



Ministry of Climate Change and Environmental Coordination

CLIMATE CHANGE ADVERSE IMPACTS AND COPING EFFORTS

National Adaptation Plan for Pakistan



WATER



AGRICULTURE



URBAN



ECOSYSTEMS



FINANCIAL

“Adapting Today for Sustainable Tomorrow”

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Authored by : Waseem Gulzar



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Executive Summary:

This research report provides a synthesis of climate change impacts and coping efforts in Pakistan. The country faces various adverse effects including glacial melting, water scarcity, heatwaves, and agricultural losses. Vulnerabilities are evident in water resources, agriculture, forestry, and health, particularly affecting women in rural and urban areas nationwide.

The Government of Pakistan has initiated coping measures across sectors such as water quality monitoring, climate-resilient agriculture, and afforestation. Efforts are integrated into development plans targeting water management, agriculture, disaster risk reduction, and infrastructure vulnerabilities.

Provincial governments are focusing on water, agriculture, biodiversity, and disaster preparedness. They are also emphasizing climate-resilient agriculture practices and improved early warning systems.

However, gaps remain, including weak implementation, limited access to climate data, insufficient funding, and a lack of public awareness and gender-sensitive policies.

The review also examines funding arrangements, alignment with international frameworks, and opportunities for co-financing with international organizations and public-private partnerships.

List of Abbreviations used:

ADB - Asian Development Bank
ARE - Alternative and Renewable Energy Policy
BCM - Billion Cubic Meters
ccGAP - The National Climate Change Gender Action Plan
COP - Conference of Parties
CPEIR - Climate Public Expenditure and Institutional Review
CPS - Country Partnership Strategy
DNA - designated national authority
DRR - Disaster Risk Reduction
EAD - Economic Affairs Division
EIA - Environmental Impact Assessment
EPA - Environmental Protection Agency
FAO - Food and Agriculture Organization of the United Nations
FATA - Federally Administered Tribal Area
FP - Focal Point
GCF - Global Climate Fund
GEF - Global Environment Facility
GCISC - Global Change Impact Studies Centre
GDP - gross domestic product
GHG - greenhouse gas
GLOF - glacial lake outburst flood
HEIS - high efficiency irrigation system
HKH - Hindukush-Karakoram-Himalaya
INDC - Intended Nationally Determined Contribution
IPCC - International Panel on Climate Change
IRS - Indus River System
KPK - Khyber Pakhtunkhwa
LIBS - Lower Indus Basin in Sindh
MoCC - Ministry of Climate Change
MM – Millimeter
MoE - Ministry of Energy
MoF - Ministry of Finance

MoH - Ministry of Health
MoNFS&R - Ministry of National Food Security & Research
MoPD&SI - Ministry of Planning, Development and Special Initiatives
MoWR - Ministry of Water Resources
MRV - Measurement, Reporting and Verification for Emissions and Mitigation in Livestock and Agroforestry
NAP - National Adaptation Plan
NCCP - National Climate Change Policy
NDMA - National Disaster Management Authority
PARC - Pakistan Agriculture Research Council
PCRWR - Pakistan Council of Research in Water Resources
PDMA - Provincial Disaster Management Authority
PMD - Pakistan Meteorological Department
PSDP - Public Sector Development Program
REDD+ - Reducing Emissions from Deforestation and Forest Degradation
SDGs - Sustainable Development Goals
SLR - sea level rise
UIB - Upper Indus Basin
UNDP - United Nations Development Programme
UNDESA - United Nations Department of Economic and Social Affairs
UNEP - United Nations Environment Programme
UNESCAP - UN Economic and Social Commission on Asia and Pacific
UNFCCC - United Nations Framework Convention for Climate Change
WAPDA - Water and Power Development Authority
WBG - The World Bank Group

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This collective effort has laid the foundation for a robust and inclusive NAP process that will enable Pakistan to effectively address the challenges posed by climate change, protect our vulnerable communities and ecosystems, and build a sustainable and climate-resilient future.

We look forward to continued collaboration and partnership as we move forward with the implementation of the NAP, turning these strategies into impactful actions that benefit our country and its people.

Thank you for your unwavering commitment and support to a climate-resilient Pakistan.

Waseem Gulzar
Climate Change Adaptation Expert
Ministry of Climate Change

Date:

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1. Climate Literature Review

Climate change is one of the most urgent and complex challenges facing Pakistan today. It poses serious threats to the country's socio-economic development, natural resources, human well-being, and national security. Pakistan is highly vulnerable to the impacts of climate change, such as rising temperatures, erratic rainfall, floods, droughts, sea level rise, and glacial melt. These impacts have adverse consequences for various sectors, such as water, agriculture, health, energy, and urban development.

The literature review glimpses the climate change adverse impacts and beneficial coping strategies in Pakistan. It aims to provide a comprehensive overview of the current and future climate risks and vulnerabilities in Pakistan, as well as the existing and potential adaptation measures and practices in critical sectors at various levels of governance. It draws on the latest scientific evidence, policy documents, and stakeholder consultations to assess the climate change situation in Pakistan. It identifies the major gaps and challenges in adaptation planning and implementation, as well as the approaches for enhancing adaptation effectiveness.

The review offers effective and sustainable adaptation strategies that enhance its resilience and reduce its vulnerability. It can contribute to inform Pakistan's commitments and obligations under the nationally determined contributions (NDCs) for the United Nations Framework Convention on Climate Change (UNFCCC), the poverty reduction strategy papers for the International Monetary Fund (IMF), and the sustainable development goals (SDGs) for the Paris Agreement. It can serve as a valuable resource for policymakers, practitioners, researchers, and stakeholders involved in climate change adaptation.

Aim and Scope:

The task aims to review and assess the adverse effects of climate change on the various vulnerable sectors of the country, the steps taken and to be taken as coping efforts and strategies, to enhance resilience of Pakistan. It further aims to integrate adaptation and resilience measures into existing and new policies considered for the development in the country.

