shared across different regional and national contexts and inform related work, projects, and research.

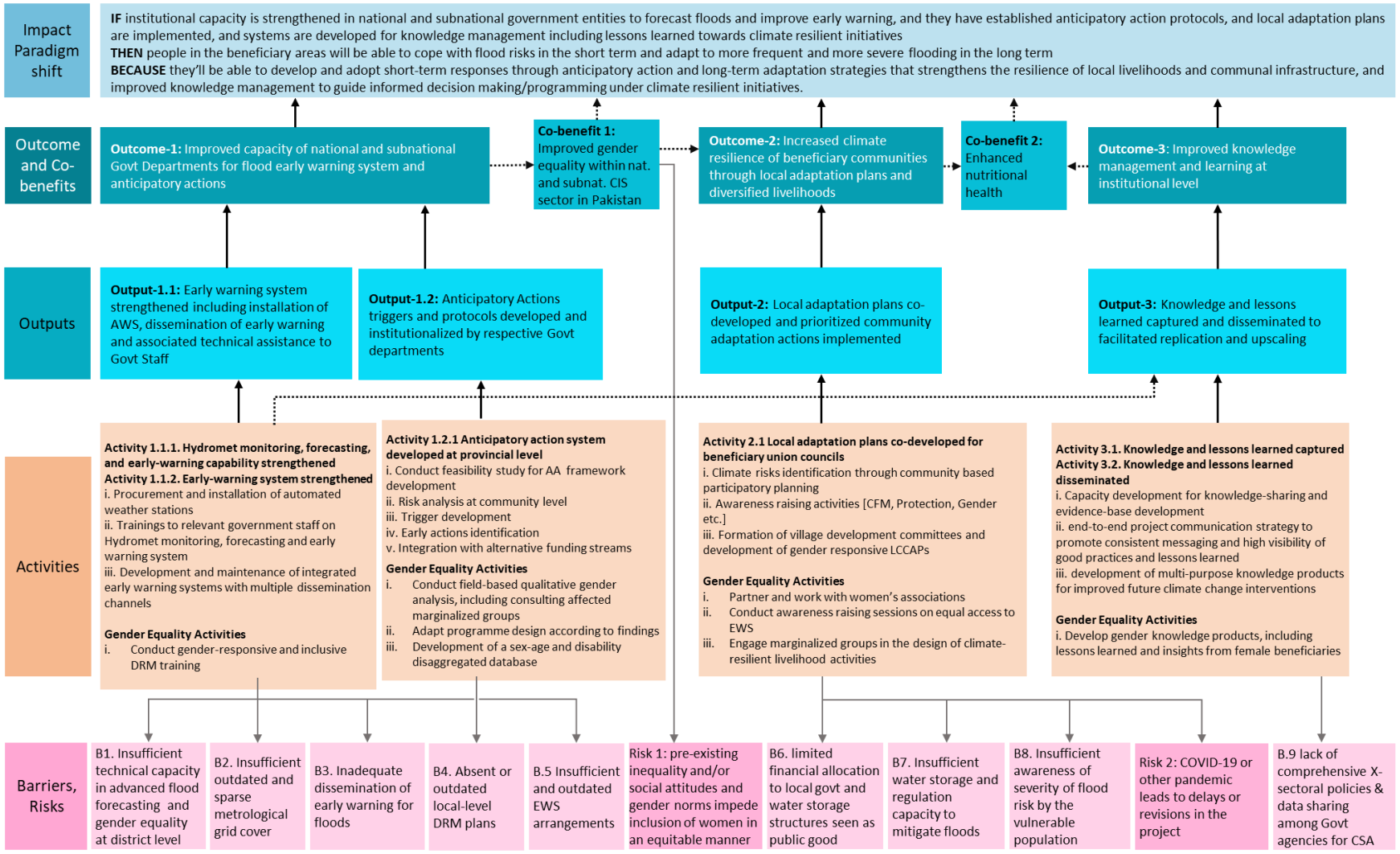
Output 3: Knowledge and lessons learned captured and disseminated to facilitate replication and upscaling

Project funds under this output will be employed to: i) ensure that the capacity of project stakeholders to capture/record project outcomes and generate an evidence-base for replication/upscaling is strengthened; ii) develop usable knowledge products to raise awareness on climate change risk and adaptation strategies appropriate for the Pakistan context; and iii) coordinate the knowledge management and learning (KML) aspects of components 1 through 3. By providing a platform for curation and dissemination of the project evidence-base for replication and upscaling, this output will ensure consistent and streamlined communication before, during, and after project implementation as well as realise maximum visibility and awareness-raising potential. There will be specific emphasis on capturing knowledge that benefits disproportionately vulnerable groups such as women, the elderly, youth, and people with disabilities (PWDs) under this output.

