KHYBER PAKHTUNKHWA
CLIMATE CHANGE POLICY
2022

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF KHYBER PAKHTUNKHWA
FORESTRY, ENVIRONMENT & WILDLIFE DEPARTMENT

EXECUTIVE SUMMARY

Climate Change poses critical and significant challenges to Pakistan's ecosystems, particularly in Khyber Pakhtunkhwa (KP) Province, but they can be addressed through bold and creative climate actions. Climate Change-related disasters such as riverine floods, storm water, glacier bursting, heat strokes, droughts and other vector-borne diseases are expected to become more common in the coming decades, according to scientific evidence.

Following the 18th Constitutional Amendment, Khyber Pakhtunkhwa was the first province to develop a Provincial Climate Change Policy that was consistent with the updated National Climate Change Policy (2021). The Policy emphasizes the province of Khyber Pakhtunkhwa vulnerability to Climate Change and how to take protective measures such as adaptation and mitigation in relevant sectors of the economy. It focuses on the effects of Climate Change on the province's natural economy and emphasizes the need for the province to adapt and mitigate the effects of Climate Change. It also focuses on Climate Change awareness in the province.

The adaptation approach to Climate Change seeks to reduce the vulnerability of natural and human systems or to capitalize on anticipated changes in climatic conditions, whereas mitigation seeks to reduce greenhouse gas emissions through technological advancement or by reducing activities that generate greenhouse gases. A salient feature of the Policy is the specific recommendations and strategies for the sectors where adaptation and Mitigation is required.

Governance, planning, risk management, resources, communication and monitoring are all critical to the successful implementation of the provincial Climate Change Policy. Once implemented, it will open new avenues and attract the international community, such as United Nations Agencies and the Global Environment Facility (GEF), to invest in adaptation and mitigation sectors in the future, more likely allowing the KP Province to achieve sustainable development and create resilience against natural disasters, thereby securing the province’s fragile economy in the coming challenging environment.

MESSAGE

Climate Change poses a greater security threat to Pakistan because it has the potential to affect temperatures, environment, economy, and the country's future policies. There is mounting evidence that the effects of climate change on the systems that sustain people and other species are occurring sooner than expected.

The Govt. of Khyber Pakhtunkhwa has formulated the first Provincial Climate Change Policy in 2017, realizing that the economy of the province is in grave danger as a result of climate change impacts and is vulnerable due to its geographical spread. The government is very committed to implement the policy in letter and spirit.

Due to merger of newly merged districts into the province, revision of National Climate Change Policy 2021 and to fulfill the commitments of updated Nationally Determined Contributions 2021, the Govt. of Khyber Pakhtunkhwa felt it imperative to update the previous Climate Change Policy into KP Climate Change Policy 2022. The revised policy aims to outline the provincial government commitments to combat climate change scenarios through mitigation and adaptation measures.

The Khyber Pakhtunkhwa Climate Change policy provides a roadmap through a comprehensive Climate Change Action Plan which aims to reduce the devastating effects of the nature induced calamities in the province through consolidated efforts of all provincial departments. It is further aimed to link with a sustainable infrastructure like strengthening and reorientation of investment strategies and to avail the significant opportunities of low-carbon, climate-resilient infrastructure; transforming finance to enable and drive change; and phasing out fossil fuel consumption contributing to global agenda on UNFCCC.

MAHMOOD KHAN
Chief Minister
Government of Khyber Pakhtunkhwa

FOREWORD

Khyber Pakhtunkhwa Province, is one of Pakistan's most sensitive provinces when it comes to the adverse effects of Climate Change. The Government of Khyber Pakhtunkhwa began responding proactively to the Climate Change implications by updating the Provincial Climate Change Policy 2022 and formulation of Provincial Climate Change Action Plan 2022 simultaneously for the very first time.

This preemptive strategy shows the seriousness of the Govt of KP towards mitigating the effects of climate change.

In order to provide recommendations and a way forward on Climate Change in the Province, the Forestry, Environment & Wildlife Department (FE&WD) established a Climate Change Cell in Environmental Protection Agency (EPA) which further keeps liaison with the Federal Govt on Climate Change Agenda.

The Provincial Climate Change Policy and Action Plan 2022 are consistent with the updated National Climate Change Policy 2021. The policy also gives a roadmap to cope with the health hazards caused by nature and human induced calamities.

For effective implementation of policy and action plan, the roles and responsibilities of provincial climate change implementation committee have been emphasized in the policy to make the strategy a success.

SYED MUHAMMAD ISHTIAQ URMAR
PROVINCIAL MINISTER FOR
Environment Government of Khyber Pakhtunkhwa

MESSAGE

Following the 18th Constitutional Amendment and the mounting signs of Climate Change in the province, the Environmental Protection Agency (EPA) took the initiative and established a "Climate Change Cell" mandated to interact with all other government agencies and departments to incorporate climate change scenarios into their respective policies, strategies, and actions, as well as to mitigate the adverse effects of Climate Change.

The first step in this regard was to formulate a provincial Climate Change policy in 2017 and now it has been updated in 2022. For its effective implementation, Khyber Pakhtunkhwa government formulated the Provincial Climate Change Action Plan 2022 which is consistent with the National Climate Change Policy 2021 and Nationally Determined Contributions 2021.

The Provincial Climate Change Action Plan 2022 is well aligned with the vulnerabilities of Khyber Pakhtunkhwa to Climate Change and the implementation of various adaptation and mitigation measures highlighted in the policy will cause a positive impact in boosting all sectors besides imparting awareness to the masses of the province on Climate Change.

The forestry, environment & wildlife department appreciates the contribution of the parliamentarians, line department, civil societies, academia and intelligencia for their efforts in realization of KP Climate Change Policy and Action Plan 2022. The document will contribute to revive the fragile ecosystem and sustainable development of natural resources.

MUHAMMAD ABID MAJEED
SECRETARY TO GOVERNMENT
OF KHYBER PAKHTUNKHWA
Forestry, Environment & Wildlife Department

ACKNOWLEDGEMENT

The formulation of Provincial Climate Change Policy (PCCP) 2017 was a milestone in the history of KP Environment sector. The updated National Climate Change Policy 2021, NDCs 2021 together with national and international commitments to reduce GHG emissions necessitated updation of Provincial Climate Change Policy and to formulate the Provincial Climate Change Action Plan for the province.

In this regard, the efforts of Provincial line Departments, Deputy Commissioners of the Province, Private & Public Sector Organizations and Experts are worth appreciation in formulation of the Khyber Pakhtunkhwa Provincial Climate Change Policy & Action Plan-2022. The contribution of Climate Change Cell of Environmental Protection Agency (EPA), Government of Khyber Pakhtunkhwa, deserves much accolade as they worked wholeheartedly. Besides academia and civil society also participated and demonstrated their keen interest in suggesting measures by providing valuable comments and feedback in refining this document.

In formulation of this Action Plan, special focus was given for Youth & Women Development. The role of Mrs. Aisha Bano Member of Provincial Assembly & Mrs. Amna Durani Director on the Status of Commission of Women Khyber Pakhtunkhwa and other women working in International and National Public / Private Sector Organizations also added valuable contributions during various consultation workshops etc. We highly appreciate the critical analysis of Chairman Environmental Sciences Department, University of Peshawar, Abdulwali Khan University Mardan and Haripur University, which were valid and contemporary. We also acknowledge the support of various Universities, Chairman Textbook Board Peshawar, KP Chamber of Commerce and Industry, SRSP, IUCN, WWF, Ministry of Climate Change and especially the UNDP (under GLOF-II Project, Scaling up of Glacial Lakes Outburst Flood in Northern Pakistan) for financially supporting the formulation of Khyber Pakhtunkhwa Climate Change Policy & Action Plan 2022.

We also appreciate Honorable Minister and Secretary Forestry, Environment & Wildlife for supporting and providing guidance and platform to accomplish the activity in a professional manner.

We highly appreciate the dedication and commitment of Dr. Qamar uz Zaman Chaudhry (Ex. Director General, Pakistan Meteorological Department) in the formulation of Climate Change Policy and Action Plan for the province. For the successful implementation of the Policy and Action Plan in the province, the EPA is looking forward for support of all stakeholders in order to reduce the risks posed by climate change and to build a resilient province.

MUHAMMAD ANWAR KHAN
Director General
Environmental Protection Agency
Government of Khyber Pakhtunkhwa

PREAMBLE

As the effects of Climate Change become more obvious around the world, vulnerable countries such as Pakistan are attempting to comprehend the challenges they will face in the future. Pakistan has an authorized and updated National Climate Change Policy in 2021. However, following the 18th amendment to Pakistan's constitution, the subject of environment was devolved to the provinces. Taking into account the possibility of a high degree of vulnerability of Khyber Pakhtunkhwa (KP) province to the visible effects of Climate Change, the Government of KP decided to formulate a Provincial Climate Change Policy in consultation with Government line Departments to be more specific, target oriented and also in line with the updated National Climate Change Policy of Pakistan 2021. As a result, a Provincial Climate Change Policy was developed for the first time in September 2017 and updated in July 2022 to reflect the specific needs of the province and include Newly Merged Districts (NMDs) and new hazards, such as locust, dengue and other viral diseases.

This Policy statement proposes two approaches, adaptation and mitigation, to be implemented in the most vulnerable sectors to the effects of Climate Change. The Policy was developed in collaboration with government line departments such as forestry, wildlife, irrigation, agriculture, livestock and food department, academia, NGOs, CSOs and other relevant stakeholders.

The Policy focuses on sectors that require mitigation measures, such as energy, transportation, waste, industry and urban planning etc. The Policy also outlined methods for capacity building and training of government line departments for sustainable development. It also emphasizes the need to streamline Climate Change in various sectors of the economy and development projects in the province in order to achieve sustainable development and resilience to natural disasters. The successful implementation of the Policy in relevant sectors of KP would lead to the stabilization of fragile economy of Khyber Pakhtunkhwa.

LIST OF ABBREVIATION

AR6	Sixth Assessment Report of IPCC
CCD	Climate Compatible Development
CO2	Carbon Dioxide
CIP II	Community Infrastructure Program Phase 2
CSOs	Civil Society Organizations
DRR	Disaster Risk Reduction
ECNEC	Executive Committee of the National Economic Council
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FAO	Food And Agricultural Organization
FE&WD	Forestary, Environment & Wildlife Department
GDP	Gross Domestic Product
GGI	Green Growth Initiative
GGV	Green Growth Vision
GIS/RS	Geographic Information System/Remote Sensing
GLOF	Glacial Lake Outburst Flood
GHG	Greenhouse Gas
Govt. of KP	Government of Khyber Pakhtunkhwa
Ha	Hectares
HLZ	Holdridge Life Zone
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
KP	Khyber Pakhtunkhwa
MAF	Million Acre Feet
NDMA	National Disaster Management Authority
NGOs	Non-Governmental Organizations
NTFP	Non-Timber Forests Produce
NUDP	National Urban Development Policy
OECD	Organization for Economic Co-operation and Development
OCHA	Office for Coordination of Humanitarian Affairs
P&DD	Planning & Development Department
PCCPIC	Provincial Climate Change Policy Implementation Committee
PDMA	Provincial Disaster Management Authority
PRS	Poverty Reduction Strategy
PV	Photovoltaic
REDD	Reducing Emissions from Deforestation and Forest Degradation
RWSSP	Rural Water Supply and Sanitation Project
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WWF	World Wide Fund for Nature (Formerly, World Wildlife Fund)

TABLE OF CONTENTS

1. VISION

The Policy envisions a province that is both sustainable and climate resilient for the people of Khyber Pakhtunkhwa.

1.1 MISSION STATEMENT

To ensure resilience in all sectors of economy of the province through adaptation and mitigation strategies and ultimately to contribute to national and global efforts against Climate Change under the United Nations Framework Convention on Climate Change (UNFCCC).

1.2 GOAL[1]

To ensure that Climate Change is mainstreamed in economically and socially sensitive areas of the economy and to lead Khyber Pakhtunkhwa toward climate-compatible growth.

[1]This Policy goal has been stated so as to be completely in line with the National Climate Change Policy.

2. POLICY OBJECTIVES

- Formulate a more appropriate and Province-specific Policy that is consistent with Pakistan's updated National Climate Change Policy 2021.
- Develop awareness on Climate Change among all stakeholders in order to implement essential adaptation/mitigation actions to combat and mitigate detrimental effects.
- Incorporate adaptation and mitigation strategies into major relevant sectors, policies, strategies and plans.
- Facilitate Climate Change adaptation and mitigation actions in Khyber Pakhtunkhwa, including short-, medium- and long-term climate resilient and sustainable development.
- Improve the inter- and intra-departmental coordination and cooperation for effective planning and execution of actions against Climate Change.
- Ensure sustainable water, food and energy resource planning, development and management for Khyber Pakhtunkhwa province in the face of a changing climate.
- Address Climate Change risks, particularly those posed by climate induced disasters.
- Ensure that the concerns of vulnerable, marginalized and indigenous communities are effectively considered in climate development strategies and planning.
- Ensure that the Climate Change Policy is gender inclusive.
- To develop climate-resilient infrastructure.
- To develop and plan reductions in Greenhouse Gas (GHG) emissions in accordance with the most recent NDCs and GHG inventories.
- To carry out Climate Inclusive Multi-Hazard Vulnerability and Risk Assessment (CMHVRA) at the district level.
- To encourage public and private sector investment in adaptation and mitigation measures by developing suitable economic incentives.
- To accelerate the Policy coherence and integration to achieve the United Nations' Sustainable Development Goals (SDGs) in the light of its Sustainable Development Report 2020 (SDR2020).
- To strengthen an enabling environment for Pakistan's Nationally Determined Contributions (NDCs) implementation.
- To develop a climate smart plan for the province.
- To develop provincial climate-inclusive agro-ecological zones and enforcing their implementation
- To encourage tree plantation, natural resource conservation, nature-based solutions and long-term sustainability.
- To ensure climate-inclusive project planning and implementation.
- To provide downscaled NDCs at the provincial and district levels, as well as a GHG emissions inventory, enabling target-oriented effective implementation.
- To develop guidelines for climate-inclusive provincial water, agricultural and energy policies.
- Develop foundations for securing adequate financial and technology assistance, as well as strengthening institutional and human resource capacities to accomplish Policy objectives; and be able to tap internationally available financial and technological opportunities.

3. INTRODUCTION TO CLIMATE CHANGE

The Earth's climate has changed frequently over long periods of geological time in responses to changes in the strength of the Sun, the shape and tilt of the earth's orbit around the Sun, the position and shape of the continents and the composition of the atmosphere. There is strong evidence that Greenhouse Gases (GHGs) emission from human activities are now raising the earth's temperature and causing changes in climate. Emissions are projected to rise significantly over the next few decades leading to significant increase in global temperatures with profound risks for the natural environment and human society worldwide.

According to the latest Intergovernmental Panel on Climate Change (IPCC) report AR-6, average global temperatures are expected to rise by 3° C to 6° C by 2100 under SSP[2] 2 4.5 and SSP 5 8.5 scenarios, respectively. If aggressive actions are taken to reduce emissions, the temperature change could be modest. If the present course is continued, however, the amount of change will be substantial. Most experts agree that the changes are anthropogenic — caused by humans — largely from emissions of heat-trapping gases released to the atmosphere when fossil fuels are burned. Carbon dioxide (CO_2) is the most significant of these gases; CO_2 levels are at their highest in 650,000 years.

Climatic variations play a pivotal role in the development and survival of natural ecosystems and of human societies which place an additional stress on natural systems. Climate Change is also now considered as a significant factor in these increases, it is one of the major challenges that the world is facing in the 21st century and is adversely affecting sustainable development and communities, people's livelihoods, health, shelters and in some cases, even lives.

What is the Greenhouse Effect?

The atmosphere is composed of nitrogen (78%), oxygen (21%), carbon dioxide (0.04%), argon (0.9%), water vapours (0-4%) and trace gases such as argon, xenon, neon, krypton and helium. Carbon dioxide and other gases such as methane and nitrous oxide trap the infra-red radiation from the sun and prevent it from escaping by a natural process called "the greenhouse effect". This phenomenon maintains the temperature of the earth allowing living things to survive.

Excessive burning of fossil fuels for anthropogenic activities releases additional CO_2which builds up and traps additional heat which would otherwise escape. This human-caused blanket effect leads to warming of the planet, disrupting the atmospheric balance that keeps the climate stable.

Climate Change is expected to result in increased air and sea temperatures, a gradual rise in sea level, increased variability and seasonality in precipitation and changes in the frequency and strength of floods, storms, cyclones and hurricanes. Asia has experienced the most natural and weather-related disasters in the recent decade, accounting for 27.5 percent of global economic damage (IPCC, 2014a[3]). Pakistan, an Asian country, suffered estimated damages of 10 billion US dollars as a result of the 2010 floods (World Bank and Asian

[2] Shared Socio-economic Pathways (SSP)
[3] IPCC. (2014a). Climate Change 2014, Synthesis Report, Summary for Policymakers.

Development Bank, 2010[4]). Not only have such recurring weather catastrophes become more common, but their consequences for human health, livelihoods and economic development have grown in magnitude and extent.