Objectives:

The primary objectives of this literature review are to comprehensively assess the adverse impacts of climate change across critical sectors in Pakistan, identify regional vulnerabilities and imminent climate risks, analyze existing coping efforts and measures, evaluate their effectiveness, and highlight gaps and challenges. It also aims to contribute to the knowledge base on climate change in context of Pakistan, and provide valuable insights to inform evidence-based policymaking at both national and local levels.

Methodology:

This literature review has been conducted via a systematic methodology to delve into the dynamics of climate change impacts and the beneficial coping efforts and measures employed in context of Pakistan. The process involves a series of steps to ensure a thorough explication of the subject matter.

- **Step-1** - An exhaustive (Google) search strategy is adopted for incorporating relevant keywords related to climate change adverse impacts, coping mechanisms and beneficial

strategies adopted by critical sectors. This approach includes a comprehensive exploration of both scholarly papers and various literature sources.

- **Step-2** - A set of criteria is applied to select credible sources relevant to climate change in Pakistan, including peer-reviewed articles, and government and international organization reports to enhance the reliability the information. A detailed review of latest available technical reports comprising, policy documents, action plans, various framework reports of ministries, the national strategies for sustainable development under the United Nations Cooperation Framework, and national Poverty Reduction Strategy Papers. This forms a literature review of adverse effects of climate change and coping efforts, helps identify links to national development and informs the adaptation priorities.
- **Step-3** - The extraction of essential data and key points from the secondary sources and primary information from stakeholder consultations capture, analyze and validate crucial information and insights concerning the nature of climate change adverse impacts, demographics affected, and the beneficial coping strategies planned and implemented that effectively address climatic challenges with outcomes.
- **Step-4** - The reviewed information organizes the key points thematically for discussion in pertinence to vulnerability in respective sectors. This comparative analysis helps identify and comprehend the variations in severity of climate change impact and the effectiveness of the implemented interventions in critical sectors.
- **Step-5** - The conclusion and findings delve into a gap analysis, critically examining various aspects of the overall literature review in national context to find potential directions for recommending course of action based on climate change related adaptation and policy gaps that could enhance the understanding of climate change impacts and coping strategies suitable to curtail climate change vulnerabilities and risks in Pakistan.
- **Step-6** - The citations and referencing are maintained throughout the review, ensuring the transparency of sources and providing the access to the original materials.

1.1 Adverse Impacts of Climate Change in Pakistan:

Numerous studies and reports have examined the adverse impacts of climate change in Pakistan. The prevailing climate change literature posits significant impacts of climate change that are undergoing drastic shifts on an annual basis.

1.1.1 Increasing Temperature:

The global increase in greenhouse gas (GHG) emissions is driving a rise in the worldwide temperature. In Pakistan, the escalation in temperature is predominantly attributed to rising carbon emissions that have grown by 123% since 1994 as the emphasis on economic growth rises to four times in next 15 years¹.

1.1.2 GHG Sources:

The causes are further attributed to direct GHG emissions from sources owned by organizations in public and private sector, and indirect GHG emissions associated with the production of electricity, steam, heat, and cooling.

1.1.3 Vulnerable Sectors:

The most vulnerable sectors to climate related risks are; water resources, crop and animal production, and related service activities; forestry and logging; fishing and aquaculture; mining

and quarrying; manufacturing; water supply; sewerage and waste management, electricity, gas, steam and air conditioning supply; construction, transportation and storage; and real estate activities².

1.2 Climate Vulnerabilities and Risks:

1.2.1 Rise in GHG:

The rise in GHG emissions in Pakistan has been phenomenal. The higher GHG emissions are causing direct impacts on the climate of the country. The direct impacts include changes in carbon dioxide levels, precipitation, and temperatures, while indirect effects involve wider decline in water resource availability, soil characteristics, erosion, pests, diseases, invasive species, and arable land due to coastal submergence and desertification³.

1.2.2 Increased CO₂:

In 2008, the emissions were 147.8 million tons of carbon dioxide (CO₂) equivalent, and are increasing at an annual rate of 6% or 18.5 million tons of CO₂ equivalent⁴. The per capita CO₂ emissions have increased by 0.06 in the figure of 0.77 CO₂ tons per person in 2015. This represents a change of 7.8% in CO₂ emissions per capita⁵.

1.2.3 Rise in Temperature:

The rise in temperature has also been considerable. Pakistan experienced a warming of 0.57°C in the 20th century slightly below the South Asia average of 0.75°C. The rise in temperature was 0.47°C between 1961–2007 in the winter and post-monsoon months. The Southern regions i.e., Punjab, Sindh, and Balochistan warmed by 0.91°C–1.12°C, while Northern region i.e., Khyber Pakhtunkhwa saw 0.52°C warming. Pakistan is facing above-average warming rates leading to a rise of 1.3°C–4.9°C by year 2090 compared to the 1986–2005 baseline with varying emissions pathways⁶.

1.2.4 Increase in Precipitation:

Historically, precipitation in Pakistan was decreased as a majority of the country received very little rainfall, with the exception of the Northern regions, where monsoon fall can bring upwards of 200 mm a month from July to September⁷. Precipitation in Pakistan averaged 287.75 mm from 1901 until 2021, reaching an all-time high of 420.43 mm in 1944 and a record low of 187.52 mm in 2018. Although, precipitation in Pakistan decreased to 228.18 mm in 2021 from 392.53 mm in 2020⁸. However, in recent extreme climate events, the increasing precipitation levels have caused fall of monsoon rains five times more than normal levels⁹.

1.2.5 Extreme Climate Events:

1. Floods - Major extreme climate events include large scale flooding since 1998 which had become more frequent and intense in years such as in 2010 and 2022. Localized cloud burst events happened in 1996, 2001 and 2009.

2. Droughts - Drought events occurred in 1998 till 2001, and in 2014 till 2018. The drought of 1998–2002 is considered the worst in 50 years. This particular drought was due to an El Niño event, which started to develop in the Pacific Ocean in 1997¹⁰.