- **Activity 3.1.** Knowledge and lessons learned captured
- **Activity 3.2** Knowledge and lessons learned disseminated

Theory of Change diagram

Annex 2: Pre-feasibility Study



Assump-tions	•The project receives continued support from both the provincial Government of KP and the national Government •Climate adaptation continues to be a high priority for both the provincial Govt of KP and national Government •The political situation stays stable during the project implementation timeframe •As main implementing entity, Government of KP ensures timely procurement and availability of field staff to support project implementation •No major flooding events occurs during the first year of the project implementation in the beneficiary districts •The potential for inclusion of all members of the community is sufficient as to also reach and generate information uptake in women, elderly, disabled and marginalized groups

Synergies with other GCF projects

The WWF-Pakistan and WFP project development teams met during March 2023 to discuss complementarity between their respective projects and ensure that spatial and thematic duplication is avoided. Both organizations presented an overview of their projects and discussed potential entry points for collaboration and shared learning during the implementation phase.

The WWF-Pakistan project, "Recharge Pakistan: Building Pakistan's resilience to climate change through Ecosystem-based Adaptation (EbA) and Green Infrastructure for integrated flood risk management", will be implemented in the south-eastern and central areas of the country, while the WFP project's target districts are in the northern part of Pakistan. There is therefore no spatial overlap or duplication between the two projects. There is however a common administrative boundary at the provincial level, since the DI Khan project area of the WWF project is within Khyber Pakhtunkhwa (KP) Province (in the south), as is the WFP project (in the northeast). This scenario presents a synergistic opportunity to collaborate and share lessons learned within common governance structures and engagements with government at the provincial level in KP.

Three primary entry points were identified that maximize synergy and efficiency of GCF resources to the benefit of the WWF and WFP projects, as well as future climate change interventions in Pakistan. The entry points are described below.

Thematic entry point	WWF activities	WFP activities	Synergy
Adaptation planning	Technical assistance for the development and adoption of updated procedures for the Implementation Framework of the National Water Policy, NAP and four Provincial Adaptation Plans for implementing EbA and green infrastructure.	Co-development of local adaptation plans and priority adaptation actions at union council level	Collaborate to ensure vertical integration between adaptation plans at the national, provincial, and district/union council level. There is potential for subnational experiences and learnings to inform national and provincial aspects and vice versa.
Knowledge & awareness	Develop an evidence-based case of the climate change adaptation benefits of EbA and green infrastructure in Pakistan to inform public sector reform and decision-making around climate-resilient flood and water resources management.	Knowledge creation and evidence base development for replication and upscaling of AA, EWS, and adaptation planning	Ensure the integration of evidence, good practice and lessons learned generated by the two projects into the development and use of knowledge products and decision-making tools.
Capacity development	Strengthen capacity for implementing EbA and green infrastructure at national, subnational level and community level, as well as strengthen climate-resilient agricultural livelihoods at the community level	Strengthen capacity for flood forecasting, anticipatory action at national, provincial levels. Improve the capacity for adaptation planning and climate-resilient agriculture at the community level.	Joint capacity development events at federal and provincial level based on complementarity between EbA, green infrastructure, EWS, AA for flood resilience as well as adaptation planning

7. STAKEHOLDER ANALYSIS AND CONSULTATION PROCESS

Overview of key stakeholder groups and consultation processes

WFP Pakistan is working closely with National, Provincial and district disaster management authorities and providing technical, infrastructural, and training support across Pakistan. During the development of the proposed GCF project, extensive consultations were conducted with stakeholders at different levels. This includes stakeholders in national, provincial and local government, as well targeted communities and several international organisations.