To address the implications caused by Climate Change, appropriate strategic actions are required. Climate Change actions can be split into two categories:

Mitigation — a process of reducing GHG emissions that contribute to Climate Change. It comprises measures for lowering GHG emissions and improving GHG sinks.

Adaptation — a process, or combination of actions and measures, that reduces the susceptibility of natural and human systems to the impacts of Climate Change. Adaptation can also be defined as learning to live with the threats of Climate Change.

Climate Change adaptation and mitigation are often regarded as Policy domains. Table 1 summarizes the major features of international and national Climate Change Policy instruments.

Trends[5] of stresses on several natural systems and ecosystems due to Climate Change have been observed, recorded and debated upon by international organizations: UNESCO, IFAD, World Watch Institute, FAO, WHO, OECD, WWF & UNEP.

Table 1: Key aspects of Climate Change Policy

Policy Response	Objectives and Targets
United Nation Framework Convention on Climate Change (UNFCCC)	UNFCCC seeks to reduce international GHG emissions by setting National level targets based on the concept of 'common but differentiated responsibility'. This means that nations which emit majority of GHGs need to reduce GHGs at a greater rate.
UNFCCC's Kyoto Protocol	Under the UNFCCC's Kyoto Protocol, developed countries agreed to reduce their overall emissions of a basket of GHG by 5.2 percent below 1990 levels over the period 2008-2012.
Updated National Climate Change Policy 2021	It facilitates the transition to a resource-efficient, low-carbon economy in order to achieve sustainable growth. It provides a long-term framework for action to factor in resource efficiency in a balanced manner in several Policy sectors, including Climate Change, energy, transportation, industry, agriculture, biodiversity and regional development.
Updated NDCs 2021	Under the updated NDCs, the government of Pakistan set a cumulative aggressive objective of overall 50 percent reduction in projected emissions by 2030, with 15 percent coming from domestic resources and the remaining 35 percent contingent on international grant financing.

[4] World Bank and Asian Development Bank (2010), Pakistan *Floods 2010: Preliminary Damage and Needs Assessment*
[5]Detailed information on climate-induced stresses is available on: http://www.igbp.net.

4. CLIMATE CHANGE IMPACTS IN KHYBER PAKHTUNKHWA

Khyber Pakhtunkhwa (KP), a topographically diverse province of Pakistan, is situated in the northwest region of the country. The land of KP is an abode to Hindu Kush, Himalayan and Karakoram Mountain ranges predominantly in the Northern, North-West and Eastern parts of the province. In contrast, southern parts of KP are dominated by central valley plains comprising agricultural land and rangelands. Extreme climate conditions range throughout the province. The northern region of KP experiences extremely cold and snowy winters, with heavy rainfall and pleasant summers, whereas the southern parts of KP experience fairly less severe winters, moderate rainfall and hotter summers. Chitral, the highest district of KP experiences the lowest temperatures in winter; hence many glaciers are found in this district. D.I Khan, the southernmost district of KP, experiences milder winters and therefore is dominated by agricultural and rangelands due to optimum climate conditions for agriculture.

4.1 Khyber Pakhtunkhwa – An Ecological Classification

According to the study conducted by Helvetas Pakistan in cooperation with Swiss Development and Cooperation (SDC), Khyber Pakhtunkhwa (KP) is divided into nine **agro-ecological zones** based on climate, rainfall, temperature, altitude, soil and topography. This zonal distribution has been used in this text to allow convenience in identifying potential future impacts from external forces such as Climate Change (Source: Nizami et al., 2020)

Table 2: Details of the agro-ecological zones of KP

No.	Zone Reference Code		Classification	Weather / Climate Rain (mm) &Temp (°C)	Moisture: (Seasonal R / Humidity Range) Morning - evening	Topography, Soil and Elevation
1		AI	**High Dry Mountains**	**Northern parts of Zone** Rain: 100 – 200 mm Snow: 2 – 4 ft Temp: 12 – 14 °C Dec – Apr: Wet and Cold May – Jun: Dry and warm Jul – Sep: Dry and Hot Oct – Nov: Dry and Cold **Southern parts of Zone** Rain: 200 – 400 mm Snow: 1 – 2 ft Temp: 14 – 16 °C Dec – Apr: Wet and Cold May – Jun: Dry and Hot Jul – Sep: Dry and Humid Oct – Nov: Dry and Cold	Winter 80 – 50% Spring 70 – 40% Summer 60 – 30% Fall 50 – 20%	Rugged high and dry mountains with steep slopes lacking vegetation with frequent debris flow. Valley soils are deep (> 100 cm) dominantly fine texture (loam and clay loam) under laid by bed rocks and gravelly, loamy to sandy loam-textured, and generally shallow (< 50 cm thick) on sloping surface. Elevation (North): 5000 – 7500 meters Elevation (South): 2850 – 5000 meters
2		AII	**Sub-Mountain Valleys**	Rain: 400 – 800 mm Snow: 1 – 2 ft Temp: 16 – 20 °C Oct – Dec: Cold and Dry Jan – Mar: Wet and Cold Apr – May: Wet and Warm June: Dry and Hot Jul – Sep: Wet and Humid	Winter 90 – 60% Spring 60 – 30% Summer 70 – 40% Fall 40 – 10%	Sub-mountain area with wide and extended valleys. Large areas come under forest and grazing lands. Valleys soils are medium textures (mainly loam to sandy clay loam) with scattered gravels and cobbles in the profile. Terraced lands on hill slopes are shallow with coarse texture soil material dominated by boulders and gravels. Elevation: 1700 – 3000 meters
3		BI	**Sub-Humid Mountains**	Rain: 800 – 1000 mm Snow: 2 – 3 ft Temp: 18 – 22 °C Oct – Dec: Cold and Dry Jan – Mar: Wet and Cold Apr – May: Dry and Warm June: Dry and Hot Jul – Sep: Wet and Sub-Humid	Winter 70 – 30% Spring 50 – 20% Summer 80 – 50% Fall 40 – 10%	Sub-humid mountains with most of the land under forest. Piedmont soils are coarse texture (sandy loam to loam) and comparatively thinner. Distant soils from the mountains have fine texture (silty clay loam to clay loam) and with thick profile. Elevation 800 – 1500 meters
4		BII	**Wet Mountains**	Rain: 1000–1400 mm Snow: 3 – 5 ft Temp: 18 – 22 °C Oct – Dec: Cold and Dry Jan – Mar: Wettest and Cold Apr – May: Dry and Warm June: Dry and Hot Jul – Sep: Wettest and Humid	Winter 70 – 30% Spring 50 – 20% Summer 90 – 60% Fall 50 – 20%	Wet mountains with forest covered slopes. Valleys and small planes are used for agriculture and fruit cultivation. Mountain soils are gravelly loamy sands and sandy, shallow, dark brown coloured. Soils in the middle and lower slopes medium textured (loams and fine sandy loam), brown to dark yellowish coloured and moderately deep at the foot of mountains. Elevation: 300 – 1700 meters
5		C	**Valley Plains**	Rain: 350 – 1000 mm Temp: 20 – 24 °C Sep – Oct: Hot and Dry Nov – Dec: Cold and Dry Jan – Mar: Wet and Cold Apr – May: Dry and Hot June: Dry and Very Hot Jul – Aug: Hot and Very Humid	Winter 70 – 40% Spring 50 – 20% Summer 70 – 40% Fall 50 – 20%	Irrigated plains with alluvial valleys, all used for crops, vegetables and fruits. The basin parts (Peshawar valley and Bannu basin) are deep fine textured silty clay loam to clay loams. Soils in the upper reaches of the valley are admixture of alluvial and loess redeposit with medium textured (sandy loam and sandy clay loam). Elevation: 300 – 650 meters
6		DI	**Piedmont Plains**	Rain: 400 – 600 mm Temp: 20 – 22 °C Sep – Oct: Warm and Dry Nov – Dec: Cold and Dry Jan – Feb: Wet and Very Cold Mar – Apr: Wet and Warm May – June: Dry and Very Hot Jul – Sep: Wet and Humid	Winter 60 – 30% Spring 50 – 20% Summer 60 – 30% Fall 40 – 10%	Semi-wet mountains composed of barren hills with steep slopes. Most of the land is used for grazing. On part of the loamy soils wheat and fruit crops are grown. Piedmont plains landform soil varies from gravelly very fine sandy loam to clay loam. The plains have deep to very deep, fine texture soils ranging from loam to clay loam and clayey soil. Elevation: 2300 – 3500 meters
7		DII	**Semi-Arid Piedmont**	Rain: 300 – 400 mm Temp: 22 – 24 °C Oct – Nov: Cold and Dry Dec: Very Cold and Dry Jan – Feb: Wet and Very Cold Mar – Apr: Warm and Dry May – June: Dry and Hot Jul – Sep: Semi-wet and Humid	Winter 70 – 40% Spring 40 – 10% Summer 60 – 30% Fall 30 – 10%	Dry Mountains and barren hills. Most of the land is used for grazing. Soil textures vary from very coarse to fine sand and sandy loam in the southern piedmont plan, very deep soil. Soil in the plain valleys is medium to fine textured loamy, sandy loam and sandy clay loam having scattered salt patches. Elevation: 800 – 1500 meters
8		E	**Western Mountains**	Rain: 600 – 800 mm Snow: 2 – 3 ft Temp: 18 – 20 °C Oct – Nov: Cold and Dry Dec – Feb: Wet and Very Cold Mar – Apr: Wet and Cold May – June: Dry and Warm Jul – Sep: Dry and Hot	Winter 90 – 60% Spring 60 – 30% Summer 50 – 10% Fall 40 – 10%	Wet-cold high rock mountains with steep slopes covered with forests. Valleys soils are very deep and are sandy loam to loam. The plains are dominated by rock outcrops with gravels and pebbles on surface and coarse textured soils. Elevation: 600 – 900 meters
9		F	**Desert Plains**	Rain: 200 – 300 mm Temp: 24 – 26 °C Nov – Dec: Cold and Dry Jan – Feb: Wet and Cold Mar – Apr: Dry and Warm May – June: Dry and Very Hot Jul – Sep: Dry and Hot / Humid	Winter 60 – 30% Spring 50 – 20% Summer 60 – 30% Fall 30 – 10%	Extended Piedmont plains of the tail of Sulaiman Range with barren and desert land. Plains are dominated by sandy and very fine sandy textured soils (sand ridges and dunes) while the depression and the high tracts are dominated by loess deposit having silty and very fine sandy loam soils. Elevation: 115 – 350 meters

Table 3: District-wise distribution of the agro-ecological zones of KP

S. No.	District	AEZs with Percentage area	% geographical area under the zone
1	Abbottabad	AI: Sub-Mountain Valleys	91%
		C: Valley Plains	9%
2	Bajaur	C: Valley Plains	62%
		AI: Sub-Mountain Valleys	38%
3	Battagram	C: Valley Plains	77%
		BI: Sub-Humid Mountains	23%
4	Bannu	F: Desert Plains	54%
		DII: Semi-Arid Piedmont	33%
		C: Valley Plains	13%
5	Buner	AI: Sub-Mountains Valley	93%
		BI: Sub-Humid Mountains	7%
6	Charsadda	C: Valley Plains	100%
7	Chitral	AI: High Dry Mountains	91%
		AI: Sub-Mountain Valleys	9%
8	DI Khan	F: Desert Plains	90%
		C: Valley Plains	6%
		DII: Semi-Arid Piedmont	4%
9	Hangu	DII: Semi-Arid Piedmont	95%
		C: Valley Plains	3%
10	Haripur	E: Western Mountains	2%
		AI: Sub Mountain Valleys	73%
		C: Valley Plains	27%
11	Karak	DII: Piedmont Plains	77%
		C: Valley Plains	23%
12	Khyber	DII: Semi-Arid Piedmont	61%
		E: Western Mountains	17%
		C: Valley Plains	13%
13	Kohat	DII: Piedmont Plains	9%
		C: Valley Plains	85%
		DII: Semi-Arid Piedmont	10%
14	Kurram	DII: Semi-Arid Piedmont	67%
		E: Western Mountains	15%
		AI: High Dry Mountains	7%
15	Laki Marwat	F: Desert Plains	87%
		DII: Semi-Arid Piedmont	10%
		C: Valley Plains	3%
16	Lower Dir	C: Valley Plains	74%
		AI: Sub-Mountain Valleys	26%
17	Lower Kohistan	AI: Sub-Mountain Valleys	93%
		BI: Sub-Humid Mountains	7%
18	Malakand	AI: Sub-Mountain Valleys	65%
		C: Valley Plains	35%
19	Mansehra	AI: Sub-Mountain Valleys	42%
		BI: Sub-Humid Mountains	37%
		C: Valley Plains	11%
		BII: Wet Mountains	10%
20	Mardan	C: Valley Plains	90%
		AI: Sub-Mountain Valleys	6%
		BI: Sub-Humid Mountains	4%
21	Mohmand	AI: Sub-Mountain Valleys	79%
		C: Valley Plains	21%
22	Nowshera	C: Valley Plains	100%
23	Orakzai	DII: Semi-Arid Piedmont	68%
		E: Western Mountains	21%
		C: Valley Plains	6%
		AI: Sub-Mountain Valleys	5%
24	Peshawar	C: Valley Plains	83%
		DI: Piedmont Plains	17%
25	Shangla	AI: Sub-Mountain Valleys	93%
		AI: High Dry Mountains	4%
		BI: Sub-Humid Mountains	3%
26	Swabi	C: Valley Plains	83%
		AI: Sub Mountain Valleys	17%
27	Swat	AI: High Dry Mountains	50%
		AI: Sub-Mountain Valleys	40%
		BI: Sub-Humid Mountains	10%
28	Tank	F: Desert Plains	56%
		DII: Semi-Arid Piedmont	26%
		C: Valley Plains	18%
29	Torghar	AI: Sub-Mountain Valleys	97%
		BI: Sub-Humid Mountains	3%
30	Upper Dir	AI: Sub-Mountain Valleys	58%
		AI: High Dry Mountains	42%
31	Upper Kohistan	AI: High Dry Mountains	47%
		BI: Sub-Humid Mountains	36%
		AI: Sub-Mountain Valleys	17%
32	Waziristan North	DII: Semi-Arid Piedmont	51%
		E: Western Mountains	23%
		C: Valley Plains	14%
		AI: Sub-Mountain valleys	12%
33	Waziristan South	DII: Semi-Arid Piedmont	53%
		E: Western Mountains	26%
		AI: Sub-Mountain Valleys	21%

Note: This study provides agro-ecological zones for entire KP (considering 33 Districts).

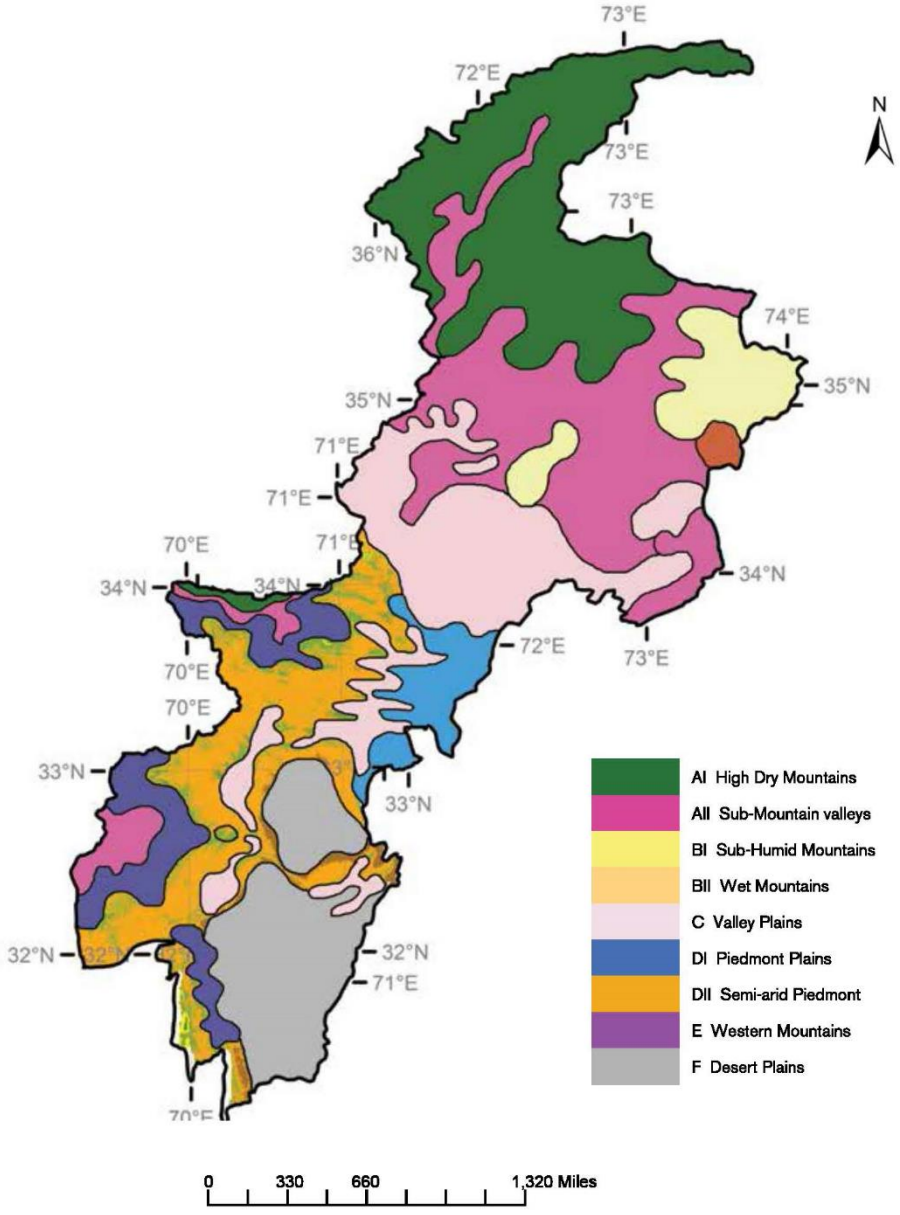


Figure 1: Agro-ecological zones of KP (Source: Nizami et al., 2020)

In order to identify the types of impacts which each zone is prone to, it is important to identify the land cover and land use in each zone. 33% of the forests covers of Pakistan are located in KP (Atlas of Pakistan 2012). The land cover of KP has varying characteristics from north to south, therefore has different usage, 20.3% of KP is covered with forests, primarily the Hindu Kush Himalayan Region. (The description is given in Table-3).