3. Rain falls - Pakistan experienced the heaviest rains on record in June-August, 2022. Pakistan faced intense heat waves in 2003, 2007, 2015 and 2022. The events of severe cyclonic storms happened in 1999, 2007 and 2016.

4. GLOF - Intense rains and GLOF caused flash floods in 2022. More than 1,100 people have died and 33 million people were impacted. Flood torrents smashed through entire villages and farmland wiping out crops¹¹.

5. Impacts and Risks - All climate change events have caused increased monsoon variability, increased risk of extreme floods, droughts, cyclones, heatwaves, sea level rise, intrusion of sea water causing water security, severe water conditions due to threatened Indus River System flows, food insecurity due to less crop yield, energy security, increased health risks, increased deforestation and loss of biodiversity¹².

1.2.6 Climate Impacts Severity:

1. Heatwaves - The repercussions of climate change in Pakistan are far-reaching and multi-faceted. There has been a noticeable surge in the frequency and severity of heatwaves, leading to dire consequences such as heat-related illnesses, dehydration, and fatalities, particularly impacting the more susceptible segments of society.

2. Water Scarcity - The disrupted water availability resulting from climate change has precipitated heightened water scarcity and prolonged drought conditions. These disruptions have engendered detrimental effects on agriculture, livestock sustainability, and the accessibility of clean drinking water in both rural and urban areas.

3. Food Insecurity - The evolving trends concerning water resources and agricultural vulnerability pose a threat to food security¹³, causing a steep surge in the prices of staple crops like wheat and rice, which have quadrupled in just the past two years. Alterations in rainfall patterns, prolonged droughts, and extreme weather events have engendered crop failures, a disconcerting phenomenon leading to food insecurity, surging food prices, and an augmented reliance on food imports¹⁴.

1.2.7 Vulnerability Ranking:

The Notre Dame 'GAIN Index Ranking (2019)¹⁵ ratified Pakistan 152nd on vulnerability scale and its susceptibility to climate change i.e., lower the scale, higher the vulnerability. The ranking used key indicators and their measures for Pakistan including; percent of undernourished population (12.3%)¹⁶, national poverty rate (24.3%), wealth share of 20% bottom (8.9%)¹⁷, net annual migration rate (-0.11%), infant mortality rate (ages 0-1) (6.1%), average annual urban population change (2.53%), dependents per 100 independent adults (64.4)¹⁸, urban population as % of total (37.2%)¹⁹, external debt ratio to gross national income (27.6%), and government expenditure ratio to gross domestic product (21.5%)²⁰.

1.2.8 Increased Risks:

1. Economic Conflicts - Despite contributing less than 1% of the global greenhouse gas emissions, the Global Climate Risk Index ranked Pakistan 'the eighth most vulnerable nation to the climate crisis' like floods, droughts, heatwaves, and cyclones impacting critical sectors such as water resource, agriculture, health, and biodiversity, exacerbating conflicts and economic challenges while also posing potential cross-border disputes²¹. The country is paying a hefty price with lives, destroyed schools, homes, and infrastructure.

2. Agriculture and Ecosystem Challenges - These vulnerabilities further intensify health risks, threaten livelihood, increase ecosystem challenges, worsen drought conditions, extreme flood exposure, crop yield declines, and pose risks to urban residents and outdoor workers, highlighting the climate risks especially given existing levels of undernourishment and deprivation²².

1.3 Provincial Climate Vulnerabilities and Risks:

1.3.1 Increased GLOFs:

Pakistan's heavy reliance on glacial meltwater, coupled with escalating temperatures and inadequate water management, has heightened the risks of water insecurity, reduced river flows, and frequent glacial lake outburst floods (GLOFs). The GLOF risk has significantly increased in recent years, particularly in Khyber Pakhtunkhwa province²³. The twin challenges of water scarcity and glacial melting are now the predominant consequences of climate change in Pakistan, particularly acute in Northern Pakistan (Khyber Pakhtunkhwa and Gilgit-Baltistan). This has severely impacted water supply, agriculture, hydropower generation, and access to drinking water due to the compromised glacier-fed river systems²⁴.

1.3.2 Erratic Monsoons:

The volatility in monsoon patterns, another consequence of climate change, leads to erratic rainfall.

1. Flash Floods - This phenomenon contributes to both droughts and flash floods, disrupting crop cycles and thereby impacting food security and livelihoods²⁵. Increased intensity of rainfall events has led to frequent flooding, resulting in loss of life, community displacement, infrastructure damage, disrupted livelihoods, and agricultural losses. Altered precipitation patterns and rising temperatures further threaten food security and the livelihoods of agriculture-dependent communities²⁶.

2. Sea Level Rise - The looming challenge of sea level rise poses a threat to coastal regions, causing erosion and affecting communities as well as infrastructure along the coastlines. Moreover, the adverse impacts to biodiversity pose a danger to various ecosystems, leading to the destruction of habitats, loss of species, and disruptions in natural balance²⁷.

3. Health Risks - The shifting monsoon patterns are contributing to the proliferation of diseases like dengue fever and malaria, exacerbating health risks. Urban drainage systems may be further stressed by high rainfall and flash floods²⁸.

1.3.3 Temperature Rise:

1. Increased Hot Days - The marked rise in temperatures with increase in the number of hot days, severely affect grazing systems such as pastures and grazing lands due to drought, loss of land productivity, decrease in fodder quality and quantity, and increase in disease epidemics. Similarly, water availability for hydropower generation may decline.

2. Increased Energy Demand - Hotter temperatures increase energy demand due to increased air conditioning requirements. Warmer air and water temperatures decrease the efficiency of nuclear and thermal power plant generation²⁹. Furthermore, the frequency and intensity of heatwaves are on the rise deteriorating air quality, and impose significant strain on human health like heat-related illnesses, fatalities, particularly affecting women and vulnerable populations³⁰.