As part of the stakeholder consultation process, an assessment was undertaken to determine the capacity needs for Climate Information Services (CIS) in Pakistan. The assessment was conducted to: i) identify the gaps in the quality, accessibility and availability of current CIS in the country; ii) understand the users' needs for CIS in different sectors (e.g. agriculture, water, energy); iii) map the climate information services system and institutional partnerships at local and national level and the needs for effective co-production and delivery of climate information services; iv) assess key bottlenecks and intervention points within the overall system, including where and how technology is inhibiting the analysis, communication, uptake and use of such information; and v) identify key intervention points to enhance the production, uptake, use and impacts of CIS in the country. In order to capture all aspects of climate information services, a questionnaire was administered that was divided into two sections that included: i) national legislation, policy and institutional frameworks and planning; and ii) capacities for production, tailoring and communication of climate services at the national level.

Profiles and selection criteria of direct and indirect beneficiaries

Based on the stakeholder consultations conducted during project development, an analysis of potential direct and indirect project beneficiaries was conducted in line with the methodology for selecting targeted areas for the project. This was done by identifying the most vulnerable areas which are relatively more prone to natural hazards (floods) overlapping with vulnerability to food insecurity. Table 15 below provides a breakdown of the criteria considered during beneficiary calculations. These criteria included consideration of the population and population growth rate, household size, the number of households, the prevalence of specific climate hazards and the ratio of men and women living in the area.

Furthermore, WFP's Generic eligibility and vulnerability criteria cover various elements, including hazards like floods, which contribute to overlapping vulnerability to food insecurity. WFP prioritizes households exposed to shocks or hazards, such as floods, that demonstrate overlapping vulnerability to food insecurity.

The final results are summarised in Table 16.

Table 15. Overview of beneficiary analysis.

#	District	Tehsil	Union Council	Project Priority	Pop 2017	Growth rate	Pop 2023	HH size (average)	Number of households	Male	Female	Disaster types (Floods)	Disaster risk (High)
1	Buner	Chagharzai	Batara	Primary	30689	3,05	35663,4	9,536	3740	17763,94	17899,46	1	3
2	Buner	Mandanr	Makhranai	Primary	29353	3,05	34110,84	9,536	3577	16990,61	17120,23	1	3
3	Shangla	Alpuri	Mian Kalay	Primary	29906	2,98	34635,6	9	3848	17615,67	17019,94	1	3
4	Shangla	Alpuri	Pir Khana	Primary	36547	2,98	42326,87	9	4703	21527,45	20799,42	1	3
5	Buner	Gadezai	Malakpur	Alternative	29353	3,05	34110,84	9,536	3577	16990,61	17120,23	1	3
6	Shangla	Alpuri	Kuz Kana	Alternative	21616	2,98	25034,55	9	2782	12732,57	12301,98	1	3
		Male	**Female**	**Total**	**Hh**								
	Direct	73 898	72 839	146 737	22 227								

Table 16. Final results of beneficiary analysis.

District	Tehsil	Union Council	Growth rate	Pop 2017	Pop 2023	Male	Female	Disaster types (Floods)	Disaster risk (High)	Overall Priority
Buner	Chagharzai	Batara	3,05	30689	35 663	17 764	17 899	1	3	Priority One
Buner	Mandanr	Makhranai	3,05	29353	34 111	16 991	17 120	1	3	Priority One
Shangla	Alpuri	Mian Kalay	2,98	29906	34 636	17 616	17 020	1	3	Priority One
Shangla	Alpuri	Pir Khana	2,98	36547	42 327	21 527	20 799	1	3	Priority One

8. IMPLEMENTATION ARRANGEMENTS

This section provides detailed information on the implementation structure and processes of the project highlighting the outcomes stakeholder consultation process and capacities of the executing entities.