Although KP has been divided into nine agro-ecological zones, each zone can have cross cutting sectors, such as forests, agriculture, water and biodiversity. A description of these sectors and the zones in which they are most common is given below.

Forests

The northern part of the Province is comprised mainly of snowcapped high mountains and forests. The high northern mountains of Chitral, Hazara and Swat above 4000m have low vegetative cover. Alpine zone forests are found between 3350-3360m. Dry temperate coniferous are present in the dry ranges of Himalayas and Hindukush. Himalayan moist temperate forests are found in Hazara division (Kohistan, southern parts of Palas Valley, Lower Kaghan Valley) at an elevation of 1525-3660m. There is a narrow zone of subtropical forests between 900-2000m in the Southern parts of the Himalayan Mountains of Hazara and Swat Valley (Ahmad & Khan, n.d.).

Agriculture

Central Valley Plains and Piedmonts are used for agriculture and livestock grazing purposes. Livelihood is majorly based on agriculture and livestock in KP, with over 80% of the population dependent on agriculture for income. The agriculture sector also contributes to 20% of the provincial GDP and employs 44% of the labor force (Source: EPA, Govt. of KP). Major crops include wheat, rice, sugarcane, maize etc.. Livestock contributes approximately 52% to agriculture Sector.

Water

With the province heavily dependent on agriculture for livelihood, water plays an important role in the sustenance of the population. The Indus River and its tributaries are the main source of water for the province. The province has many lakes which contribute aesthetically to the region providing tourist attractions as well as freshwater. These lakes, such as Lake Saif-ul-Malook, Lake Dudipatsar, Lake Lulusar, Lake Shandur, Broghal Lake, etc. also come under protected wetland sites of KP wildlife biodiversity (KP Wildlife Biodiversity Preservation, conservation and management Act, 2015), whereas Tanda Dam in Kohat District & Thanedar Wala in Lakki Marwat District are the Ramsar sites identified under the Ramsar convention.

In addition, glaciers are important reservoirs for KP province. They feed into the Indus River and its tributaries and provide freshwater for agriculture and domestic use, moreover, these are important reservoirs for the future and indicators of Climate Change. The Karakoram-Himalayan ranges are snowbound throughout the year and have the greatest ice and snow cover in any mountainous system outside the Polar Regions. Glaciers are cold deserts; however, their significance for the future and present of KP and Pakistan is immense.

Biodiversity

The topographic variety of Khyber Pakhtunkhwa makes the province diverse in species. The Himalayan forests are the habitats for many mammal and bird species. Out of 188 species of mammals that occur in Pakistan, 98 mammal species are found in Khyber Pakhtunkhwa, amongst these endangered species are the Snow Leopard, Brown Bear, Ibex and Lion-eared bat. Moreover 456 species of birds, 56 species of reptiles and approximately 4500 species of plants are also found in KP (Source: EPA, Govt. of KP)

4.2 Land Cover of Khyber Pakhtunkhwa

Different agencies and reports have different estimates of land cover in Khyber Pakhtunkhwa. However, the latest land use/land cover classification is provided by ESRI based on Sentinnel-2, 2021 data. The KP land cover has been extracted from the same data and provided in Table 4 and Figure 2.

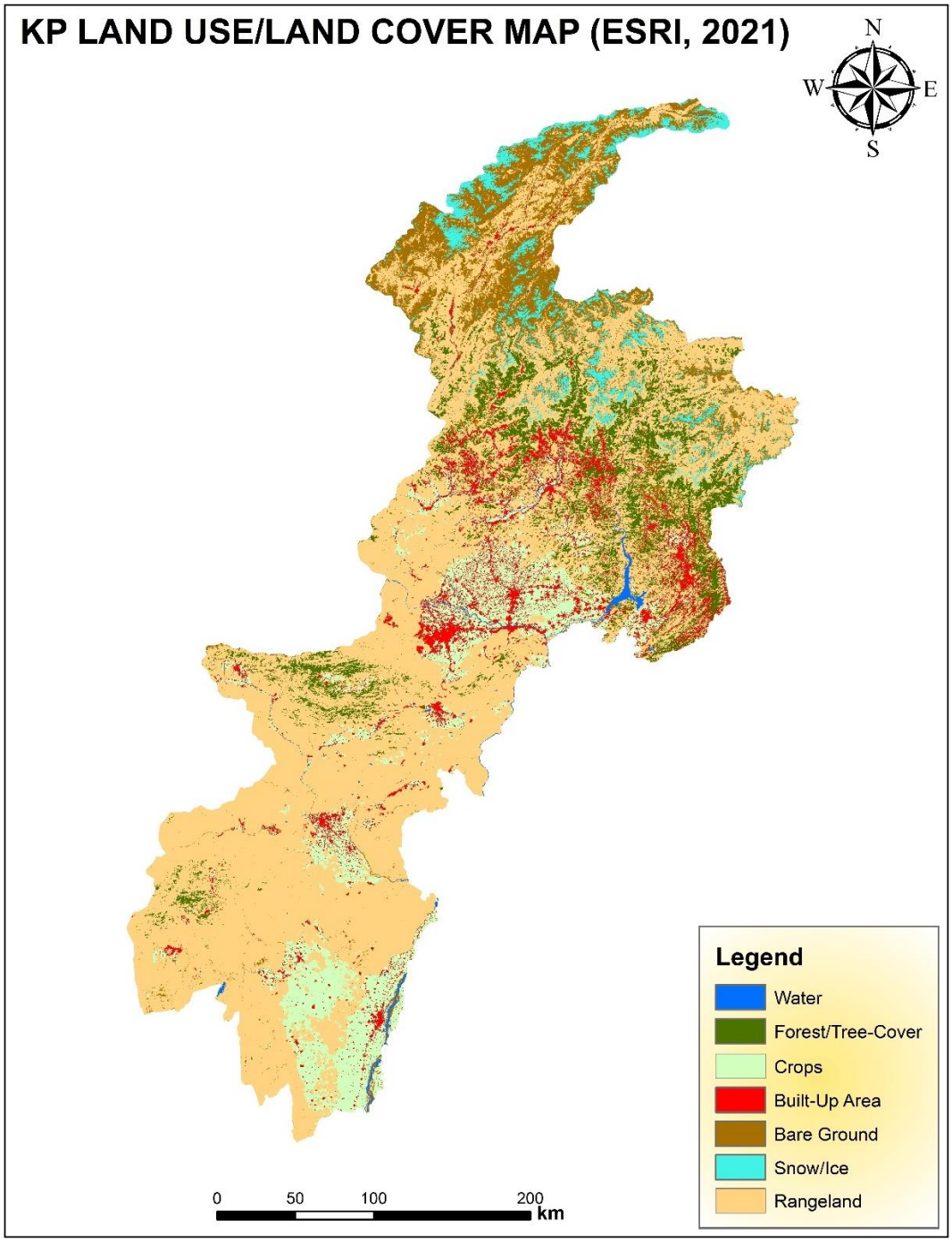


Figure 2: Land Use/Land Cover Map for KP (Source: ESRI, 2021)

Table 4: Land Use/Land Cover distribution of KP

Land Use	Area (ha)	Area (%)
Water	73,254	0.72
Forest/Tree-Cover	842,415	8.28
Crops	1,177,143	11.57
Built-Up Area	605,359	5.95
Bare Ground	1,031,654	10.14
Snow/Ice	371,355	3.65
Rangeland	6,072,920	59.69

(Source: ESRI Land Use-Land Cover Classification, 2021)

4.3 Climate Hazards in Khyber Pakhtunkhwa

Climate Change is having an impact in many parts of the world. The Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR-6) 2021 acknowledges the relationship between Climate Change and its impacts on natural and human systems. Furthermore, there is mounting evidence that Climate Change is responsible for the disruption of weather patterns, which is catalyzing glacier melting, Glacial Lake Outburst Floods (GLOFs), changes in hydrological systems, species diversity due to changes in migration pathways and changes in crop production and yield, which are threatening existing food production patterns. According to the report, the frequency of heat waves in Asia is predicted to grow and last for longer periods of time. The number of cold days and nights will decrease, while the number of warm days and nights will increase. As a result, regardless of what is causing Climate Change, there are evidences from historical events all across the world that Climate Change is endangering the natural balance of nature and demonstrating human dependence and sensitivity to nature (IPCC, 2021).

Over the past decade, impacts of Climate Change have been experienced in the form of warming of the atmosphere and ocean, rise in sea level and increase in concentration of greenhouse gases. Therefore, there is no ambiguity related to the evidence that Climate Change is happening. Impacts of Climate Change also make the destruction caused by natural hazards even worse. Increase in events of heavy precipitation accompanied by rise in average surface temperature; alter the natural weather patterns & thus natural hazards become more intense in vulnerable areas. Natural hazards are defined as naturally occurring events which are potentially dangerous to communities in difficult and disaster-prone terrains. Earthquakes, landslides, floods, droughts, hurricanes and volcanic eruptions can be classified as naturally occurring hazards. Without proper risk reduction, mitigation and adaptation methods, these natural hazards can turn into catastrophic disasters. KP Climate Change hazards include glacier melting, drought, floods, Glacial Lake Outburst Floods (GLOFs), high winds, avalanches, land sliding, locusts, dengue and smog etc.

Khyber Pakhtunkhwa is highly prone to negative impacts of Climate Change. Table 5 shows vulnerability of districts in KP to climate hazards based on National Disaster Management Plan (NDMP), 2012. However, these hazards need to be addressed based on simulation modeling and projections.

Khyber Pakhtunkhwa is located in the mid-latitude region on the globe. In the sixth annual assessment report of the IPCC, 2021, mid latitude regions have been warned of extreme weather pattern. Monsoon rainfall has been predicted to increase and go further up North due to warmer temperatures. Wet regions (such as the sub humid wet mountains) will get more precipitation and dry regions (Central Valley and Piedmont Plains) will receive less precipitation than before. These heavy precipitation patterns will accelerate glacial melting resulting in GLOFs in Northern regions and flash flooding while less precipitation will contribute to droughts in dry regions.

Table 5: District-wise Natural Hazards Vulnerability Assessment

S.No	District	Flood Risk	Landslide Risk	Earthquake Risk	Cyclone Risk	Drought Risk	GLOF Risk
1	Charsadda	5	3	5	2	3	1
2	Shangla	5	4	5	2	4	5
3	Swat	5	5	4	2	2	5
4	Nowshera	5	3	5	2	3	1
5	Mansehra	4	5	4	2	1	5
6	Buner	5	4	4	2	4	1
7	Bajaur	3	3	5	2	2	1
8	Peshawar	5	3	5	2	3	1
9	Mohmand	3	4	4	1	2	1
10	Upper Dir	4	5	4	2	2	5
11	Swabi	5	3	5	2	2	1
12	Bannu	4	2	5	2	4	1
13	Abbottabad	3	5	5	2	2	1
14	Khyber	3	4	3	1	2	1
15	D. I. Khan	5	1	2	2	2	1
16	Batagram	3	4	4	2	3	5
17	Mardan	5	3	5	2	1	1
18	Lower Dir	4	4	5	2	1	1
19	Haripur	3	5	4	2	1	1
20	Hangu	3	3	4	2	3	1
21	Malakand	4	3	5	2	1	1
22	Orakzai	2	4	3	2	4	1
23	Tank	4	1	3	2	4	1
24	Kohistan	3	4	3	1	1	4
25	Kohat	3	2	3	2	2	1
26	South Waziristan	2	2	2	1	1	1
27	Chitral	3	4	2	1	1	3
28	Lakki Marwat	3	1	3	2	1	1
29	North Waziristan	2	2	2	1	2	1
30	Kurram	3	2	2	1	1	1
31	Karak	2	2	2	1	1	1
Legend		**5 (Very High)**	**4 (High)**	**3 (Medium)**	**2 (Low)**	**1 (Very Low)**	

Source: National Disaster Management Plan - 2012
Note: Number of districts are as per NDMP-2012

The natural hazards that are most likely to occur in the province in the coming years are discussed below in detail.

Floods

Khyber Pakhtunkhwa has an intricate river system, with many smaller rivers draining into the Indus River running through the province. The major rivers that cross the region are Indus River, Kabul River, Swat River, Kurram River and Gomal River. The Indus River and its tributaries have a capacity of 154 MAF (Million Acre Feet) of water annually, which includes 145 MAF from North-Western Rivers (Indus, Jhelum, Kabul and their adjoining smaller rivers) and 9 MAF from eastern rivers (essentially Ravi and Sutlej) (EPA, Govt of KP).

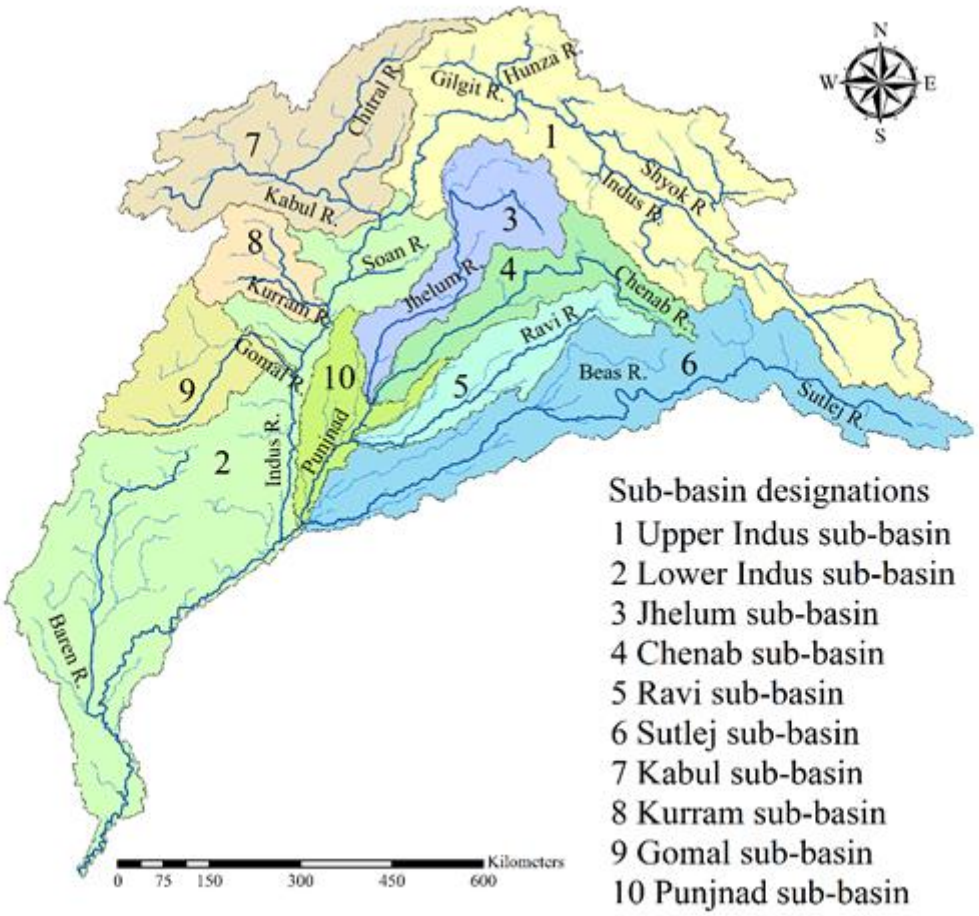


Figure 3: River system of Indus Basin (Mukhopadhyay and Khan,2016[6])

Due to these river systems, the region is prone to flash flooding during heavy monsoon season. Flood frequency has been increased in the Khyber Pakhtunkhwa region in the past few years. Almost every year, the region is flooded due to heavy precipitation. In 2007, Kohistan was badly flooded due to torrential rain and glacial melting. Khyber Pakhtunkhwa experienced even worse flooding in 2010 – the worst in recent history - resulting in displacement of hundreds of thousands of people. The following years - 2011, 2012, 2013, 2014 and 2015 - saw a repetition in the pattern, admittedly though, with less intensity. The repetitive flooding over the years with rehabilitation from previous floods still underway made conditions even more challenging and costly. In the flood

[6] B. Mukhopadhyay and Khan,2016, Handbook of applied hydrology, Chapter 109: Indus River Basin

of 2010, according to data collected by OCHA, 4,725,695 people were affected in Khyber Pakhtunkhwa. The flood of 2015 was one of the most severe GLOF disasters, affecting 321, 644 people in Chitral and destroying 1200 acres of standing crops (PDMA, 2015[7]). Other devastating GLOFs events have occured in the Golen Gol and Reshun Valleys in recent years.