1.3.4 Increased Droughts:

Changes to Pakistan's rainfall and runoff regimes, and hence its water resources, are highly uncertain, but an increase in the incidence of drought conditions is likely³¹. Droughts occur approximately four times every 10 years in Pakistan, with the southern region being the most exposed to hydrological threats due to its arid climatic conditions³². The average rainfall distribution assessment over Pakistan showed only 9% of the area receive around 508 mm, over 22% receive more than 254 mm and less than 508 mm, and 69% receive less than 254 mm³³.

1.4 Climate-Induced National Development:

1.4.1 NDCs Commitments:

In response to the multifaceted challenges posed by climate change, in the updated NDCs for 2021, the Government of Pakistan outlines ambitious mitigation actions, including a 50 percent reduction in projected emissions by 2030, with 60 percent of energy from renewables, a 30 percent target for Electric Vehicles (EVs) in new vehicle sales by 2030, a moratorium on new coal power plants from 2020, and significant afforestation efforts through the Ten Billion Tree Tsunami Programme. Additionally, they aim to increase protected areas from 12% to 15% by 2023³⁴.

1.4.2 Adaptive Measures:

To support NDCs, the Government has implemented various adaptive measures. These include developing irrigation infrastructure, promoting water conservation practices like rainwater harvesting and drip irrigation, undertaking afforestation and reforestation efforts, enhancing early warning systems, and fostering climate-resilient agricultural practices. Additionally, Pakistan has embraced renewable energy sources such as solar and wind power, and instituted social protection programs like cash transfer schemes for vulnerable communities³⁵.

1.4.3 Climate Coping Profile:

The government responds with initiatives to deal with climate change impacts, like water scarcity to heatwaves, floods, crop loss, coastal erosion, biodiversity threats, and health risks.

1. Climate Policy and Resilience Frameworks - the initiatives like the National Climate Change Policy (NCCP) Implementation Framework and the Ten Billion Tree Tsunami Programme aim to increase resilience. Other effective measures such as, the Clean Green Pakistan Movement promotes environmental awareness.

2. Disaster Risk Reduction - includes early warning systems. The NDMA manages disaster preparedness nationally.

3. Climate Resilient Agriculture - enhances farming practices, including crop diversification and developing climate resilient crops.

4. Energy Reforms - energy sector diversify energy sources, such as alternative renewable sources to fulfill nation-wide energy demands.

5. Climate Gender Equity - the National Climate Change Gender Action Plan (ccGAP) empowers women, and international collaborations engage Pakistan internationally under UN Sustainable Development framework.

6. Capacity Building Measures – aim to enhance research, data collection, and community awareness. These measures showcase Pakistan's commitment to resilience and sustainability amidst climate challenges.

7. Major Gaps and Challenges - include weaker implementation, staggered funding, and weaker coordination among stakeholders.

1.4.4 Coping Climate Adverse Impacts:

Addressing climate issues demands enhanced implementation, increased funding, and collaborative efforts, reinforcing the importance of adaptive strategies, sustainability, and international cooperation for resilience. Table-1 explains the predominant adverse impacts of climate change in Pakistan and the measures and coping efforts taken by the Government of Pakistan listed in relevance to their implications.

Table 1: The Adverse Impacts of Climate Change and Coping Efforts

Adverse Impacts of Climate Change	Measures Taken by the Government of Pakistan
Water Scarcity and Glacial Melting Pakistan heavily relies on glacier-fed rivers for water supply. The melting of glaciers due to rising temperatures leads to reduced water availability, affecting agriculture, hydropower generation, and drinking water supply.	GLOF I&II underway – Integrated Water Resource Management – Ground Water Recharge - Ten Billion Tree Tsunami Programme: Launched to combat deforestation and restore ecosystems, enhancing carbon sequestration. National Climate Change Policy (NCCP): Emphasizes adaptation, resilience building, and mainstreaming climate change considerations into various sectors. Related Capacity Building Efforts: Enhancing institutional capacity, research, data collection, and community awareness. International Collaboration: Participation in international climate agreements (the Paris Agreement), and seek support and funding for climate adaptation and mitigation projects in agriculture/water resource sector.
Frequent and Intense Heatwaves Increasing temperatures result in more frequent and intense heatwaves, putting stress on human health, particularly vulnerable populations. Heatwaves can lead to heat-related illnesses and deaths.	National Adaptation Efforts: Integrate adaptation into policies and programs, focusing on water resources, agriculture, health, etc. Clean Green Pakistan Movement: Promotes cleanliness, hygiene, and environmental awareness, reducing pollution and improving urban environments. Capacity Building: Enhancing institutional capacity, research, data collection, and community awareness.
Erratic Monsoon Patterns Changing monsoon patterns contribute to irregular rainfall, leading to both droughts and flash floods. Crop cycles are disrupted, impacting food security and livelihoods.	Climate-Resilient Agriculture: Introduces climate-resilient crop varieties and improves water management in agriculture. Disaster Risk Reduction (DRR): Implements disaster management plans and early warning systems to mitigate impacts of extreme climate events.
Floods and Heavy Rains Erratic rainfall patterns and glacial melt contribute to intense and sudden rainfall, causing flash floods. These events lead to loss of lives, displacement, damage to infrastructure, and disruption of agriculture.	National Disaster Management Authority (NDMA): Coordinates disaster preparedness, response, and recovery measures in collaboration with provinces.
Reduced Crop Yields Altered precipitation patterns and heat stress affect crop yields. This impacts food security and livelihoods of millions of people dependent on agriculture.	Climate-Resilient Agriculture: Introduction of climate-resilient crop varieties and improved water management. Gender-Responsive Policies: Develop National Climate Change Gender Action Plan (ccGAP) to address gender-specific vulnerabilities and empower women in climate adaptation, in particular to their role in agriculture sector, and household and WASH related aspects.