Experience and track record of AE and EE

Accredited Entity Role

The government of Pakistan has requested WFP to act as the Accredited Entity (AE) for the proposed project. WFP is the leading humanitarian organization saving lives and changing lives, delivering food assistance in emergencies, and working with communities to improve nutrition and build resilience of the communities against climate change through livelihoods diversification. For its efforts to combat hunger, for its contribution to bettering conditions for peace in conflict-affected areas, and for acting as a driving force in efforts to prevent the use of hunger as a weapon of war and conflict, WFP was awarded the Nobel Peace Prize in 2020. In 2022, WFP assisted ~158 million people around the world. WFP globally has an excellent track record and experience in implementing climate adaptation and disaster risk reduction programmes and projects and is currently implementing five GCF adaptation projects. WFP Pakistan has a strong field presence with field offices and cooperating partners throughout Pakistan, including a WFP sub-office in Peshawar. These executing arrangements have been discussed on numerous occasions ahead of the submission of this concept note with the Planning and Development Department of the Khyber Pakhtunkhwa Government, the Ministry of Climate Change and other stakeholders at provincial and national level. Partnerships with other agencies at the provincial level, including the Regional Meteorological Centre Peshawar, the Provincial Disaster Management Agency and the Flood Forecasting Division will be explored when developing the funding proposal.

Executing Entity(ies) Role(s)

The co-Executing Entity, WFP Pakistan, has a robust programme track record and has supported several of Pakistan's national development priorities since it began operating in-country in July 1968. WFP's core operations and programmes consist of interventions to improve food security and livelihood resilience, reduce malnutrition, promote market alliances, support school feeding and enhance education and improve gender equality. The project is aligned and contributes to the Strategic Outcome 1 of WFP's Country Strategic Plan: "*Communities in Pakistan at higher risk of vulnerability to climate change and other shocks are more resilient and have enhanced capacity to improve their livelihoods by 2027*"[199]. WFP Pakistan has a strong field presence with field offices and Cooperating Partners throughout Pakistan, including a WFP sub-office in Peshawar. WFP Pakistan has well-established and robust implementation capacity in the resilience-building, disaster risk reduction, and capacity development fields in the country as a whole, as well as in Khyber Pakhtunkhwa province, and is therefore well placed to execute the project.

The other co-Executing Entity, the Planning and Development Department Khyber Pakhtunkhwa (P&D). The P&D Department's mandate is provincial and sectoral policy and decision-making in the field of development in the Khyber Pakhtunkhwa province. It is responsible for the implementation and monitoring of the overall development plans of the province and is the entry point for international partners in the province. Their primary role in the project will be to facilitate, plan, coordinate, oversee (appraise and review) and ensure smooth implementation of the project's activities.

WFP's current Country Strategic Plan (CSP) for Pakistan (2023-2027) aims to enhance the resilience of vulnerable communities to climate-related shocks and expand livelihood opportunities with a budget of approximately 153 million USD. In 2023, over 5.5 million vulnerable people benefited indirectly from WFP's

[199] World Food Programme. 2022. Pakistan Country Strategic Plan 2023-2027. [Online]. Available: https://www.wfp.org/operations/pk02-pakistan-country-strategic-plan-2023-2027

interventions, with one-third of these activities involving women participants. The CSP includes capacity strengthening at institutional and community levels, partnerships with provincial Planning and Development Departments, and initiatives to address disaster risk reduction and emergency preparedness, particularly in flood-prone areas. WFP's interventions also focus on strengthening food security and nutrition, especially in remote and volatile areas, through structural interventions, capacity development activities, and livelihood programs.

WFP's partnership with the Planning & Development (P&D) Department of Khyber Pakhtunkhwa (KP) exemplifies our commitment to an integrated approach, aligning and strengthening government systems and institutions in line with national priorities. Our MOU with the P&D Department, aligned with the UNSDCF and Pakistan Vision 2025, signifies our shared goal of supporting Pakistan's development agenda. This partnership extends to specific projects, including Annual Work Plans or Letters of Understanding, demonstrating our commitment to impactful collaboration.

In KP, the P&D Department plays a pivotal role, managing a substantial budget of Rs. 462 billion for the financial year 2023-24. With over 1,000 regular employees, the department oversees major initiatives such as the "Khyber Pakhtunkhwa Spending Effectively for Enhanced Development (SPEED) Program" worth US$ 400 million in partnership with the World Bank. This foreign-funded development portfolio includes 66 projects worth Rs. 849 billion reflected in the Annual Development Program, with Rs. 114 billion allocated for these projects in the current fiscal year.