The main regions of KP which are expected to continue having flood hazards are the Himalayan moist temperature forests between 1525-3660m. Due to climate change, this region will experience intense precipitation especially in lower Kaghan Valley, Galiat and southern parts of Kohistan. Therefore, these areas of Khyber Pakhtunkhwa are at high risk of flooding and strategic actions to mitigate and adapt to these weather events are of great importance.

Droughts

Droughts in the southern parts of Khyber Pakhtunkhwa are more common as compared to the northern parts. The central valley plain, Piedmont plain and Suleiman Piedmont are areas dedicated mostly to agriculture. The total cultivated area in Khyber Pakhtunkhwa is about 1.65 million ha. This signifies the magnitude of impact of a drought on food security in the province. With rising temperatures and decrease in rainfall in dry regions, particularly in southern parts, are most likely going to be water stressed region in the coming years. The climate ranges from warm and sub-humid in valley plains to hot and arid southern parts. Dera Ismail Khan is the area which will be most prone to droughts. Although, drought is a less common hazard compared to floods, the implications on food security cannot be ignored. Deserts in southern parts like Karak Lakki Marwat and DI Khan may expand in case of prolonged droughts.

The southern parts of the province receive less rainfall and higher temperatures in the summer and drier winters. Climate forecasts predict that dry regions will get drier and wet regions will get wetter. As these areas are drier especially during the winter and hot during the summers there is an expected increase in average temperatures in the summer. These high temperatures may be optimal for some crops to cultivate but high temperatures will increase evapotranspiration which in turn increases the demand of crops for water. Therefore, the quantity and availability of groundwater and irrigation water will be vital in determining water stress in the area.

4.4 Impacts of Climate Change

Natural hazards are not the only impacts of Climate Change which will be experienced by Khyber Pakhtunkhwa. In fact, there are other impacts as well which give rise to many development challenges. These impacts will be experienced across the nine agro-ecological zones of Khyber Pakhtunkhwa.

Increase in surface temperature- According to the IPCC AR-6 assessment, nearly the entire globe has witnessed surface warming. This will result in hotter, longer summers and shorter, milder winters, which will have a substantial impact on cropping patterns of Khyber Pakhtunkhwa. Higher temperatures also mean that monsoon rainfall will be more severe, increasing the risk of flooding and glacial melting in northern parts of the province, which are the epicenters of glaciers and subtropical forests.

Variation in precipitation- More intense rainfall over a shorter period of time will cause flash flooding in the mountainous regions (northern parts of the province) , while the floodplains – the

[7] PDMA. (2015, 08 01). Reliefweb. Retrieved from http://reliefweb.int/report/pakistan/special-report-chitral-and-situational-update-floods-khyber-pakhtunkhwa

main centers of population and agricultural activity (central valley plain and piedmont plain) due to alluvial soil – will be affected by massive riverine floods. Intense rainfall can cause soil erosion and nutrient depletion. Furthermore, a lack of rainfall in drier areas of central valley and southern parts with high altitudes would result in drought.

Changes in food production- This impact is most significant on central valley and southern parts where majority of the agricultural activity occurs. Changes in crop variety and quantity will occur when weather patterns shift, temperature rises and rainfall becomes more irregular. Under the expected changing climate, viral infections, weeds and pest attacks are projected to grow. Farmers will also have to cope with depleting water supplies and extreme temperatures that are unfavorable for crop growth. Moreover, they will have to deal with frequent insect infestation due to favorable warmer humid climate for insects. In the north with an increase in temperature, more crops will be able to be cultivated, such as wheat, maize, rice etc., whereas the Central Valley Plain, which is currently the main region for agriculture and also the southern Piedmont region, will face water shortage due to decrease in rainfall, causing a decrease in crop production. These changes along with natural hazards such as floods (which completely destroy agricultural fields and ready to harvest crops) and droughts will cause food security issues in the province.

Shifting weather patterns- The people, flora and fauna of KP may be severely impacted by the changing weather patterns, which include heavy rainfall and temperature rise. Warmer weather stimulates the growth of forest insects, which damages the trees. Droughts, on the other hand, have a comparable weakening impact. Temperature rise also encourages the spread of viruses and bacteria, posing health concerns to individuals, particularly those who consume polluted water. Moreover, droughts and floods play a significant part in the scarcity of potable drinking water.

Glacial melting- The Hindu Kush Himalayan Range is dominated by glaciers throughout the year. Glacial Lake Outburst Floods (GLOFs) are one of the most serious hazards that affect the mountain areas of the province. Higher temperatures and longer summers have led to rapid glacier melting. Normally, the spring season aids in the freezing process of glaciers because the temperature is lower. However, due to global warming and extremely short spring season, glaciers do not have enough time to freeze. As a result, glaciers melt at a faster rate throughout the summer. These glaciers are natural, huge reservoirs of fresh water that take many years to fill up. As a result, if glacier melting is not addressed appropriately, the province may face more GLOFs events together with freshwater crisis.

Loss of species diversity- Climate Change is also a threat to diversity of species. There are approximately 100 endemic species in Pakistan, with 90 percent of these are found in the province of KP. Several mammal species, seven bird species and twelve internationally endangered endemic and migratory birds live in the Himalayan range and sub humid forests of KP. As a result, mountain regions are more vulnerable to biodiversity loss as a result of Climate Change . Furthermore, changes in precipitation and temperature patterns affect ecosystems, which provide habitat for numerous forest bird, mammals and insect species. Many plant species are unable to adapt to rapid Climate Changes. The same is true for mammals. Furthermore, changes in ecosystems can trigger changes in animal feeding patterns, weakening them and eventually leading to extinction (IPCC, 2021).

People and society- Climate Change has an impact on how people live. People must devise policies and strategies that will not only minimize the effects of Climate Change but will also slow down the rate of Climate Change. Extreme weather events caused by Climate Change have a significant impact on human health, livelihood, infrastructure and culture. People are also displaced as a result of Climate Change due to the loss of infrastructure and livelihood.

4.5 Need for the Updated Provincial Climate Change Policy for KP

So far, the KP Climate Change Policy 2017 has served as the guiding framework in the province on adaptation and mitigation measures. An updated provincial Policy is now required for the following reasons:

- The National Climate Change Policy has been updated in 2021
- The Nationally Determined Contributions have been updated and agreed in 2021
- The IPCC latest report based on state-of-the-art tools and data has been released in 2021
- The earlier Climate Change Policy was based on AR-5 datasets, whereas now the AR-6 datasets are available for future hazards assessment.
- The previous Policy does not cover some of the new challenges and hazards, such as locust attacks, dengue and other viral diseases
- Update Policy priorities, guidelines, Policy instruments and measures to address Climate Change as applicable and relevant to KP Province including Newly Merged Districts (NMDs).

The revised Climate Change Policy will provide comprehensive guidelines to the Government of Khyber Pakhtunkhwa for implementing the major Climate Change objectives of national and provincial priorities related to adaptation and mitigation of GHG emissions.

5. CLIMATE CHANGE ADAPTATION

Agriculture and livestock are a source of income and livelihood for almost 80% of the Khyber Pakhtunkhwa population. Dependence on agriculture as a source of livelihood is significantly higher in rural areas than in urban areas. By value, crops constitute about 70% of the agricultural produce whereas livestock rearing is around 30% of the same. Majority of the land owners are small farmers which depend on rain fed agriculture. Land for cultivation is irrigated through a network of canals and streams and also through rain. Khyber Pakhtunkhwa major crops include wheat, maize, sugarcane and tobacco etc. Khyber Pakhtunkhwa has a significant advantage in production of fruits namely watermelon, apricot, guava, walnut, apple, mango etc. In Khyber Pakhtunkhwa livestock rearing is practiced mainly for meat, wool, dairy products and eggs from poultry. Cows, buffalo, goat and sheep etc. are some of the common livestock animals reared in Khyber Pakhtunkhwa.

Unpredictable weather due to change in climate is threatening the agriculture and livestock sector of Khyber Pakhtunkhwa. Climate variations affect growth duration, soil moisture, nutrient levels and water availability for crops. These can increase the chance of reduced yields or even crop failure. Heat waves can increase animal mortality, increase prevalence of pathogens, threaten pasture and feed supplies.

5.1 Agriculture and Livestock

The agriculture sector in KP is plagued by a variety of issues. Small farmers own about one-fifth of the cultivable land in the province. The strain on natural resources is increasing as a result of urbanization, the scarcity of uncultivated land and the ineffectiveness of the existing irrigation system. The province is highly dependent on the import of various products from other provinces, including wheat. The crop production is low because the fertilizer and seed quality is substandard. Approximately 20% of cultivable land is uncultivated and a large portion of this uncultivated land is prone to land degradation (water logging and salinity), urbanization and inefficient water usage. The use of fertilizers and pesticides should not be excessive in order to increase agricultural productivity. Farmers frequently use pesticides in excess of their permitted limits due to lack of regulation and awareness and they often utilize chemicals that are forbidden in the international market. The institutional capacity of the KP government's departments and research is inadequate. Other issues confronting the agriculture sector include a lack of economic incentives and financial structures for farmers and weak market mechanisms, which needs improvement.

Rangelands and livestock in Khyber Pakhtunkhwa complement each other and consequently play an important role in the rural economy. The majority of the livestock are cows, goats and sheep, however there are donkeys, buffaloes, horses, mules and yaks. Domestic poultry is also employed for egg and protein production. Transhumance livestock farming is also practiced at higher altitudes, in which households keep a primary home at lower elevations where they live along with their animals for a specific period (mostly seven months). During the winter and early spring months, when livestock feeds on hay, straw and dry alfalfa, problems develop owing to a severe lack of fodder availability. Due to the low nutritional value of dry grass, livestock become weaker and malnourished during this time. During the summer, the animals gain optimal weight because they are fed on fresh grass and shrubs by taking them to grazing lands and alpine pastures. This

annual cycle of under-nourishment and over-nourishment in animals is a primary cause of low milk, meat and wool production, as well as low animal immunity to viral and bacterial infections. The provision of veterinary services is a challenge, hampered by a lack of staff, equipment, drugs and farmer awareness, as well as seasonal relocation of animals to inaccessible locations.

Policy Measures

I. Technology

- Promote biotechnology in terms of more carbon-responsive crops, improved breeds and livestock production through genetic engineering. (H) [8]
- Improve irrigation practices by adopting modern techniques such as laser land-leveling, sprinklers and drip irrigation wherever feasible. (H)
- Using GIS/RS remote sensing techniques, monitor land-use and land-cover for KP and develop a land-use plan to manage and plan for agricultural activities. (M)
- Encourage the use of appropriate technologies for small-scale irrigation, water re-use (waste/water recycling) and rainwater harvesting, etc. (H)
- Encourage the development of biogas plants in order to reduce GHG emissions. (H)
- Efficient utilization of crop residue & agro-industrial by products for animal feeding by using modern techniques. (M)
- Promoting water conservation techniques such as raised beds, mulching and inter-cropping. (H)
- Encourage measures to increase productivity including use of soil management techniques, organic farming land resource management, artificial insemination and livestock feed enrichment techniques. (H)
- Diversification in the Livestock Sector by modern techniques. (M)

II. Research

- Develop new crop varieties that are high yielding, resistant to heat stress, drought tolerant, less vulnerable to heavy rains and less prone to insect and pest attack. (H)
- Develop and introduce improved livestock breeds that have higher milk and meat productivity, are less prone to heat stress and are drought tolerant. (H)
- Develop high-quality datasets on crop, soil and climate-related parameters in order to find optimal cropping patterns for each zone and to support research work on Climate Change impact assessment and productivity projection studies. (H)
- Develop research on climate smart agriculture and livestock sector, exploring impacts of Climate Change on productivity of the two sectors and ways these can be addressed and reduced. (H)
- Enhance the research capability of several relevant organizations in order to make reliable projections of climatic parameters and river flows for seasonal, inter-annual and inter-

[8] H= High priority, M = Medium priority and L = Low priority

decadal timeframes to assess the related anticipated consequences on various crops and develop appropriate adaptation methods. (H)

- Develop and propagate low-cost food preservation and storage technologies. (M)
- Enhance veterinary extension services and research technology development. (M)
- Strengthening of coordinated Research and Development activities through sharing and access to resources and equipment, GIS, IT & Networking etc. (H)

III. General Management

- Revise agriculture and livestock legislation, policies and plans to reflect Climate Change considerations and compliance with the National Agriculture Policy 2018. (H)[9]
- Document and promote appropriate indigenous knowledge and best practices together with Integrated Pest Management (IPM). (H)
- Map potentially harmful weeds (such as Parthenium) and implement protective measures. (H)
- Strengthen regulatory and monitoring mechanisms to reduce the use of harmful/banned fertilizers, herbicides and pesticides while encouraging the use of organic farming techniques and water and soil conservation. (H)
- Streamline agriculture extension services especially to include Climate Change adaptation for better productivity and enhance the capacity of farmers. (M)
- Ensure the access of high-quality feed and fodder to livestock to supplement their grazing on rangelands. (M)
- Improve feed nutritional quality by using multi-nutrient blocks (MNB) made from urea, molasses, vitamins and minerals. (H)
- Establish Climate Change Units in agricultural research institutions to develop adaptation strategies for the projected impacts of Climate Change on agriculture. (H)
- Promote fodder conservation and preparation of feed supplement for livestock. (H)
- Strengthen capacities of relevant stakeholders including farming communities on sustainable farming techniques. (H)
- Recommendation of result-based prophylactic measures in concerned area for remedial purpose. (H)
- Develop climate-smart agriculture and green plans for the province. (H)
- Defining climate-inclusive agro-ecological zones in provinces to facilitate more area-specific and action-oriented research, climate-compatible planning and development. (H)
- Preparation of a district-level sectorial GHG emissions inventory. (H)
- Downscaling of Nationally Determined Contributions (NDCs) at district levels. (H)

[9] H= High priority, M = Medium priority and L = Low priority

- Development / downscaling of district wise climate scenarios to link climate adaptation and mitigation measures with district development plans. (M)
- Prepare baseline for Climate Change measurement and monitoring at provincial level. (H)

IV. Risk Management

- Develop a proper risk management plan, including crop insurance to protect against crop failures caused by extreme weather events (such as floods and droughts) and locusts attack. (H) [10]
- Assess, manage and reduce risks to crops by developing risk management systems for extreme weather events, water conservation strategies, desert cultivation and crop insurance. (H)
- Assess, manage and reduce risks to livestock by developing risk management systems for extreme weather events, livestock disease monitoring, surveillance system and livestock health units. (H)
- Encourage farmers, particularly in rain-fed areas, to avoid monoculture and instead cultivate a diverse range of heat and drought-resistant low delta crops to prevent crop failure. (H)
- Encourage agriculture drought management practices that recognize drought as a component of a highly variable climate, rather than considering it as a cause of natural disasters. (H)
- Enhance collaboration between the environmental agencies and livestock sector, to facilitate the farming communities for the upcoming environmental changes. (M)
- Conduct awareness campaign, which can enable farmers to focus their attention on adoption and change in livestock practices to meet the new challenges. (H)
- Capacity building of farmers on appropriate animal husbandry practices & disease prevention. (H)
- Production of veterinary biologics on large scale for livestock / poultry disease prevention. (M)
- Assess probable viral infections in the future and propose preventive actions in the wake of Climate Change. (H)

5.2 Forestry

According to the Planning and Development Department Govt. of KP, the forest cover provides a source of income for many people in Pakistan. This sector requires a lot of labor and it has a lot of potential for generating income and alleviating poverty. Aside from being a source of income, forests also serve as a home for a variety of species. Climate Change has an impact on forests both directly and indirectly. Climate Change affects not just forest production and growth, but it is

[10] H= High priority, M = Medium priority and L = Low priority

also associated with an increase in the number of forest disturbances. Carbon dioxide levels in the atmosphere, precipitation and temperature are all important factors influencing forest productivity. Storms, droughts and decreased tree health are some of the forest disturbances that influence forest productivity and tree species distribution. Due to lack of preventive techniques for improving forest health, valuable goods and services derived from forest ecosystems may be lost. Non-Timber Forest Produce (NTFP) is a vital source of revenue for forest inhabitants, providing a variety of fodders, resins, medicinal plants, honey, Mazri leaves and gums. Over exploitation of forests and Climate Change have significantly influenced KP's forest sector. As a result, restoration of damaged natural forests, watershed sources and pasturelands in the province must be prioritized.Moreover, promotion of NTFP is imperative in reducing poverty and improving the livelihood of people dependent on it.