	International Collaboration: Participation in international climate agreements (the Paris Agreement), and seek support and funding for climate adaptation and mitigation projects in agriculture/water resource sector.
Sea Level Rise Coastal areas are vulnerable to sea-level rise, causing coastal erosion and affecting communities and infrastructure along the coastline.	Disaster Risk Reduction (DRR): Implementation of disaster management plans and early warning systems for mitigation
	Capacity Building: Efforts to build institutional capacity, improve research, and raise awareness among communities regarding climate impacts.
	International Collaboration: Participate in international climate agreements like the Paris Agreement and seek support and funding for climate adaptation and mitigation projects.
Biodiversity Loss Climate change threatens biodiversity, leading to habitat destruction, loss of plant and animal species, and disruptions in ecosystems.	Ten Billion Tree Tsunami Programme: Tree planting and ecosystem restoration to combat deforestation and enhance carbon sequestration.
	National Climate Change Policy (NCCP): Emphasis on adaptation, resilience building, and mainstreaming climate change considerations into sectors.
	Enhance the Number of Protected Areas: The government's target is to increase protected areas such as national parks, wetlands and wildlife reserves to 15 per cent of the country's total area by 2023 ³⁶ .
	Disaster Risk Reduction (DRR): Implementation of disaster management plans and early warning systems for mitigation.
Health Risks Changing climate patterns contribute to the spread of diseases like dengue fever and malaria. Heatwaves and degraded air quality exacerbate health issues.	Water, Sanitation and Hygiene (WASH) Efforts: Provision, coordination and implementation of safe and clean drinking water to vulnerable communities.
	National Disaster Management Authority (NDMA): Coordination and implementation of disaster preparedness and response.
	Gender-Responsive Policies: Development of the National Climate Change Gender Action Plan (ccGAP) to empower women in climate adaptation and their inclusion in all vulnerable sectors in particular Health.
	International Collaboration: Participation in international climate agreements and seeking support for health sector projects.
	Capacity Building: Enhancing institutional capacity, research, data collection, and community awareness related to health risks and diseases.
Urban Resilience Climate Change Impacts rural and urban life equally, lack of clean and reduced water availability, low ambient air and water quality, heatwaves, health issues due to	Water, Sanitation and Hygiene (WASH) Efforts: Provision, coordination and implementation of safe and clean drinking water to vulnerable communities.
	Clean Green Pakistan Movement: Promotes cleanliness, hygiene, and environmental awareness, reducing pollution and improving urban environments.

virulent diseases, reduced water flows in rivers affect hydropower generation, leading to energy shortages. This impacts industries, households, and economic growth.	Disaster Risk Reduction (DRR): Implements disaster management plans and early warning systems to mitigate impacts of extreme climate events.
	Ten Billion Tree Tsunami Programme: Tree planting and ecosystem restoration to combat deforestation and enhance carbon sequestration to reduce heatwaves impacts, and number of hot-days.
	Energy Sector Reforms: Diversify energy sources and invest in renewable energy to reduce dependency on fossil fuels and enhance energy security.
Adaptation-related Projects and Plans	Pakistan Public Sector Development Program (PSDP): Climate adaptation is interwoven into diverse sectors, with specific projects tackling water management, agriculture, disaster risk reduction, and infrastructure vulnerabilities. Cross-sectoral integration to ensure resilience in infrastructure endeavors and to enhance institutional capacity for effective adaptation. The budget is allocated to climate-related initiatives.
	Provincial Annual Development Programs (ADPs): Tailored to individual province's needs, climate adaptation initiatives encompass agriculture, disaster risk reduction, urban resilience, and ecosystem conservation. Foster climate-resilient agriculture, sustainable farming practices, and efficient water management, projects addressing local challenges such as floods, droughts, and urban heat stress, programs prioritize nature-based solutions, including ecosystem protection and restoration.

1.4.5 Pakistan's Climate Adaptation:

Pakistan faces evolving climate change impacts, including water scarcity and agricultural challenges driven by global greenhouse gas emissions. The literature provides empirical evidence from Pakistan. These studies indicate major climate change vulnerabilities and risks by highlighting adaptation gaps linking to regional contexts of provinces. These adaptation gaps in various vulnerable sectors mainly identify clear deficiencies in addressing vulnerabilities and need for adaptation efforts, beneficial coping strategies and programs.

1.4.6 Major Adaptation Gaps in Vulnerable Sectors in Pakistan:

Adverse effects of climate change in Pakistan have shown vulnerabilities across key sectors necessitating adaptation strategies. However, significant gaps still persist hindering effective responses and resilience building.

1.4.6.1 Water Resource:

1. Vulnerabilities - In water resource sector, and water intensive agriculture & livestock sectors, major vulnerabilities are related to shifting precipitation patterns and increased droughts³⁷.

2. Adaptation Gaps - arise from limited water-efficient technologies, inadequate infrastructure for water management, and insufficient investment in climate-resilient crop varieties³⁸.

1.4.6.2 Health Sector:

1. Vulnerabilities - In health sector and disaster preparedness, the rising temperatures and extreme weather events exacerbate health risks³⁹.

2. Adaptation Gaps - are inadequate heatwave preparedness plans, limited capacity to manage vector-borne diseases, and a lack of advanced early warning systems for disasters⁴⁰.

1.4.6.3 Forestry and Biodiversity:

1. Vulnerabilities - In forestry, and biodiversity and living ecosystem, the heightened risks of deforestation and declining biodiversity and restoration of ecosystems are imminent threats⁴¹.

2. Adaptation Gaps - underlie limited funding for reforestation efforts, insufficient protected areas, and weak policies to combat deforestation, protect biodiversity and conserve living land and marine ecosystems⁴².

1.4.6.4 Urban Planning:

1. Vulnerabilities - Urban resilience is under threat and infrastructure is susceptible to flooding and extreme heat stress⁴³.

2. Adaptation Gaps - include poor urban planning, inadequate green infrastructure such as urban-forests, and a lack of resilience-focused building codes⁴⁴.