One of the significant projects managed by the KP government is the "Ten Billion Tsunami Tree" project, with a total estimated cost of 125.1843 billion Pakistani rupees. This initiative, aimed at environmental conservation through mega tree plantation drive, part of it is a co-financing from the KP government to WFP GCF project.

WFP will sign a subsidiary agreement with the Planning and Development Department of Khyber Pakhtunkhwa Province.

Project Governance Structure

The governance structure of the project includes a Project Steering Committee at provincial level, a Technical Advisory Group, a Project Management Unit and District Coordination Groups. The project governance structure is presented in Figure 30 and a detailed description of the roles and responsibilities is presented in Table 17.

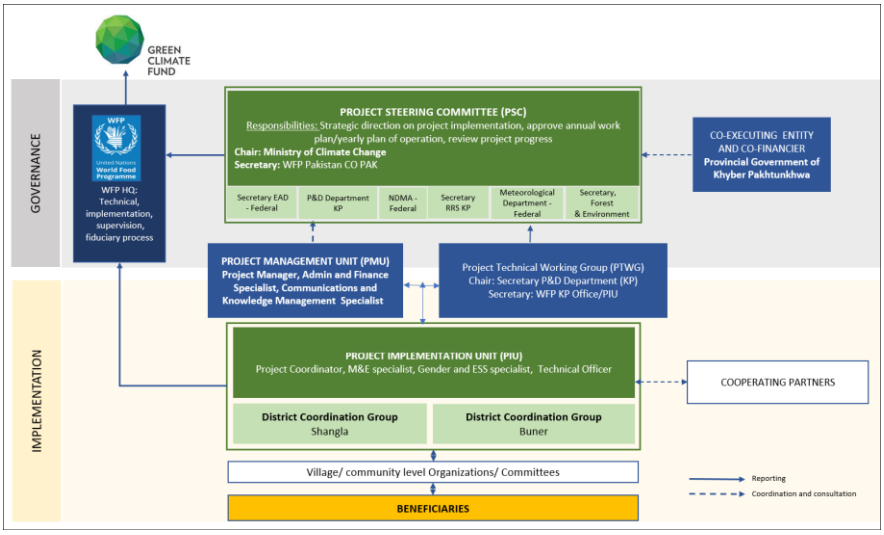


Figure 30. Project management structure.

Table 17. Detailed description of the roles and responsibilities of the entities part of the project governance structure

PROJECT ENTITY	ROLES AND RESPONSIBILITIES
Project Steering Committee (PSC)	– Provide strategic orientation for project implementation – Provide decision-makers information on project progress, results, and impacts. – Ensure alignment of the project with national policies and provincial policies/plans – Ensure transparency of processes – Ensure ownership of actions for addressing climate issues by national authorities – Ensure sound inter-institutional coordination – Ensure in-kind co-financing from government agencies is delivered in a timely manner – Show strong leadership commitment to gender mainstreaming for the project – Review and approve the annual work plans and budget
Project Technical Working Group (PTWG)	– Monitor implementation, and safeguard compliance – Invite, where relevant, representatives of accompanying institutions. – Mobilize timely technical expertise from the participating institutions as per agreed annual work plan – Provide technical assistance for the project implementation and management
Project Management Unit (PMU)	– Prepare the annual work plan and budget for review and approval by the PSC and WFP – Reports to PSC on execution (physical and financial) on quarterly basis or as required by the PSC – Prepare the procurement, contracting, administrative and accounting documents for action by WFP – Prepare and keep an updated record of financial records, data and information, briefs, reports (monthly, quarterly, annual) presentations, record notes, notifications/orders, minutes, executive notes, official correspondence and any other project record required by government. – Update, monitor, supervise and coordinate project progress and report to WFP's M&E unit – Manage day-to-day project activities and coordinate with the Project Technical Working Group (PTWG) – Establishment and regular coordination with two District Coordination Groups (Shangla and Buner), to ensure sound implementation at the local level
Project Implementation Unit (PIU)	– Provide support to PMU in strategic orientation to the implementation of the project at provincial level – Assist PMU, provincial level decision-makers information on project progress, results, and impacts – Ensure alignment of the project with provincial policies/plans in-lieu of overall project goals and objectives – Ensure transparency of processes at District and Provincial level – Ensure sound inter-institutional coordination – Ensure in-kind co-financing from government agencies is delivered in a timely manner – Show strong leadership commitment to gender mainstreaming for the project – Assist in drafting the annual work plans and budget in consultation with Provincial Line Departments – Ensure the quality of the activities at field level through robust monitoring and supervision.