Over the last five years, significant efforts have been made to revitalize the provincial forest resources. Billion Tree Afforestation project is a step towards green growth initiative of the province. At national level, the TBTTP is an extension of the Billion Tree Afforestation Project (BTAP), which was undertaken in the Khyber Pakhtunkhwa province from 2015 to 2018 and successfully planted one billion plants. Both of these programs are well-known around the world.

Policy Measures

I. Research

- Conduct research and data collection using modern methodologies and instruments to assess the current state of forests and the effects of Climate Change on forestry. (H)
- Improve capacity and create research opportunities for assessing, planning and monitoring the rising climate challenges. (H)

II. Awareness Raising

- Encourage multinational organizations and agencies to sponsor 'Corporate Social Responsibility' awareness campaigns about the benefits of forest ecosystems. (H)
- Increase public and private sector awareness of the benefits of conservation, including reduced land degradation, heat waves, high winds, intense rainfall and floods, as well as the protection of existing forests and the benefits of afforestation. (H)
- Female engagement in plant nurseries should be encouraged. (H)
- Facilitating plantation drives at the school, college and university levels. (H)

III. Governance Reforms

- Streamline legislation – if necessary - and undertake concerted legal action against the timber mafia to prevent poaching of forest timber and for adoption of new management approaches, regularization of mechanism for NTFP management, taking measures for the promotion of ecotourism, provision of magistrate power to forest staff and leasing plus mining within forest etc.(H)

- The regulation of appropriate ecological and environmental functions must adhere to UNFCCC resolutions, as well as the REDD+ and REDD++ approach. (M)

IV. Enhancing Adaptive Capacity

- Encourage adaptive forest management and conservation approaches tailored to specific areas, with more participation from forest-dependent communities and a gender-inclusive approach. (H)
- Establishment of gene bank of forest species to preserve the genome in order to combat the possibility of erosion of any individual species or gene within the gene pool of Khyber Pakhtunkhwa Forest. (H)

V. Forest Management

- Investigate and create innovative forest management and adaptive planning solutions in accordance with Climate Change scientific studies. (H)
- Assess the Natural Capital Accounts (NCA) for protected habitats. (H)
- Maintain and enhance ecological and environmental values of forests that include but are not limited to water yield, carbon sink, land stabilization and biodiversity conservation to stabilize ecosystem and nature conservation for recreation, games and sports. (H)
- Develop capacities for assessment, planning and monitoring of the forest resources, to remove threats to deforestation and loss of biodiversity so that adverse changes that may arise can be detected and redressed through revised codes and management plans. (H)
- Establish a network of forest protected areas, buffer zones and ecological corridors, where possible, to conserve biosphere reserves particularly in unique types of forests. (M)
- Conserve and promote Non-Timber Forest Products (NTFP) through sustainable use mechanisms and proper processing and marketing management in order to boost income from these activities and improve the livelihoods of underprivileged people living in forest zones. (H)
- Manage, develop and rehabilitate the rangeland through the creation of a new rangelands management circle. (M)
- Encourage private sector for increasing forest cover on available wastelands particularly for enhancing timber production. (M)
- The entire watershed area of Khyber Pakhtunkhwa needs to be treated simultaneously through the mechanism of complete valley treatment instead of patch plantation approach. (M)
- Ban all the anthropogenic activities in the fragile areas of all ecosystems especially not to allow housing schemes inside or nearby forest areas. (H)
- Fuel wood extraction being the main cause of forest depletion can be controlled by arranging alternative energy sources to the forest areas. (H)

- Promote urban and peri-urban forestry. (H)
- Ensure forest land is not transferred or leased to any government institution or private entity for purposes other than preserving and enhancing the forest value. (M)
- Promote urban forestry, for Landscape improvement, social forestry and farm forestry to increase woody biomass out of forest areas. (H)
- Develop mechanisms for more preservation and less conservation approaches to ensure more sustainable management of all types of forests by developing working plan codes and manuals of strategic, operational management plans, as well as Village Land Use Plans (VLUPs) that include biodiversity working circle, gender working circle, community welfare working circle, eco-tourism working circle and improvement working circle in addition to conventional/traditional protection or commercial working circles through participatory integrated management approach. (H)
- Facilitate urban plantation along highways, buildings and high-rise infrastructure. (H)
- Cultivate diverse and aged forest belts around forest parks to mitigate the effects of potential snow and wind storms. (M)
- Create efficient methods to protect the interests of vulnerable forest-dependent populations. (H)

VI. Reducing Forest Fires, Disease Outbreaks and Other Damage

- Enhance capacity building of forest department to combat forest fires and include forest communities in wildfire detection and suppression. (H)
- Provide forest fire prediction and protection services. (H)
- Adopt tissue culture technique to combat the impact of climate on natural regeneration and seed viability issues. (H)
- Maintain viable populations of predatory birds and insects to ensure biological control of forest pests. (H)

VII. Reducing Soil Erosion

- Identify and declare vulnerable uphill fragile watershed areas as sensitive and place them under specific silvicultural management by incorporating local populations in order to prevent floods and siltation of water reservoirs. (H)
- Afforestation of barren and degraded lands as well as uphill watershed areas to control sediment and various types of soil erosion. (H)

5.3 Human Health

Human health vulnerability to Climate Change is determined by exposure, sensitivity and coping capacity. With rising temperatures and the frequency of natural disasters, disease prevalence is expected to rise, particularly for water-borne diseases and infections (IPCC, 2021). Heat strokes, gastrointestinal problems, respiratory diseases, skin diseases, eye infections, malaria and

mortality due to extreme weather events are likely to increase in severity, frequency and intensity. Storms, floods and droughts, caused by Climate Change, can force people to migrate to urban centers of the province. This can have spill-over effects such as lack of housing facilities, water and sanitation problems and an increase in transfer of diseases in high population density areas of KP. The province already suffers from high mortality rates for infants, children and women and inadequacy of public health facilities and service, which are likely to be exacerbated by the impacts of Climate Change if not addressed effectively.

Policy Measures

- Carry out research to assess the effects of Climate Change on human health and the health sector in KP Province, evaluating the risk of conditions, symptoms and diseases that are likely to have an influence on human health. (H)
- Inform, sensitize, educate and train health professionals and the general public on Climate Change-related health risks. (H)
- Ensure that preventive measures and resources such as vaccinations, high-quality medication and safe drinking water, are widely and affordably available to the general public, particularly during climate-related extreme events. (H)
- Develop plans and strategies to forecast, monitor and address the impacts of Climate Change (extreme temperatures, extreme weather events and resulting effects) on health through both preventive - measures such as building more healthcare facilities in both urban and rural areas, providing vaccines, improving access to clean drinking water - and curative measures such as medications. (H)
- Identify the vulnerable communities, enhance their access to and quality of health services and strengthen their knowledge and capacities to minimize their health susceptibility to Climate Change. (H)
- At all levels of service delivery, improve data recording, reporting, analysis and storage of climate-sensitive disorders. (H)
- Prioritize climate-related risks based on assessment and identification of technology and infrastructure alternatives to improve resilience in the Water, Sanitation and Hygiene (WASH) sector. (H)
- Consider public-private partnerships to address the issue of WASH service provision financial access as well as quality assurance. (H)
- Inform, sensitize, educate and train health professionals and the general public about Climate Change related health risks like dengue, particularly those affecting women and children. (H)
- Take the required actions to incorporate "Health in All Policies" (HiAP) and enforce the "One Health" Policy. (H)
- Create a network of community-based rescue and first-aid services. (M)

5.4 Water Resources

KP water resources are used by agriculture, domestic households, industries and power generation. Tarbela, Warsak and Dargai-Jaban dams, situated in KP, are vital for hydro-electric power generation. In KP, surface water is found in the form of springs, precipitation, lakes streams and rivers and glaciers. Ground water can be found as aquifers and alluvial deposits.

In KP water stress has been exacerbated by reckless dumping of municipal and industrial waste into surface-water bodies, exploitation of underground water and water intensive manufacturing processes, with increasing pressure generated by population growth, agriculture, deforestation and impacts of Climate Change. With losses to storage capacity of water and increasing water stress per capita, surface water availability in KP is likely to fall.

Climate Change is likely to increase water demand for cultivation and other uses, shrink water supplies and untreated waste dumped into the rivers can degrade water quality. Climate Change induced shifts in snowfall and precipitation patterns are likely to increase the stress on existing water resources. Changes in the hydrology are likely to impact the intensity, frequency and cost of extreme events. Flooding and droughts are likely to become more frequent and severe.

Water scarcity will have a disproportionate impact on agriculture and food security. KP accounts for 22.414% of provincial area available for cultivation (Agriculture Statistics, 2018-19). Rain-fed farming is practiced on nearly half of the cultivatable land of the province. A decline in KP's water availability can have serious implications for KP and adjacent provinces. This can have a significant influence on agriculture, livestock, industry and household, resulting in monetary losses and migration. Improved water resource management can boost agricultural land income and reduce water scarcity.

The risk of Climate Change exacerbates the situation because water is the primary medium through which Climate Change will threaten the livelihoods and well-being of societies. Investing in water management contributes right now to poverty reduction and in longer term to climate resilience and sustainable development. Water security is the cornerstone of economic growth, it cuts across a wide range of sectors like agriculture, industry, mining, energy, domestic supplies, health and education. The Khyber-Pakhtunkhwa province is endowed with vast water resources, which are essential for basic human needs, agriculture, hydropower, industries and to sustain aquatic environment. However, the Climate Change has impacted the water resources of the province to a great extent, threatening the human as well as ecological sustainability.

Policy Measures

I. Water Storage and Quality

- Assess and address the needs for additional water storages and distribution infrastructure and the quantity and sources of water available in the province. (H)
- Set up a water quality monitoring and management system, as well as enforce water quality standards. (H)
- Assess climate-inclusive water availability, water use and balance (for surface and groundwater) and identify prospective future development sites in KP. (H)

- Construct new multi-purpose small, medium and large dams. (H)
- Construct ponds and encourage rainwater harvesting. (H)
- Ensure the early rehabilitation, remodelling and up-gradation of the existing irrigation infrastructure in order to make it more resilient to Climate Change-related extreme events. (H)
- Identify hill-torrents and the development of their storage in KP. (H)
- Extend the life of existing reservoirs through watershed management. (H)

II. Water Conservation Strategies

- Promote water conservation by promoting rainwater harvesting techniques, sustainable ground water exploitation, wastewater recycling through proper treatment and its reuse. (H)
- Development of water management activities for existing irrigation systems and dams. (H)
- Develop contingency plans for short-term measures to adapt to water shortages that could help to mitigate droughts and floods. (H)
- Reduce water losses by rehabilitating irrigation systems, water courses and sediment removal. (M)
- Introduce incentives to encourage efficient water use. (H)
- Implement water pricing in various districts based on water availability and groundwater situation. (H)
- Encouraging the use of water-saving technology, such as demand-based irrigation systems with soil-moisture sensors and automated gates at watercourses (H)

III. Integrated Water Resource Management

- Preserve groundwater through management and technical measures such as regulatory frameworks, water licensing, delay-action dams, artificial recharge, sub-surface/recharge dams and the use of integrated water resources management concepts and practices, particularly for threatened aquifers. (H)
- Introduce environment-friendly pesticides and fertilizers to reduce intrusion of toxic compound into surface and ground water sources. (H)
- Assess the Climate Change impacts on water resources on regional scale, including knowledge and strategy gaps in water resource management, spatial variability and vulnerability characteristics (among communities, locations and eco-systems). (H)
- Determine best practices and techniques, including traditional knowledge. (H)
- Ensure wastewater recycling through proper treatment and its reuse, such as in agriculture, artificial wetlands and groundwater recharge. (H)

- Develop local adaptation plans on pilot basis to increase resilience of local communities in participatory mode and capacity to address critical water resources management issues. (M)
- Enhance water security and climate resilience through better water resources management in Khyber-Pakhtunkhwa province. (H)
- Build capacities of institutions and stakeholders to integrate water security and climate resilience in development planning and decision-making processes. (H)
- Improve sustainability of poverty alleviation, rural development and water resources development projects and programs. (H)
- Improve livelihoods of communities at local level through pilot projects on climate resilience with stress on agriculture and food security. (H)

IV. Legislative Framework

- Legislate and enforce waste management practices in the industrial and domestic sectors to protect the environment, particularly water resources. (H)
- Using a participatory approach of the farmers, develop and enforce reforms, laws and regulations required for efficient water resource management. (H)
- Investigate the possibility of joint water quantity, quality and watershed management of trans-boundary catchment areas with neighbouring countries. (H)
- Investigate the possibility of establishing a water treaty and conducting joint research with Afghanistan. (H)

V. Enhancing Capacity

- Increase investment in water sector research to improve water efficiency, identify latest tools and technologies, develop the best financial and monitoring systems and reduce water losses. (H)
- Strengthen capacities of all relevant stakeholders for monitoring, protection and conservation of water resources. (H)
- Improve hydro-climate telemetry and early warning system. (H)

VI. Increasing Awareness

- Promote awareness on the importance of conservation and sustainable use of water resources. (H)

5.5 Biodiversity

Khyber Pakhtunkhwa biodiversity includes a diverse array of ecosystems and species and provides for a wide range of ecosystem services, such as providing fresh water, regulating the climate, inhibiting soil erosion, regulating surface runoff and providing bio-resources.

Apart from Climate Change, the biodiversity in KP Province faces major threats like deforestation, overgrazing, soil erosion, salinity and water logging, non-sustainable agricultural practices and hunting. It is predicted, however, that, in future, Climate Change will be the single biggest driver of biodiversity loss next to land-use change[11].

Climate Change affects a range of environmental factors such as temperature and moisture, which in turn affect species habitat and health. Some species are more adaptive, but, for others, a changing environment is a threat to their ability to survive and therefore threatens their existence.

Efforts so far to address threats to biodiversity have mainly been in terms of management of protected areas for the preservation of flora and fauna in their natural state. The protected areas (Figure 4) including wildlife sanctuaries and game reserves spanning over 1.05 million hectares attract vast varieties of migratory species every year and they face similar threats to their survival including Climate Change. There are six national parks, three wildlife sanctuaries, 38 game reserves, 22 private game reserves,84 community game reserves, two wildlife refuges and eight wildlife parks in KP Province[12].

According to the Wildlife Department in KP Province[13], impacts of Climate Change are being observed which affect both migratory and indigenous flora and fauna. These include:

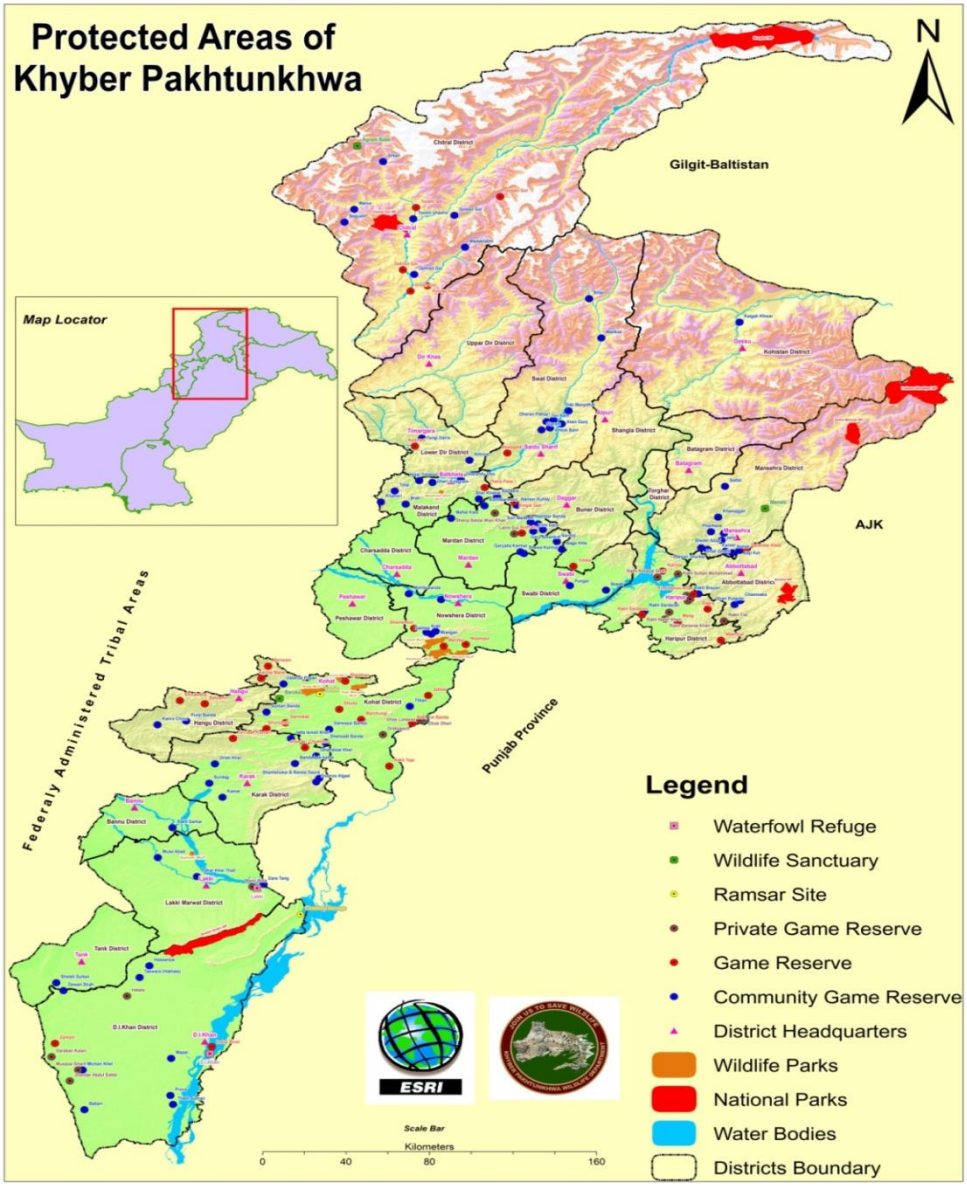
- Land degradation due to extreme weather events, natural hazards and soil erosion that causes loss of soil fertility and agricultural productivity.
- Changes in water quality and quantity in inland freshwaters.
- Degradation of vegetation in watersheds due to Climate Change.
- Changes in terrestrial, inland, wetland and fisheries systems, their species and ecosystem services, due to changes in rainfall regimes, rising temperatures and natural hazards such as earthquakes and floods.
- Changes in growth rates, reproduction and geographic ranges of species and penology of plants due to climatic changes.