1.4.6.5 Gender Impacts:

1. Vulnerabilities – include lack of gender inclusion and social equity of the vulnerable populations, especially women are disproportionately affected⁴⁵.

2. Adaptation Gaps - encompass a lack of gender-sensitive policies, inadequate support for women in climate resilience initiatives, and limited access to resources⁴⁶.

1.4.6.6 Sectoral Coordination:

1. Cross-Sectoral Coordination Challenges - such as weak institutional mechanisms and inter sectoral coordination are hindering and limiting the collective influence of the holistic adaptation efforts⁴⁷.

1.4.6.7 Climate Data:

1. Limited Climate Data and Research - hampers evidence-based decision-making vis-a-vis inadequate funding constrains the implementation of comprehensive strategies⁴⁸.

Bridging these adaptation gaps is crucial for enhancing Pakistan's resilience to climate change impacts. Efforts should focus on integrating climate resilience into policies, strengthening cross-sectoral collaboration, and allocating resources for sustainable adaptation measures.

2 Climate Resilience Assessment:

The analysis of adaptation gaps in Pakistan's vulnerable sectors necessitates a thorough examination of national and local development strategies, along with resilient climate change programs. The Government of Pakistan has taken various measures to address these challenges, but assessing international cooperation and financing strategies is equally vital. This comprehensive review is crucial for pinpointing shortcomings in current policies and paving the way for more effective climate adaptation efforts in vulnerable sectors.

2.1 Climate Review:

Pakistan has taken some steps to address climate change, such as developing national policies and plans, implementing adaptation and mitigation projects, and participating in international negotiations and agreements⁴⁹. Review of all relevant national and local development strategies

and resilient climate change programs and plans gives a glimpse on current and future projected climate development in the country.

2.1.1 Critical Precipitation Levels:

According to the climate studies, the future climate change scenarios show that the largest increase will be in Southern Pakistan with critical changes in the precipitation levels making Pakistan more vulnerable to climate risk. The projections show that projected temperature will be higher than global mean by 1 degree centigrade⁵⁰.

2.1.2 Water Vulnerability:

Climate change parameters have increased water vulnerability by manifold. The major sources of surface water are glacier and snow melt which contribute to 80% of water resource in Indus system. Rainfall seasonal availability for 75% of arid courtiers is less than 225mm rainfall, and rest 20% receives less than 1.5 mm.

2.1.3 Water Availability:

Pakistan's total water availability is 250 billion cubic meters (BCM). The 90 per cent goes to agriculture, four per cent to industry and six per cent to domestic consumption. This means that out of 250 BCM, 15 (BCM) is available for domestic consumption⁵¹. Water availability in Pakistan has plummeted from 5,229 cubic meters per inhabitant in 1962 to just 1,187 in 2017⁵².

2.1.4 Agriculture Vulnerability:

As for the future water needs for sustainable agriculture in Pakistan, it is projected that feeding nine billion people by 2050 will require a 60 percent increase in agricultural production and a 15 percent increase in water withdrawals⁵³.

2.1.5 Critical Arid and Semi-arid Regions:

The 41% semi-arid and arid regions of Pakistan, where irrigation cannot be done by canals and agriculture is dependent on precipitation. The semi-arid region is a subtype of dry land, having average precipitation of between one-fifth, high solar radiation, high wind speed, and potential plant water demand is half⁵⁴. However, due to the large fluctuation of climate and lack of observed quality of rainfall data, uncertainties in rainfall projections are high in these regions⁵⁵.

2.1.6 Fall in GDP:

Studies indicate agriculture sector which contributes 20% to national GDP also suffers climate change vulnerability due to reduced water availability as water requirement tends to increase by 6.11%.

In the face of these severe climate-induced challenges, adaptation becomes an unavoidable necessity to address the adverse impacts of climate change, which are anticipated to become even more critical in the future. ⁵⁶.

2.2 Climate Change Initiatives:

1. Policies:

The Ministry of Climate Change (MOCC) in Pakistan employs both mitigation and adaptation strategies to address climate change. The National Climate Change Policy (2012) and Climate Change Act (2017) provide a framework for these efforts, with a strong focus on building resilience through adaptation⁵⁷.

2. NDCs:

Finalization and submission of Pakistan's Nationally Determined Contributions (NDC) strengthen Pakistan NDC partnership for technical assistance in 2017. It includes revising Pakistan's NDCs for reducing GHG Emissions by 20% in 2020, and adaptation planning support through UNEP in 2020.

3. Adaptation Planning:

MOCC initiated adaptation planning with UNEP support, funded by GCF, aligning the National Adaptation Plan (NAP) process to reduce vulnerability to climate change impacts and integrate adaptation into policies. Gender sensitivity is emphasized through the National Climate Change Gender Action Plan (ccGAP)⁵⁸ to bridge gender gaps in climate resilience. However, weak institutional coordination and capacity challenges hinder policy implementation.

2.2.1 Climate Actions:

In this, MOCC with provincial line departments has done interventions in various sectors such as water, agriculture and livestock, forestry and biodiversity, and transport, energy, and industries for urban resilience, through adaptation and mitigation measures in the form of projects.

The federal and provincial governments initiated projects specifically; WASH (MOCC), Ten Billion Tree Tsunami Programme, Clean Green Pakistan Index, Ecosystem Restoration, and Climate resilient Urban Development and Green Building Code to address climate change.

Some of the interventions in critical sectors are being discussed here.

2.2.2 Water Initiatives:

Water is critical sector to climate change vulnerabilities.

1. WASH Programme - The Ministry of Climate Change is managing two active projects; establishing Pakistan WASH Strategic Planning and Coordination Cell (2019-2023) and capacity building on water quality monitoring in SDG 6 (6.1) Reporting (2021-2023)⁵⁹.