PROJECT ENTITY	ROLES AND RESPONSIBILITIES
District Coordination Group	– Ensure the effective and efficient implementation of the activities at the district level and timely / regular coordination with PMU. – Communicate and coordinate any challenges and bottlenecks in the implementation of the project activities and consult with the CP and PMU to resolve the issues – Monitor and supervise the project activities of the CPs

Project Steering Committee (PSC)

The PSC will provide strategic orientation to the implementation of the project and will be chaired by the Ministry of Climate Change and Environmental Coordination (MOCC) with the Provincial Government of Khyber Pakhtunkhwa and WFP as members. The Committee will be located in Islamabad and meet twice a year; however, the Chairperson(s) may also convene *ad hoc* meetings to discuss oversight or implementation issues. Decisions taken at the PSC level will be mutually agreed by the Chair (MoCC) and co-chair (WFP) Minutes of POC meetings will be made publicly available and circulated to all Committee members and all other project stakeholders. PSC will consist of the following organisations MoCC (Chair), P&DD -cochair, WFP representative (co-chair/Secretary), Forest and Environment Department, PDMA/RRS Department, Social Welfare Department, Agriculture Department, Regional PMD and District Administration of Buner and Shangla (all as members) The Committee Chair will have the option of inviting other experts and may invite representatives from other key projects funded by government or through development assistance to attend as observers, or for knowledge sharing and peer assistance.

Project Management Unit (PMU)

A Project Implementation Unit will be set up in Peshawar (the capital of Khyber Pakhtunkhwa). The PIU will be headed by a Project Coordinator contracted by WFP and comprising staff (existing WFP staff and also dedicated project staff) and consultants from WFP and the Planning and Development Department of Khyber Pakhtunkhwa province. The PIU will be managed by the Project Coordinator who will be responsible for project implementation and coordination with all stakeholders. The PIU will be responsible for overseeing the implementation of day-to-day activities with the participating provincial government, CPs, and other stakeholders.

Project Technical Working Group (PTWG)

The PTWG will provide technical back-stopping to the PSC and will be chaired by Additional Chief Secretary P&DD KP and will consist of representatives from the Departments of the Provincial Government of Khyber Pakhtunkhwa, (IDS P&DD KP, On-Farm Water Management, Social Welfare Department, irrigation department, PDMA, soil conservation department, Environment Protection Agency, Forest Department, WFP (Secretary), UNDP, WWF and academia (if required/as needed) as members. The Committee Chair will have the option of inviting other experts and may invite representatives from other key projects funded by government or through development assistance to attend as observers, or for knowledge sharing and peer assistance. The PTWG Will provide technical inputs to the project on the implementation of the activities in the field and will review the progress on quarterly basis. The PTWG will also provide support in resolving any bottleneck in the implementation and will have authority to re-design the activity on the need basis with approval of WFP and PSC within the scope of overall project activities align with GCF rules and regulations

District Coordination Groups

Within the PMU, there will be one District Coordination Group for each of the Districts of Shangla and Buner. The Groups will be responsible for coordination between the Cooperating Partners in the Districts, the PMU and other stakeholders. The Project Manager will be responsible for oversight of the District Groups.

This prevailing focus on the institutional arrangement aims to strengthen government systems, build capacity and enhances service delivery; all of which is part of the project's strategy for ensuring project benefit streams are sustainable – and can even be scaled up – beyond project closure. Such partnership-oriented

implementation arrangements are thus not only needed for effective project delivery, but also to equip the country to continue driving the process of sector transformation in the medium/long term. Detailed project implementation arrangements are summarized in Figure 25, and further explained below.

Table 18. Detailed description of the roles and responsibilities of the entities part of the project governance structure.