[11] Millennium Ecosystem Assessment (2005) Synthesis Report

[12] Information received from KP Wildlife Department as part of the consultative process adopted for development of this Policy

[13] Information received from Wildlife Department as part of consultation process for development of this Policy

Figure 4: Protected Areas of KP, Source: Wildlife Department KP (Newly merged districts have not been mapped)



In December 2019, the Government of Pakistan launched its highly innovative 'Ecosystem Restoration Initiative (ESRI)' to support the transition to an environmentally resilient Pakistan by mainstreaming adaptation and mitigation through ecologically targeted initiatives. This initiative also established an independent, transparent and comprehensive financial mechanism in Pakistan called the "Ecosystem Restoration Fund (ESRF)" to fund the projects and programs under the initiative. This fund will aid Pakistan's transition to climate compatible development. The fund's present initiatives include afforestation, biodiversity conservation, marine conservation, eco-tourism promotion and electric vehicle.

In addition, the Government of Pakistan launched the "Protected Areas Initiative" in 2020. The main goal of the initiative is to create 15 model protected areas across the country and expand protected areas to cover at least 15% of Pakistan's area by 2023. Furthermore, biodiversity conservation will be boosted through proper management plans, legislative interventions and standardized eco-infrastructure designs.

Policy Measures:

- Establish and manage protected areas and increase their resilience for sustainable benefits of present and future generations, ensuring complementary schemes to mitigate adverse impacts on livelihoods of local communities. (H)
- Explore funding opportunities through recently launched initiatives such as Ecosystem Restoration Fund (ESRF) and Protected Areas Initiative. (H)
- Develop mechanisms to incentivize local communities to forge certain uses of land to be protected and to contribute to protection of such land. (H)
- Negotiate and agree on proper management of the protected areas and revise trophy hunting rules to further improve the transparency, governance and equitable sharing of resources among the communities. (H)
- Establish nature reserves, botanical gardens and gene banks in all the districts for recreational needs and educational purposes and increase awareness and strengthen capacities of relevant institutions, NGOs, CSOs, communities and nature conservationists for conservation and sustainable use of biodiversity. (M)
- Improve understanding of the Climate Change impacts on biodiversity and monitor the impact on biodiversity due to the changing climate. (H)
- Facilitate ecosystem-based adaptation14 of biodiversity to Climate Change by increasing – in particular – the resilience of the protected areas and of fisheries. (H)
- Ensure implementation of hygiene regulations regarding aquatic habitats i.e., rivers, lakes, streams etc. (M)
- Ensure proper management and mitigation of invasive species that are spreading as a result of Climate Change. (H)
- Ensure the use of Integrated Pest Management (IPM) to control pests (such as locust). (H)
- Ensure that current protected area coverage is expanded and that these protected areas are fully functional with an appropriate ecological management plan to ensure future ecosystem sustenance. (H)

[14] **Ecosystem based adaptation** provides a cost-effective strategy that can be undertaken by parties and is especially effective at local levels with community involvement. Ecosystem-based adaptation may also contribute to Climate Change mitigation through the preservation or sequestration of carbon

5.6 Land and Vulnerable Eco-systems (Mountain Areas, Pastures, Arid and Semi-arid Areas, Wetlands, Rangelands)

Ecosystems provide valuable goods and environmental services for social and economic wellbeing. KP's natural ecosystems are experiencing degradation due to anthropogenic pressures and aggravation in the impacts of the Climate Change manifested by increase in extreme weather events and glacial melt, resulting in Glacier Lakes Outburst Floods (GLOFs).

The agro-biodiversity has suffered seriously due to introduction of high-yield varieties of food and cash crops and use of agrochemicals. The major threats to terrestrial ecosystems are from overgrazing and deforestation due to increasing population pressure and poverty. Deserts in KP may expand. Due to prolonged droughts and extreme weather conditions, certain areas of KP in the southern districts may develop desert characteristics in the long run, while characteristics of cold deserts may arise in certain northern districts of KP.

In KP rangelands play an important role in Climate Change mitigation as they store and sequester large amount of CO2 in the form of biomass and organic matter. Rangelands are very important for rural livelihoods and ecological stability of the province.

Policy Measures

- Identify vulnerable ecosystems in KP Province and take measures to increase their resilience to changing climate while encouraging sustainable use of such ecosystems. (H)
- Map and monitor glacier lakes using remote-sensing data, techniques and state of the art tools in conjunction with field expeditions. (H)
- Assess potential risks in GLOFs prone areas and developing adequate remedial measures to save people and ecosystems. (H)
- Establish Early Warning System (EWS) in potentially hazardous lakes and ensure its sustainability. (H)
- Create and maintain a sustainable community-based disaster response and risk management system to deal with the impacts of GLOFs. (H)
- Impart trainings and drills periodically to the community regarding mitigation of GLOFs. (H)
- Enhance work on Lake Breach Modelling (LBM). (H)
- Conduct a Climate Change impact assessment in mountain areas to identify future potential for agricultural development due to extended high temperature periods in cold areas. (H)
- Establish Solid Waste Management (SWM) system to preserve nature and the ecosystem of mountain areas. (H)
- Avoid farming on steep slopes with high-delta crops. (H)
- Ensure slope stabilization during developmental projects such as road construction. (H)

- Promote eco-tourism as opposed to traditional forms of tourism restricting commercial activities to ensure assimilative capacities of vulnerable ecosystems are maintained and improved. (H)
- Restrict commercial activities such as illegal timber trade and other developmental activities that are harmful to mountain ecology with community participation. (H)
- Establish coordination between relevant and appropriate stakeholders particularly forest, wildlife, irrigation and livestock departments for efficient management of ecosystems including rangelands, wetlands and other resources while ensuring the rights of the indigenous people. (H)
- Revive threatened ecosystems such as rangelands and enhance ecosystems by creating artificial wetlands wherever secondary water resources are available or rain harvesting is possible and by increasing grasslands in waterlogged zones. (H)
- Recognize the role played by wetlands in natural disaster protection and ensure controlled conversion of wetlands and their immediate surroundings for agriculture and grazing purposes. (M)
- Generate financial resources and take the necessary steps to establish a Provincial Ecosystem and Rangeland Management Fund. (M)
- Take measures for promotion of rangeland research technology and development in KP. (M)
- Encourage glacier related research, such as glacier mass balance and the effects of black carbon on glacier health. (H)
- Conduct Surveys to identify rangeland areas through GIS and Remote Sensing technology. (H)
- Trace potentially harmful weeds (such as Parthenium) and propose/implement protective measures. (H)

5.7 Disaster Preparedness

KP is prone to multiple and frequent disasters of various types, predominantly floods, due to its geographical and topographical conditions and droughts in some areas. Climate Change is making the occurrence of extreme climatic events more frequent. According to data compiled by the Federal Flood Commission, the combined flow of River Swat and Kabul reached a new record level of 400,000 cusecs in 2010 compared to the previous figure of 250,000 cusecs recorded in 1929.

The increased frequency of flash floods and floods is anticipated to result in surface runoff, avalanches, riverbank cuttings, soil erosion and landslides, causing damage to properties, roads, houses and agricultural fields. The recent floods witnessed in the month of August 2022, inundated crops, demolished infrastructure and resulted in mass migration/displacement across the province.

Policy Measures

- Develop a Provincial Disaster Risk Reduction (DRR) Policy to ensure the implementation of the Sendai Framework and National DRR Policy (2013), with a focus on climate-induced extreme events and disasters. (H)
- 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. (H)
- Develop Nature-based Solutions (NbS) for Disaster Risk Reduction (DRR). (H)
- Conduct climate-inclusive Multi-Hazard Vulnerability and Risk Assessment (MHVRA) studies on district-level. (H)
- Improve the early warning system inclusive of potential Climate Change hazards. (H)
- Update and revise building codes in response to recent disasters and Climate Change. (H)
- Create evacuation plans with consideration for women, children, disabled and elder-people. (H)
- Carry out hazard and risk mapping of existing infrastructure for telecommunications, power, utilities, transportation, irrigation and agriculture and improve their resilience against Climate Change, earthquakes, landslides, avalanches, GLOFs and other disasters. (H)
- 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. (H)
- 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. (M)
- Develop an ‘assessment and compensation mechanism’ including insurance of losses and damages in the aftermath of disasters and measures for rehabilitation. (M)
- Plan, design, construct and strengthen appropriate flood embankments, dykes, protective bunds to protect flood plains and populations in view of likely floods. (H)
- Design, construct and upgrade disaster resilient multi-purpose buildings in relatively safer areas to use as shelter during natural calamities. (H)
- Ensure storm drainage system in major cities for intense rainfall events. (H)

5.8 Socio-economic Measures (Poverty and Gender, Marginalized People Youth Role)

5.8.1 Poverty

The rate and pattern of economic growth is a critical element in poverty eradication and, climatic factors can have a powerful bearing on both. Rapidly growing population, poverty and Climate Change impacts are some of the key drivers that lead the process of desertification and land degradation causing significant threats to food and economic security.

The percentage of people living below the poverty line in KP is estimated to be 39%, much higher than the national level. Poverty is concentrated in rural areas where more than 80% of KP's population lives. A large proportion of the population lives on or slightly above the poverty line and the vulnerability of this group worsens in the event of a natural disaster. An internal or external crisis including impacts of changing climate may push these people deeper below the poverty line.

Policy Measures

- Mainstream climate-poverty nexus in provincial planning, such as in Poverty Reduction Strategies (PRS), provincial population planning strategies and programs and annual budgetary planning. (H)
- Identify and strengthen communities at risk due to the impacts of Climate Change. (H)
- Conduct research to analyze the impact of Climate Change on poverty and on the development potential of province. (H)
- Improve governance, Policy and decision-making processes, which can have a critical bearing on the way in which policies and institutions respond to the impact of climatic factors on the poor. (M)
- Improve awareness and access of poor communities to appropriate technologies for climate smart agriculture, energy and industrial development. (M)
- Share knowledge of local agricultural practices, yields, landholding size and other relevant information with departments responsible for social welfare, safety nets and poverty alleviation, to make poor agricultural households more resilient. (H)
- Investigate, plan for and implement measures on climate induced migration as it primarily affects populations in the low-income group. (M)
- Enforce the implementation of SDGs in social-sector project planning, particularly SDG 13 and strengthen the capacities of the stakeholders (line-departments). (H)

5.8.2 Gender

While a large number of poor, rural women depend on climate sensitive resources for survival and their livelihoods, they are also less likely to have the education, opportunities, inclusion in decision-making process and access to resources they need to adapt to the changing climate. Women's vulnerability to Climate Change differs from men and Climate Change interventions that are not

gender-responsive often result in deepening the existing gender divide. There has been little progress towards bridging the gender gap in recent years.

However, Pakistan's revised Nationally Determined Contributions (NDCs) include a specific plan and strategy for involving youth and women in greater climate action. The Govt of KP and its leadership have expressed a commitment to gender equity and women's empowerment (Government of Khyber Pakhtunkhwa, 2014). To this effect, the government has set up the Provincial Commission on the Status of Women (KP-CSW) and revived the Women's Parliamentarians Caucus.

Policy Measures

- Incorporate gender perspective in development, climate adaptation and mitigation planning. (H)
- Ensure that women are less vulnerable to the impacts of Climate Change, particularly in connection to their vital roles in the community, particularly in rural regions, for water, energy, food, storage activities, pesticide handling and livestock management. (H)
- Evaluate the Climate Change impacts on gender in KP. (H)
- Create guidelines for gender-inclusive climate-change-related Policy and decision-making. (H)
- Incorporate gender and Climate Change into school and college curricula. (H)
- Plan opportunities for gender roles to mitigate the negative effects of Climate Change. (H)
- Ensure equitable participation of women during every stage of decision-making process on Climate Change mitigation and adaptation initiatives, using the local and indigenous knowledge of women to improve their welfare. (H)
- Develop gender-sensitive indicators related to adaptation to evaluate and monitor vulnerability of women to climate impacts and to address it accordingly. (M)
- Establish coherence among the institutions dealing with issues of Climate Change, gender, human rights, population planning and health Policy. (H)
- Enhance capacity of women on responding disasters in an effective way. (H)

5.8.3 Youth Role

The Paris climate agreement, to keep global temperature below 2 Degrees Celsius, was reached in year 2015 at COP21[15]. The agreement signed by more than 175 nations, includes national plans for embarking on the economic and social transformation from reliance on fossil fuels to using cleaner energy sources. The Paris Agreement has raised a big global hope in particular for the young generation, who will have to face Climate Change effects for a long-term and developed a White Paper to keep momentum going. In this connection, engaging young professionals and building their capacity to bring about positive changes in the society has become crucial. Youth could play a crucial role in combating Climate Change. The young generation inhabits the Earth and inherits the responsibility to protect the planet, in fighting against Climate Change. Educating

[15] Conference of the Parties (COP21)

youth is one of the most effective tools to combat the destructive potential of Climate Change and cultivate an international understanding among members of the next generation.

Youth are enthusiastic, innovative, quick learner and easily can adapt the low-carbon lifestyles and career choices as a part of their daily lives. However, it is the youth of the country who are going to suffer the most in future from impacts of Climate Change. Asia is home to 738 million young people and 61 percent of the world's youth but before the youth gets ready to take concrete steps, they need support to build their capacity and develop diverse knowledge about Climate Change. This requires appropriate education and relevant trainings. More efforts must be made to ensure that young people are ready to take advantage of new environment-oriented employment opportunities. Growing attention to Climate Change and sustainable development offers an ideal opportunity for green economic growth around the world. Green jobs not only provide much needed employment opportunities for youth, they also give young people an outlet to contribute directly in collective way to the fight against Climate Change by adopting green behaviors/strategies in the social, national and workplace as well.

Climate Change now has become a global challenge which is going to affect everyone in every corner of the globe. Governments would have to take strict measures to curb Climate Change and to prevent disasters.

Policy Measures

- Involve youth in the decision- making in like formulation of adaptation & mitigation strategies on Climate Change at local and provincial level. (H)
- Promote opportunities for youth groups to engage in and benefit from, KP's adaptation and mitigation initiatives. (H)
- Raise awareness among youth to play role, how to combat Climate Change through mitigation and adaptation practices. (H)
- Establish Community based Organizations (CBOs) consisting young volunteers focusing on Climate Change adaptation practices. (H)
- Involve academia and youth organizations in Climate Change mitigation and adaptation trainings and capacity building. (H)
- Develop projects on pilot basis to motivate youth at optimum level to play active role in the spreading the information and knowledge regarding Climate Change in the backward areas of the province. (M)
- Involve Media including Electronic, Social & Print in all activities of youth for boosting up their role in combating Climate Change. (H)
- Evaluate the effects of Climate Change on youth and employment in KP. (H)
- Prepare guidelines for youth inclusiveness in climate-change related Policy and decision-making. (H)
- Incorporate youth and Climate Change into college curricula. (H)

6. CLIMATE CHANGE MITIGATION

As compared to international standards, Pakistan's per capita greenhouse gas (GHG) emissions are low. In 2017-18, Pakistan's total GHG emissions were 490 million tonnes of CO_2eq. The agriculture, forestry and land use sectors account for about 46 percent of GHG emissions in Pakistan, followed by the energy sector (45 percent), industrial processes (5 percent), emissions and waste (4 percent) (National GHG inventory 2017-18).

At the 'UN Climate Ambition Summit' in December 2020, the Prime Minister, in his speech, has set the direction of Pakistan's pathway to decarbonizing the country's economy. He declared that by 2030, 60 percent of the energy produced in the country will be clean and through renewable resources, thirty percent of all vehicles in the country will be electric and that Pakistan will no longer establish imported coal power plants. These broad statements in addition to a “Ten Billion Tree Tsunami Afforestation Initiative” can provide the country’s blueprint for decarbonization and accomplishment of NDCs targets.