2. PCRWR Projects - The Pakistan Council for Research on Water Resources had completed 33 water development projects in land and water conservation, and performs water quality monitoring in rural areas in all regions of the country

3. Balochistan and Sindh Initiatives – include combating drought and desertification in Thal desert, management of water resources in Thar and Kharan-Chagai desert, transboundary effects on ground and surface water in eastern border, rain water harvesting and bio-saline agriculture in low-areas of Sindh and Kharan-Chagai desert of Balochistan, integrated water resource management in Pishin Lora basin of Balochistan, ground water quality zones in Indus plain, establishment of national capacity building institute for water quality management, and provision of safe drinking water,. So far, 38 water projects in Sindh province and 66 in Balochistan province are focused on adaptation

4. Pothwar Initiatives – include mass awareness for water conservation and development, integrated land and water management studies for agriculture development in Pothwar region,

5. Khyber Pakhtunkhwa and Baltistan Initiatives – include undertaking research in water resources management in WRRC Peshawar,⁶⁰ 03 in Gilgit-Baltistan (GB) province, and 17 in Khyber Pakhtunkhwa (KP) province⁶¹.

6. Punjab and Azad Kashmir Initiatives – sum to 11 in Punjab province, 08 in Azad Jammu and Kashmir (AJK) province.

7. Recharge Pakistan - is building Pakistan's resilience through Ecosystem-Based Adaptation for integrated flood risk management.

2.2.3 Agriculture Initiatives:

Punjab and Khyber Pakhtunkhwa Initiatives - In agriculture sector there are 27 initiatives underway in Punjab, 06 in GB and 01 in Khyber Pakhtunkhwa province have been enlisted by MOCC-NCCP progress review report of 2021.

2.2.4 Energy Initiatives:

Azad Kashmir and Baltistan Initiatives - Energy sector is also a priority sector for climate actions and large number of initiatives were undertaken in GB and AJK during recent years.

Transforming the Indus Basin - is aiming climate resilient agriculture and water management.

2.2.5 Community and Ecosystem Initiatives:

NCCP Implementation Framework - The review shows that a number of development efforts are underway concerning; poverty alleviation, disaster management, GLOF management, water management, urban resilience, environment and afforestation, and ecosystem protection and conservation in various regions of Pakistan in order to protect local vulnerable at-risk populace particularly women and children, forests and land⁶².

2.2.6 Green Cover Initiatives:

1. Ten Billion Tree Tsunami Programme - The adaptation efforts such as TBTP (2019-23) further included adaptation action planning by improving the overall conservation of the existing protected areas and encouraging eco-tourism, community engagement and job creation through the conservation to revive forest and wildlife resources.

2. Up-Scaling Green Pakistan - The Ministry of Climate Change, provincial Forest and Wildlife Departments are upscaling the Green Pakistan Programme in all provinces including Gilgit-Baltistan (GB) and Azad Jammu and Kashmir (AJK)⁶³.

The programme main objective is to facilitate transition towards environmentally resilient Pakistan by mainstreaming notions of adaptation through ecological initiatives covering afforestation, biodiversity conservation and enabling policy environment.

2.2.7 Disaster Resilience Programs:

GLOF I&II - Various interventions such as reducing and scaling-up the Glacial Lake Outburst Flood (GLOF) risk reduction and disaster risk reduction (DRR) projects such as GLOF I&II are also underway in GB and KP.

2.2.8 Urban Resilience Interventions:

1. Clean Green Pakistan Movement - interventions to increase urban resilience include programmes like Clean Green Pakistan Movement launched in 2018.

2. Ground Water Recharge - in 2019, the intervention to enhance the urban community climate change resilience at local and national level for water scarcity caused by floods and droughts initially included Rawalpindi and Nowshera cities.

3. National Rural Support Programme (NRSP) - is mandated to carry development activities for improving resilience of impoverished communities over 72 districts across Pakistan⁶⁴.

2.3 Sustainable Development Assessment:

1. Sustainable Development - Pakistan's national adaptation efforts are aligned with the United Nations Sustainable Development Goals (SDGs) by integrating initiatives such as Vision 2025. These strategies target sustainable economic growth, social advancement, and environmental preservation.

2. Poverty Alleviation - In line with this, Poverty Reduction Strategy Papers (PRSPs) have been devised to combat poverty and foster sustainable development. These papers outline strategies encompassing economic expansion, social safety nets, education, healthcare, and governance, aiming to address pivotal development issues.

2.3.1 Sustainable Development Review:

1. Sustainable Development Goals - The UN Sustainable Development Cooperation Framework (UNSDCF) between the Ministry of Economic Affairs (GOP) and the United Nations was agreed in October 2022. The UNSDCF intends to help in planning and implementing development activities at national level, and will be implemented from January 2023 to December 2027. It intends to support Pakistan achieving sustainable development goals.

2. SDGs Outcome - It is collective framework that advances five priority outcomes; basic social services, gender equality and women's empowerment, climate change and the environment, sustainable inclusive economic growth and decent work, and governance.⁶⁵ Since 2016, Government of Pakistan adopted SDGs as national development goals under a parliamentary resolution. The SDGs are aligned to national development framework 'Vision 2025'. A notable progress on SDGs was achieved on SDG 1 on No Poverty, and SDG 13 on Climate Action.

3. Strengthening Governance - To cope the climate challenges, the UNSDCF strengthens Pakistan's governance and institutional mechanisms for effectively implementing 2030 Agenda. It emphasizes availability of disaggregated data for evidence-based policy making and SDGs monitoring and accountability. It mobilizes financing resources at country level and through other funds.

4. Integrating Partnerships - It also integrates all levels of government, civil societies, community organizations, academia, private sector and trade unions forming multi-sectoral partnerships for innovative responses for various development issues and policies, and more pragmatic advancement of social and economic changes for achieving SDGs.

2.3.2 UNSDCF's Climate Role:

1. Financial Mobilization - The UNSDCF can help the Government of Pakistan strategically accesses national adaptation funding through mobilizing resources and filling financial gaps in collaboration with the UNSDCF and the UN Country Team (UNCT) to reduce climate change impacts under the 17 Sustainable Development Goals (SDGs). Resource mobilization approach will be used with approval of UNCT based on and informed by funding framework.