PROJECT ENTITY	ROLES AND RESPONSIBILITIES
Project Steering Committee (PSC)	– Provide strategic orientation for project implementation – Provide decision-makers information on project progress, results, and impacts. – Ensure alignment of the project with national policies and provincial policies/plans – Ensure transparency of processes – Ensure ownership of actions for addressing climate issues by national authorities – Ensure sound inter-institutional coordination – Ensure in-kind co-financing from government agencies is delivered in a timely manner – Show strong leadership commitment to gender mainstreaming for the project – Review and approve the annual work plans and budget
Project Technical Working Group (PTWG)	– Monitor implementation, and safeguard compliance – Invite, where relevant, representatives of accompanying institutions. – Mobilize timely technical expertise from the participating institutions as per agreed annual work plan – Provide technical assistance for the project implementation and management
Project Management Unit (PMU)	– Prepare the annual work plan and budget for review and approval by the PSC and WFP – Reports to PSC on execution (physical and financial) on quarterly basis or as required by the PSC – Prepare the procurement, contracting, administrative and accounting documents for action by WFP – Prepare and keep an updated record of financial records, data and information, briefs, reports (monthly, quarterly, annual) presentations, record notes, notifications/orders, minutes, executive notes, official correspondence and any other project record required by government. – Update, monitor, supervise and coordinate project progress and report to WFP's M&E unit – Manage day-to-day project activities and coordinate with the Project Technical Working Group (PTWG) – Establishment and regular coordination with two District Coordination Groups (Shangla and Buner), to ensure sound implementation at the local level
Project Implementation Unit (PIU)	– Provide support to PMU in strategic orientation to the implementation of the project at provincial level – Assist PMU, provincial level decision-makers information on project progress, results, and impacts – Ensure alignment of the project with provincial policies/plans in-lieu of overall project goals and objectives – Ensure transparency of processes at District and Provincial level – Ensure sound inter-institutional coordination – Ensure in-kind co-financing from government agencies is delivered in a timely manner – Show strong leadership commitment to gender mainstreaming for the project – Assist in drafting the annual work plans and budget in consultation with Provincial Line Departments – Ensure the quality of the activities at field level through robust monitoring and supervision.

PROJECT ENTITY	ROLES AND RESPONSIBILITIES
District Coordination Group	– Ensure the effective and efficient implementation of the activities at the district level and timely / regular coordination with PMU. – Communicate and coordinate any challenges and bottlenecks in the implementation of the project activities and consult with the CP and PMU to resolve the issues – Monitor and supervise the project activities of the CPs

9. PROJECT SUSTAINABILITY AND EXIT STRATEGY

The project design, as well as country ownership at the local level, ensures the sustainability and replicability of the project in the long-run. First, during project preparation, which has now included two comprehensive rounds of consultations with stakeholders from the provincial and national level in Pakistan, stakeholders highlighted challenges including a insufficient finance and the need for improved technology transfer. These consultations will continue during the funding proposal development. During project implementation, systems and mechanisms will be transferred to the Government of Pakistan.

Under Component 1, the development of SOPs will provide clarity and certainty on the roles of various institutions in how to take anticipatory action before extreme weather events occur (flooding, in this case). This organizational structure, once adopted, will remain in place and will be strengthened through capacity building of local institutions. This could be replicated by the government in other areas of Khyber Pakhtunkhwa and even in other provinces of Pakistan. The flood early warning system that this project will implement in Buner and Shangla Districts will build on the EWS set up in other parts of Khyber Pakhtunkhwa and Gilgit Baltistan provinces by UNDP/GCF GLOF2 project. Knowledge and learning from these two projects can then be pooled for effective replication and upscaling in other parts of Pakistan.

Under Component 2, Communities will take the lead in deciding and implementing adaptation actions on the ground. Knowledge and transfer of good practices will provide a robust method to ensure sustainability and ownership by the community well beyond the project lifespan. Participation in local planning, training on assets creation and maintenance, and risks management ensures that local communities take ownership of the activities and the assets built. The project will train a cadre of community resource persons, including an equal proportion of women who will support the activities including after the project period has ended. This will also ensure continuity of the project benefits after the project is completed.

Finally, activities under Component 3 ensure that the project's benefits can be financed, sustained and replicated after the project's implementation period has finished.