Therefore, the KP government will need to plan the targets that will help in achieving the NDCs targets.

6.1 Energy

The energy sector in KP Province holds great importance in terms of electricity supply for the entire country due to its hydel power stations. Other provinces in Pakistan have rather limited primary energy resources, particularly potential sites for hydel power generation and depend to a large extent on the energy produced in KP Province. Because of continued and rapid growth in population, urbanization and industrialization in recent years, the demand for electricity has increased more than its production resulting in a serious energy crisis. Due to economic growth and increase in population the electricity demand is further expected to rise in Pakistan to 40,000 MW by 2020[16] and onwards. This will put further pressure on the province to cater to additional energy needs of the country.

Energy generation is the most significant contributor to GHGs emissions with vast majority of these emissions coming from the combustion of fossil fuel (oil, gas, coal), while energy consumption is a reliable indicator of economic development. Planning for energy is required in order to overcome energy shortages, to develop indigenous energy resources for sustainable and affordable energy and to reduce GHG emissions.

Policy Measures

- Develop a provincial energy Policy on the use of indigenous renewable energy resources to reduce dependency on imported fossil fuels, which can include hydropower, solar, wind, geothermal energy, waste to energy, bio-energy and indigenously produced natural gas. (H)
- Provide an enabling political, regulatory and financial environment for uptake of renewable energy, particularly for population of remote areas. (H)

[16] Pakistan Water and Power Development Authority (WAPDA) cited in Economic Survey 2014-2015 by Ministry of Finance

- Implementation of WAPDA's recently announced "Green Bond" for energy development. (H)
- Assess GHG emissions resulting from proposed and adopted energy strategies and plans and integrate this information in future energy planning. (H)
- Promote the use of solar water heating technologies to replace traditional natural gas fuelled water heating systems, in residential, commercial and industrial buildings. (M)
- Capitalize on the opportunities presented by engaging private sector on renewable energy production and uptake. (M)
- Promote research on low carbon and renewable energy sources, technologies and on the feasibility and cost-effectiveness of available sources. (H)
- Increase the effectiveness of existing financial support mechanisms and provide further incentives such as carbon taxes, subsidies and feed-in-tariffs and tax reforms for switching to renewable energy. (M)
- Promote zero emission building designs such as Passivhaus[17] especially for public sector that have minimal non-renewable energy requirements. (M)
- Develop capacities and knowledge of relevant stakeholders, including government departments and local technicians for adoption, smooth operations and maintenance of renewable energy technologies. (M)
- Promote and improve access to technology for Waste Heat Recovery, Co-generation and Combined Cycle Power Generation. (M)
- Promote and subsidize energy innovations such as net metering, domestic solar installations, smart grids to encourage renewable energy adoption and development. (H)
- Encourage and mobilize local and foreign investment in renewable energy markets through the provision of incentives and support. (H)
- Develop regulatory frameworks to encourage off-grid renewable energy development, such as micro and mini hydro-power projects, in rural and remote areas. (H)
- Restrict timber harvesting and wood burning, as well as offering alternative energy options to mountain cold regions. (H)

6.2 Energy Efficiency and Energy Conservation

Energy efficiency has a large potential to reduce GHGs emissions at low cost and to reduce the demand for energy ensuring sufficient energy supply is diverted to achieving economic development goals. Economically efficient use of energy causes less environmental impacts required for electricity generation, better health from improved heating or cooling and energy security protecting access to energy resources.

[17]The term passive house (*Passivhaus* in German) refers to a rigorous, voluntary standard for energy efficiency in a building, reducing its ecological footprint. It results in ultra-low energy buildings that require little energy for space heating or cooling.

Policy Measures

- Establish the Khyber Pakhtunkhwa Energy Efficiency and Conservation Authority (KPEECA) and enforce energy conservation rules and regulations. (H)
- Promote uptake of energy efficient technologies and measures particularly for industries and strengthen the strategic and legal framework necessary for energy efficiency improvement in energy end-use sectors. (H)
- Link up the energy efficiency and conservation concept within the existing legislative regime especially exploring the possibility of integration with Khyber Pakhtunkhwa Environmental Protection Act (2014) and building codes and enact new legislation as necessary for energy efficiency and conservation. (H)
- Conduct research and energy audits to identify energy use by different sectors (commercial, industrial, residential) within KP and their relevant conservation potential. (H)
- Raise awareness on energy saving options including maximum use of natural day light, better insulation and use of energy efficient lighting and appliances and promote energy conservation through mass awareness campaigns. (M)
- Improve access to financing and provide financial incentives for energy efficiency practices and projects by coordination within government and with the financial sector. (M)
- Develop and implement energy efficiency standards for devices and appliances. (M)
- Encourage energy efficiency and management initiatives that include innovative energy efficiency mechanisms and techniques in various sectors, particularly power generation, transportation, industry, biomass and waste. (H)
- Subsidize projects that promote energy efficiency and conservation. (H)
- Reduce line losses through better management and updated technologies. (H)
- Improve energy efficiency through standardizing building and construction codes and creating incentives for retrofitting, maximum use of natural light, improved insulation and the use of energy-efficient lights, boilers, appliances and groundwater pumping machines. (H)

6.3 Transport

The transport sector is a key economic sector, as well as a large and growing GHG emitter. The sector constitutes 10% of country's gross domestic product and provides 11 percent of the economic activity in the province (Government of Khyber Pakhtunkhwa, 2009). An efficient transport system with modern infrastructure will further improve the economic factor of production. Govt of KP has created an independent transport department to develop the sector and to implement the Comprehensive Development Strategy 2010 - 2017.

Globally the transport sector contributes to a quarter of GHG emissions originating from energy consumption. Most of the sector emissions originate from road transportation. These emissions from road transportation are expected to increase to 90.17 Giga-tons of CO_2 by 2030 (Sanchez-Triana, 2013). In Khyber Pakhtunkhwa over 96% of passengers and 90% of freight travels by

road. Demand for road transport has been expanding at a rate much greater than economic development as a whole. On the other hand, majority of the population does not use private transport and have to use the existing public transport which is not easily accessible, reliable or safe. Shifting investments to other alternate forms of transportation and strengthening the existing transport sector would complement efforts of the Govt of KP for achievement of public service delivery improvement, socio- economic growth and, poverty and GHG emissions reduction.

Policy Measures

- Create a transport sector GHG emissions inventory at the district level. (H)
- Ensure that the National Electric Vehicles Policy (NEVP)-2020 is taken into consideration for transportation development planning. (H)
- Encourage the use of electric and hybrid vehicles, followed by CNG-powered vehicles. (H)
- Plan and design mass transit systems. (H)
- Encourage the usage of public transportation. (H)
- Improve the existing road infrastructure to reduce GHG emissions. (H)
- Regulate vehicle testing and emissions standards. (H)
- Minimize the conflict points and optimize the traffic signals to reduce the delay time leading to the GHG emissions reduction. (H)
- Standardize and enforce the use of high-quality fuels. (H)
- Construct and renovate bicycle and pedestrian paths to encourage cycling and walking. (H)
- Ensure the use of recycled water at car-wash facilities. (H)
- Build and promote an efficient railway system in the province to mitigate GHG emissions. (H)
- Take into consideration Climate Change impacts in transport sector related planning. (H)
- Develop and implement strategies to promote a clean energy mix, low-carbon transportation technologies and low-carbon transportation modes such as mass transit and hybrid cars, as well as non-motorized modes such as cycling and walking. (H)
- Develop and enforce vehicle emission standards. In particular, encourage use of energy efficient transportation to reduce GHG emissions using principles such as vehicle fitness testing. (H)
- Provide financial, political and infrastructural enabling environment for energy efficient and low-carbon transport. (H)
- Conduct research to increase knowledge on current transport activity and related GHGs emissions, feasibility and cost-effectiveness of low carbon technologies and transportation modes. (H)

- Strengthen capacities in the province for improvement of transport efficiency, assessment of sustainability of transport modes and application of transport mitigation methodologies. (M)
- Explore opportunities and platforms for accessing domestic and international finance available for sustainable and low-carbon transport via carbon markets, climate funds and interested donors. (M)
- Explore the feasibility for use of clean fuels such as bio-fuel and compressed/liquefied natural gas in the transport sector. (H)
- Explore and conduct feasibility studies to develop use of inland waterways transport. (M)
- Develop and adopt strategies for public transport management system (buses) in urban areas. (M)
- Adopt and develop polices to reduce travel demand by providing facilities at walking distance i.e. Health, Education, Shopping and other entertainments. (M)

6.4 Waste

Solid waste comprises of municipal, industrial, hazardous, construction, packaging, agricultural and electrical and electronic equipment waste. In Khyber Pakhtunkhwa, municipal solid waste is estimated to be between 0.4 and 0.6 kilograms per day per capita. Nearly 40% of the waste generated is not disposed properly and ends up in streets and public spaces (Environmental Protection Agency, 2009). This creates a host of problems including environmental degradation, pollution of water and soil, exposure of humans and animals to toxins and air pollution.

Poor sanitation is a serious environmental health risk in Khyber Pakhtunkhwa. Wastewater from households, rural and urban, is discharged untreated into the open. The untreated wastewater pollutes the soil and underground water. This problem is particularly deleterious with respect to health and environment in rural areas where open defecation increases the exposure to human excretions (Planning and Development Department, 2021).

Lack of effective waste management systems is one of the biggest challenges being faced by the Government of Khyber Pakhtunkhwa at the moment. Weak waste management systems and increasing urban sprawl have exacerbated the waste management issues already faced by Khyber Pakhtunkhwa. Without Proper incinerators solid waste burning contributes to smog which is a serious environmental issue. Solid waste collection and disposal practices across the province need attention, especially in tourist districts of Hazara (Planning and Development Department, 2011[18]).

Policy Measures

- Develop provincial solid waste standards for waste storage, collection, transport, treatment and disposal, in line with air and water standards and ensure their implementation by all sub-sectors of the economy including any commercial activity, construction, industry and agriculture. (H)
- Implement the Sustainable Consumption and Production National Action Plan (SCP-NAP) at the provincial level to achieve sustainable city goals. (H)

[18] Planning and Development Department (2011) Economic Growth Strategy, Government of KP

- Develop proper collection, storage, transport and disposal system for municipal waste and wastewater and involve private sector in implementation of the system. (H)
- Endorse segregated collection at source and recyclable, composite and biodegradable waste disposal and re-use. (H)
- Develop and enforce plastic-use guidelines and restrictions. (H)
- Promote the use of biodegradable plastic bags and their recycling. (H)
- Ensure treatment of solid waste and wastewater. (H)
- Formulate certified waste management systems for solid, hazardous and e-waste. (M)
- Identify industries and sectors producing hazardous waste and e-waste and monitor implementation of waste management systems for waste production, transportation and disposal. (M)
- Raise awareness about hazardous waste and inform all stakeholders of its toxic nature and impacts. (M)
- Conduct feasibility for waste-to-energy projects and promote the use of agricultural waste as industrial fuel. (H)

6.5 Industries

Industries in Khyber Pakhtunkhwa province have a significant contribution to economic growth. The sector contributes 13.5% to provincial GDP[19], generates employment and supplies some of the basic necessities through a competitive manufacturing sector.

Khyber Pakhtunkhwa has an extensive agriculture-based industry that produces various products including tea, tobacco, match boxes, vegetable ghee and sugar. About 78% of national marble production, 27% of cement production and 20% of mining activities take place in KP province. There are approximately 12000 small, medium and large industrial units in Khyber Pakhtunkhwa out of which, 1821 are functioning and registered with the Directorate of Industries, Khyber Pakhtunkhwa[20].

The industrial sector is faced with many challenges which include shortage of electricity and lack of infrastructure. Changing climate and its impacts render additional set of challenges on industries when faced with extreme temperatures and climate induced temperatures particularly those that affect production or supply of raw materials.

Policy Measures:

- Mainstream Climate Change considerations in KP Industrial Policy 2016 to ensure a climate resilient and compatible industrial sector is developed. (H)
- Relocate industries away from the urban hubs, wherever possible. (H)
- Facilitate the use of latest technology, methods and tools such as in the brick kilns (e.g. conversion to zig zag) and chip board industries for reducing GHG emissions. (H)
- Prepare and enforce regulations for reducing GHG emissions in industries. (H)

[19]Khyber Pakhtunkhwa Board of Investment and Trade [Investment Guide]. Khyber Pakhtunkhwa the Unrevealed Story

[20]Bureau of Statistics (2015). Khyber Pakhtunkhwa in Figures 2015

- Enforce voluntary emissions monitoring in all industries where GHG emissions are produced. (H)
- Prepare GHG emissions profile of all the industrial zones of the province. (H)
- Provide incentives to encourage industries to embrace low-emission technologies, such as dual-functional materials for Carbon Capture, Usage and Storage (CCUS). (H)
- Create opportunities for industry to help with the transition to a circular economy model and to increase market demand for recycled products. (H)
- Provide evidence and information on GHG production and GHG reduction potential in industrial sector. (H)
- Design incentives (financial and non-financial) to encourage GHG reduction, lowering energy intensity as well as renewable-energy based energy production systems in industries. (H)
- Conduct energy audits and promote energy efficiency measures in industries. (H)
- Promote and improve access to GHG emission reduction and capture technologies such as Coal Bed Methane Capture and Carbon Capture and Storage. (M)
- Encourage cleaner production and propagate 'circular economy' concept for efficient use of resources based on UNEP's Sustainable Consumption and Production guidelines. (M)

6.6 Urban Planning

Govt. of Khyber Pakhtunkhwa wants to improve the access of public services in urban areas of the province having a population of 5,875,294, which is about 17% of the total population (Census-2017). These services include water, sanitation, drainage, streets and public infrastructure. Urban planning is of paramount importance to Khyber Pakhtunkhwa as the rate of migration, both rural to urban and urban to urban, is expected to rise. Spatial planning and management of urban land can help to reduce the number of environmental problems. Water supply, sewage and sanitation, drainage, vehicular emissions and solid waste management are amongst the top priority measures for urban planning for Govt. of Khyber Pakhtunkhwa. Unplanned urban development is likely to increase the environmental degradation in urban centers. It can increase water scarcity, exacerbate energy crisis, increase air pollution and produce social issues like crime and violence. Moreover, Environmental Impact Assessment (EIA) needs to be conducted before the construction of road networks, spatial planning and management of urban land.

For the fulfillment of these purposes Govt. of Khyber Pakhtunkhwa has initiated Community Infrastructure Program (CIP II), the provincial Urban Development Project (see National Urban Development Policy - NUDP) and the Rural Water Supply and Sanitation Project (RWSSP). Water conservation is a priority in urban planning since poor maintenance and construction results in high water losses.

Policy Measures

- Assess the hazards, vulnerabilities and threats posed by Climate Change in urban areas. (H)

- Promote urban forestation and plantation. (H)
- Relocate hazardous industries from urban areas. (H)
- Develop laws and regulations to manage urbanization and to prohibit conversion of land from one particular use to another. (H)
- Promote vertical growth, mixed land use, development of open spaces, efficient transport system, horticulture and landscaping and installation of energy efficient street lighting systems. (H)
- Develop and strengthen urban Policy and planning institutions including city development agencies for improved urban planning, land use planning for commercial, residential and industrial activities and resource mobilization. (H)
- Ensure provision of education, health, waste management, water and sanitation and hygiene facilities particularly in urban slums. (H)
- Upgrade areas with high cultural, social and economic value in cities including historical architecture, slums, parks etc. (M)
- Develop, revise and update master plans for major cities to prepare for contingencies like climate-induced migration and reduce risks from extreme temperatures, minimizing the heat island effect, where possible, in new settlements. (H)
- Ensure all urban planning is informed by appropriate Disaster Risk Reduction (DRR).(H)

6.7 Carbon Sequestration and Forestry

Forests can act as carbon sinks and help to reduce the amount of carbon in the atmosphere by absorbing carbon dioxide. Removing forests can reduce the amount of carbon dioxide sequestered. Forests contain substantial carbon in the soil, trees and other vegetation and are a key component in maintaining the GHG balance. Khyber Pakhtunkhwa province has great mitigation potential to sequester carbon via afforestation and reforestation as highlighted by its provincial initiatives[21].

Policy Measures

- Limit deforestation and reduce GHG emissions associated with forestry operations. (H)
- Increase carbon sinks by afforestation, reforestation and the establishment of new forests on abandoned agricultural land or other non-forested regions utilizing indigenous species while avoiding non-native and invasive species. (H)
- Estimate the carbon stocks in existing forests. (H)
- Minimize disturbance to trees during harvesting activities and help trees get re-established faster after harvest. (M)
- Improve monitoring and policing of forests to curb incidence of forest fires and to reduce the role of timber mafia in illegal felling and clearing of forest cover. (H)

[21]Billion Trees Tsunami Afforestation Project managed by the Department of Forestry, Environment and Wildlife in Khyber Pakhtunkhwa Province.

- Promote urban forestry to adapt to extreme temperatures and to increase carbon sinks in cities. (M)
- Adopt agro-forestry, urban forestation and peri-urban forestry practices to provide secondary carbon sinks as well as alternate sources of income, fuel, timber and food. (H)
- Develop programs to provide alternate fuel and livelihood options to forest dependent communities. (H)
- Explore international opportunities to obtain voluntary carbon credits via afforestation and reforestation programs such as REDD+ and the Ten Billion Trees Tsunami (TBTT). (H)

6.8 Agriculture and Livestock

Agricultural activities such as cultivation of crops and livestock contribute about 39% to national GHG emissions[22]. About 83% of the population in KP is dependent on agriculture and livestock for their income and livelihood (Government of Khyber Pakhtunkhwa, 2014). Management of various agricultural activities can help reduce GHG emissions and contribute towards mitigating Climate Change impacts. For Livestock sector, with feasible improvements in manure management, energy use, feed quality and animal performance, the emissions could be reduced by 14 to 17 percent of the baseline GHGs emissions (Source: Agriculture Department Govt. of Khyber Pakhtunkhwa).

Policy Measures

- Promote indigenous agronomic techniques and latest technologies that increase carbon residue and carbon storage in soil, such as crop rotation, re-vegetation, retaining crop residues for accelerated decomposition in soil, avoiding row crops and deep ploughing. (H)
- Adopt tillage management practices for minimal soil disturbance and reduced erosion. (H)
- Encourage the use of laser land-levelling to conserve future water and energy consumption. (H)
- Use raised beds and intercropping to improve nitrous oxide management and reduction. (H)
- Encourage the production of biogas and the digestion of manure. (H)
- Improve agro-forestry systems to increase carbon storage and reduce soil carbon losses stemming from erosion by combining crops with trees for timber, firewood, fodder and other products and establishing shelter belts and riparian zones/buffer strips with woody species. (H)
- Employ integrated nutrient management techniques to reduce emissions on-site by reducing leaching and volatile losses, improving nitrogen use efficiency through precision farming and improving fertilizer application timing. (M)
- Improve water management through soil and water conservation by discouraging water drainage and encouraging shallower water table to increase water available in root zone

[22] National Climate Change Policy 2012

(Freibauer et al. 2004[23]); to enhance biomass production, increase the amount of above-ground and the root biomass returned to the soil. (M)

- Improve grassland and grazing management by controlling intensity and timing of grazing (e.g. stocking rate management, rotational grazing and enclosure of grassland from livestock grazing). (H)
- Develop and propagate technologies for biogas production from agriculture/ livestock wastes. (H)
- Develop and adopt new breeds of cattle which are more productive in terms of milk and meat with lower methane production from enteric fermentation. (M)
- Encourage farmers to use appropriate feed mixes and additives to reduce methane production from enteric fermentation/ digestion in cattle. (H)
- Manage water in rice paddies to control releases of methane from agricultural soil and introduce low water delta rice varieties and fish/rice farming (M)
- Take measures for herd management, Improved breeding and animal health practices to shrink the herd overhead (i.e. unproductive part of the herd) and related emissions. (M)
- Allocate budget & incentives for farmers to reduce the risk in case of loss and damage caused by Climate Change. (M)

[23] Freibauer, A., Rounsevell M., Smith P., Verhagen A., Carbon sequestration in the agricultural soils of Europe. Geoderma, 2004. 122: p. 1-23

7. CAPACITY BUILDING

Capacity building is essential for development. It is a process of understanding obstacles that may inhibit communities, government, international organizations and non-government organizations from accomplishing their development goals. Policy implementation depends essentially on the ability of various stakeholders to understand the necessity of the Policy and how to overcome hurdles in implementation. That can only be achieved by institutional development, including community participation, human resource development, strengthening of management systems and creating an enabling environment for appropriate Policy implementation. The Policy measures recommended below are an attempt to create an enabling environment for effective Policy implementation.

Policy Measures

I. Institutional Enhancement

- Assess capacity needs in order to engage stakeholders in institutional capacity development. (H)
- Ensure upgradation and strengthening of institutional capacity of existing Climate Change Cell at EPA to Directorate level. (H)
- Ensure climate-inclusiveness in the approval of all sectoral projects by empowering the provincial P&DD and Climate Change Cell. (H)
- Establish Climate Change Cells in relevant departments, particularly Agriculture, Livestock and Dairy Development, Irrigation, PEDO, WAPDA, Transport and FE&WD[24] Department. (H)
- Develop and strengthen a Monitoring, Reporting and Verification (MRV) system. (H)
- Conduct baseline studies to assess capacity needs for conservation and resource management of important forest species, biodiversity, wetlands and agro-ecological zones. (M)
- Carry out capacity building of relevant organizations in the area on natural resource management, conservation of biodiversity, forests, water resources, sensitive ecosystems, risk reduction strategies and disaster preparedness. (H)
- Establish climate-informed preparatory and government approval systems dealing with the life cycle of Climate Change related projects and schemes. (H)
- Improve capacity of government departments to develop, implement and manage projects which increase climate resilience in vulnerable population and result in mitigation of and/or adaptation to changing climate. (M)
- Conduct training of government officials and stakeholders through workshops on Climate Change mitigation and adaptation; this could be technical or non-technical depending on requirements and the audience involved. (H)
- Forge partnership with training institutions and universities for regular training workshops for various capacity building exercises. (H)

[24] Forestry, Environment and Wildlife Department

- Engage stakeholders conducting projects within the region for assessing process and outcomes of environment-friendly development. (M)
- Streamline Climate Change in provincial Policy documents and development projects. (H)
- Strengthen an enabling environment for NDC implementation. (H)
- Establish and maintain weather forecasting centers for research and climate modelling. (M)
- Extension and capacity-building policies for Agriculture/livestock farmers can facilitate the transfer and use of more efficient practices/technologies that are readily available. (M)
- Train young scientists, faculty and government officials on simulation models and adaptation planning and clean development mechanisms. (M)

II. Awareness Raising and Education

- Introduce concepts of Climate Change mitigation, adaptation and Natural Resources Management (NRM) in academic curriculums at all levels of education. (H)
- Mobilize and encourage young scientists and researchers to study Climate Change impacts and risk reduction strategies as human resource development to strengthen research and academic institutions. (H)
- Establish and strengthen Climate Change science related departments including universities through financial and technical support. (M)
- Ensure an institutional mechanism – like formation of the Climate Change cell - to conduct research and educate the public at large through campaigns and programs about Climate Change impacts, mitigation and adaptation strategies. (H)
- Provide platforms and participate in knowledge and information sharing forums on Climate Change. (H)
- Provide necessary training and support to government officials and relevant departments regarding Climate Change impacts and development issues. (H)
- Support and encourage media and other relevant stakeholders in raising awareness campaigns including the use of social media. (H)

8. TECHNOLOGY TRANSFER

Technology transfer plays a critical role in facing the challenges of Climate Change. Although it is mostly associated with Climate Change mitigation strategies it is equally important for Climate Change adaptation. Technology transfer in mitigation strategies is usually restricted to specific sectors such as energy and industries, in which reduction in carbon emissions can be measured. However, in adaptation, technology transfer and techniques are relevant for a wide range of sectors, such as agriculture, water, health etc. Technology transfer is not restricted to exchange of machinery which reduces carbon emissions. It also includes indigenous coping techniques which are important for adaptation. Moreover, adaptation techniques are less capital intensive. Where technology pertaining to mitigation strategies can be used across countries, such as solar powered lights, adaptation techniques are environment and region specific (UNEP, 2011).

Transfer of technology is usually from developed to developing countries as a result of international climate negotiations which stipulate developed countries to assist developing countries in reducing emissions, in switching to alternate energy and adapting to Climate Change impacts. Developing countries with the help of national and international support can adopt environmental friendly strategies and practices. Successful strategies practiced in other parts of the country can be adopted in other regions, whereas exchange of technology within provinces would also help to strengthen ties and pave the way for development at a national level. Technology is vital in ensuring effective implementation of Policy recommendations for both climate mitigation and adaptation.

Policy Measures

- Determine technological needs in the province for climate mitigation and adaptation by conducting technology needs assessment. (H)
- Maintain records of progress/changes in technological needs. (M)
- Identify potential indigenous and international technologies for alternate energy sources such as solar, water and wind energy and promote uptake of this technology for use. (H)
- Identify appropriate energy efficient technologies including efficient household appliances, solar water heaters, energy efficient chillers and lights for domestic and commercial buildings. (H)
- Identify potential technologies for energy efficient transportation and energy generation systems for domestic and commercial use. (H)
- Develop and introduce coping techniques and technology to aid sustainable agriculture practices and irrigation methods for water stressed conditions. (H)
- Promote partnership between international and national organizations whose Climate Change adaptation technologies in agriculture, energy, transport, forestry and water can be used in KP province. (M)

- Identify opportunities for uptake of low GHG emitting technologies such as photovoltaic power generation, natural gas turbines, biomass integrated gasification combined-cycle generation and on-grid PV power production. (H)
- Promote research on GHG reduction and adaptation related technologies in universities and in other research institutes. (H)
- Encourage investments from domestic and international, private and public players to pilot projects on Climate Change mitigation and adaptation. (M)
- Encourage public-private collaborations for technological innovation and upscaling. (H)

9. CLIMATE FINANCE

Khyber Pakhtunkhwa province in line with Govt of Pakistan has formulated its own specific Climate Change Policy. Its actual goal is to strengthen the efforts of Federal Govt on the common issue of Climate Change and further to contribute to the efforts of the global community on combating Climate Change. Adaptation, in relevant sectors, requires ample resources which are beyond the scope of fragile economy of Khyber Pakhtunkhwa.

For the effective implementation of the Climate Change Policy, the Provincial Government looks to the Federal Government and the international community, such as the UNDP, World Bank, Green Climate Fund and other donors, to invest in the field of adaptation and mitigation in the province's climate-sensitive sectors of economy. Depending on the resources allocated in the form of an adaptation budget and a mitigation budget, Climate Change challenges can be overcome and resilience in the province can be attained.

Allocating budget for adaptation would aid in disaster preparedness, which is the primary goal of the Policy, as well as contribute to the efforts of the Federal Government and the global community on SDGs, specifically Goal 13 (UNFCCC).

Policy Measures:

- Ensure that recently established Climate Change Budget Tagging and Tracking System in the province is sustainable and provide Climate Change related budget expenditure information on regular basis.
- Every fiscal year, a climate-specific budget must be allocated in the form of adaptation and mitigation budget.
- Efforts may be undertaken to secure adaptation funds from the Federal Government, international donors such as World Bank, Asian Development Bank, Green Climate Fund etc.
- Ensure the availability of appropriate economic incentives to encourage public and private sector investment in Climate Change adaptation and mitigation programmes.
- Separate section to be established either under the Planning & Development or the Finance Department to deal with Climate Finance matters in order to keep the record and to facilitate international investors in the field of Climate Change

10. IMPLEMENTATION

To guide implementation of recommended measures given in this Policy for climate mitigation and adaptation, implementation strategies and action plans relevant to each sector and sub sectors need to be devised. Moreover, the successful implementation of the Provincial Climate Change Policy depends significantly on governance, planning, risk management, resources, communication and monitoring. Some of the elements required for successful Policy implementation are:

- Strong executive level support for delivery processes of the Policy, which may even include creating a Provincial Climate Change Task Force (PCCTF) for Policy implementation;
- Well established stakeholders' engagement and communication plans for all departments;
- Supportive legal and financial services;
- Implementation road map/plan for the Policy defining roles and responsibilities of relevant departments;
- Risk assessment and management;
- Effective and timely reporting, monitoring and performance evaluation; and
- Gap analysis of data to ensure accurate predictions for the future (for example in the case of weather data).

According to the National Climate Change Policy, in order to ensure effective implementation of the Khyber Pakhtunkhwa Climate Change Policy, a "Provincial Climate Change Policy Implementation Committee (PCCPIC[25])" must be established, whose task will be to implement the Climate Change Policy and share the status of implementation based on action plans with the National Climate Change Policy Implementation Committee. The provincial committee must meet at least biannually to review strategic implementation plans. The committee will share the progress to the National Committee.

The composition recommended in National Climate Change Policy for the Provincial Climate Change Policy Implementation Committees is as below:

- Secretary Forestry, Environment and Wildlife Department, Government of KP **(Chairman)**
- Secretaries to the Khyber Pakhtunkhwa Government: (i) Agriculture (ii) Irrigation (iii) Local Government (iv) Transport (v) Planning & Development (vi) Law (vii) Finance (viii) Public Health Engineering (ix) Industries, Commerce & Technical Education (x) Health **(Members)**
- Director General, Environmental Protection Agency **(Member/Secretary)**
- Director General, Provincial Disaster Management Authority **(Member)**
- One corporate sector representative, i.e. Chamber of Commerce and Industries **(Member)**
- One Civil Society Organization representative **(Member)**
- Three experts from the relevant field **(Member)**

[25] The Govt. of KP has already notified PCCPIC vide notification SO (Envt)/FE&WD/2-3/2016/PCCPIC /1920-37 dated 08-05-2017

APPENDIX A

Forestry, Environment & Wildlife Department highly appreciates the inputs and feedback of the following listed stakeholders during consultations and review process of the updated Climate Change Policy of Khyber Pakhtunkhwa-2022.

S.No	Name	Department/Organization
1.	Miss Ayesha Bano	Member Provincial Assembly
2.	Mr. Muhammad Abid Majeed	Secretary, FE&WD
3.	Mr. Muhammad Anwar Khan	Director General EPA
4.	Mr. Khuda Baksh	Special Secretary, FE&WD
5.	Mr. Minhas Uddin	Additional Secretary, FE&WD
6.	Mr. Adnan Jamil	Deputy Secretary, FE&WD
7.	Miss Sanovia Kakar	KP Forestry, Environment and Wildlife Department
8.	Mr. Abdul Hassan	Pakistan Agriculture Research Council
9.	Mr. Abid Zareef Khan	Zareef Khan Foundation
10.	Mr. Adil Zareef	PCAA
11.	Mr. Afsar Khan	Deputy Director Climate Change KP-EPA
12.	Miss. Zakia Javed	Deputy Director MEAs KP-EPA
13.	Mr. Fayaz Ahmad	GIS Specialist KP-EPA
14.	Syed Asif Ali Shah	Assistant Director Climate Change EPA
15.	Mr. Kausar Abbas	Environmental Economist
16.	Mr. Alam Zeb	KP Irrigation Department
17.	Mr. Ashraf	KP Chamber of Commerce & Industry
18.	Mr. Ayaz Ali	PRCS/GRC Peshawar
19.	Miss Ayesha	GIZ-SAR
20.	Dr. Rafiq	IM-Sciences Peshawar
21.	Dr. Arshad Farooq	Pakistan Agriculture Research Council
22.	Dr. Habib Jan	KP-EPA
23.	Dr. Muhammad Abid	GIZ
24.	Dr. Mohsin Farooque	KP Wildlife Department
25.	Engr. Ubaid Ullah	KP Public Health Engineering. Department
26.	Engr. Waqas Ahmad Khan	UET-Peshawar (Jalozai Campus)
27.	Mr. Fazli Ghafoor	SPO
28.	Mr. Hammad Afridi	PDMA-KP
29.	Miss Haseena	KP-Wildlife Department
30.	Mr. Hasnain Khurshid Ahmad	Sarhad Chamber of Commerce & Industry
31.	Mr. Hazrat Mir	KP-Forest Department

S.No	Name	Department/Organization
32.	Mr. Kashif	SPO
33.	Mr. Muhammad Arshad	KP-EPA
34.	Miss Khadija Abid	PRCS
35.	Mr. Khalid Hussain	Pakistan Forest Institute, Peshawar
36.	Mr. Khalid Khattak	KP Irrigation Department
37.	Mr. Khurram Saeed	WWF Pakistan
38.	Mr. Muhammad Abid	PRCS
39.	Mr. Muhammad Irshad	KP-EPA
40.	Mr. Muhammad Mudassar	WWF Pakistan
41.	Mr. Muhammad Niaz	KP Wildlife Department
42.	Mr. Muhammad Osama Khan	PRCS
43.	Mr. Muhammad Ali Durrani	NDRMF
44.	Mr. Pir Muhammad Zubair	KP Transportation Department
45.	Mr. Qaswar Abbas	German Red Cross
46.	Mr. Ramzan Ali	KP-EPA
47.	Mr. M. Asif Sahibzada	Ministry of Climate Change (MoCC)
48.	Mr. Sajid Ali	PDMA-KP
49.	Mr. Salahuddin	Local Government, Elections & Rural Development Department
50.	Mr. Shakeel Hameed	SRSP
51.	Mr. Syed Aftab Hayat	KP Chamber of Commerce & Industry
52.	Mr. Zahir Shah	Pakistan Meteorological Department
53.	Miss Zeba Gul	Dr. Zareef Memorial School
54.	Mrs. Zuhra Nigar	PDMA-KP
55.	Mrs. Amna Durrani	Director, CSW

ENVIRONMENTAL PROTECTION AGENCY
GOVERNMENT OF KHYBER PAKHTUNKHWA
FORESTRY, ENVIRONMENT & WILDLIFE DEPARTMENT