2. Resource Optimization - The mutual dialogues between GoP and UNCT will help fill financial gaps. Furthermore, the UNCT will support GoP to develop financial management and planning tool for agreed cost results i.e., Integrated National Financing Framework (INFF) with broader financing mechanism to achieve SDGs in Pakistan. This approach should align with agreed cost results and fosters mutual dialogues to enhance financial support. This integrated strategy underscores cooperation and resource optimization for sustainable development to cope with climate change induced challenges.

2.3.3 PRSP Sustainable Development:

1. Poverty Reduction Strategy Papers - in developing countries are a part of the World Bank and International Monetary Fund (IMF) initiative to help countries develop comprehensive strategies for poverty reduction. The PRSPs outline Pakistan's policies, programs, and resources allocation to address the challenges of poverty and promote sustainable development. It has a secretariat under Ministry of Finance (MOF). The PRSPs were submitted in year 2001, 2003 and 2004 followed by PRSP progress report lastly submitted to IMF for year 2012-13.

2. Social Safety Programmes - The poverty reduction strategy covers key elements such as social safety programmes featuring direct-cash transfer, budgetary programmes include Benazir Income Support programme (BISP), Pakistan Bait-ul-Mal (PBM) while Zakat, Employees Old-age Benefit Institution (EOBI), and Workers Welfare Fund (WWF), and a non-budgetary programme with Pakistan Poverty Alleviation Fund (PPAF)⁶⁶.

3. Identifying Budgetary Needs - The yearly PRSP budgetary expenditure reports (FY2019-20, FY2020-21) described critical sectors' budgetary needs, expenditures on development and international aid ⁶⁷. A recent outlook of expenditures and comparison of budgetary expenditure reports shows that a critical decline in budgetary needs of the provinces and overall federal need have been occurred in all critical sectors i.e., agriculture, infrastructure, environment and water & sanitation, education, health, population planning, social security and welfare, and natural calamities & disasters⁶⁸.

2.3.4 PRSP Climate Role:

1. Poverty Alleviation - The literature approves how poverty eradication helps build resilience by lowering vulnerabilities through rapid economic development. The PRSP data signifies role of social protection measures and conditional cash transfers in Government of Pakistan's efforts towards poverty eradication funding and resilience-building. This underscores the government's commitment to providing financial support to vulnerable segments of society, enhancing their capacity to cope with climate-induced challenges during floods and droughts.

2. Enhancing Community Resilience - Similarly, the targeted funding diversification and support mainly for commodity trading, livestock farming, handicrafts, and agriculture, demonstrates a multi-dimensional approach empowering different sectors to build resilience and mitigate climate risks. These PRSP interventions indicate Pakistan's multifaceted approach to adaptation funding, encompassing both social protection and strategic investments to bolster the nation's resilience against climate impacts.

2.4 Climate Policy Interlinkages:

This section explores the alignment of national policies and programs with medium and long-term climate adaptation priorities across critical sectors. Coherence between these policies and climate adaptation is essential to shape effective adaptation measures that address development needs of the country.

2.4.1 Interlinkage Analysis:

The analysis utilizes policy documents, preparatory work by MOCC, and data from various sources, referencing policies and programs directly connected to interventions in critical sectors in table - 2. It also assesses the alignment of these policies with outcomes enhancing adaptive capacity at both national and local levels, aiming to inform and recommend adaptation priorities effectively.

Table 2: Climate Policies and Programs Interlinkages

Sector	Policies and Interventions	Programs	Outcome
Water Resource	NCCP 2012, National Water Policy (2018) ⁶⁹ , Pakistan Water Sector Strategy ⁷⁰ , Sindh Water Policy (2023) ⁷¹ ,	Living Indus Programme 4R Framework ⁷²	- Programs have increased adaptive capacity, indicated by studies on water security, infrastructure improvements, and better water availability ⁷³ .
Agriculture Sector	NCCP 2012,	Country Programming Framework (CPF), National Spatial Data, Green-AI (PSDP 2023), MRV system development (Pakistan Economic Survey 2022), Trading Corporation of Pakistan (TCP), Pakistan Agriculture Storage & Services Corporation (PASSCO), Setting Antimicrobial Resistance (AMR) zones, safe the calf projects, innovative fodder shrubs, backyard poultry projects.	- Positive outcomes include increased vegetation cover ⁷⁴ , emission reduction from livestock ⁷⁵ and soils, enhanced livelihoods ⁷⁶ , and improved agricultural productivity ⁷⁷ .
Health Sector	NCCP, National Health Vision 2016-2025 ⁷⁸	Sehat Sahulat Program, People's Primary Healthcare Initiative, Health Policy, Governance, and Leadership program of WHO ⁷⁹	- Improved health, responsiveness ⁸⁰ , social protection ⁸¹ , and efficiency - Innovative health financing, service delivery, and resource for health - Integration with disaster preparedness - International collaborations
Forestry Sector	NCCP 2012, National Forest Policy 2015	REDD+ Readiness Project 2015 ⁸² , Green Pakistan Programme 2017, Ten Billion Tree Tsunami Programme 2018 ⁸³ , Payment for Ecosystem Services (PES) projects, Miyawaki Urban Forests initiatives ⁸⁴	- Reduced vulnerability to floods and droughts - Increased Forest cover ⁸⁵ - Enhanced ecosystem services, Improved livelihoods ⁸⁶ and carbon sequestration, - Strengthened institutional capacity
Disaster Management	NCCP 2012, Updated NCCP (2021), National	Pakistan Disaster Management Strategy (2015-	- Strengthened disaster preparedness ⁸⁷ , -

	Disaster Management Act (2010)	2020), Pakistan Emergency Helpline, Disaster Recovery Centre for National Data Centre, Pakistan Preparedness and Response Plan (PPRP) 2021-22 (COVID 19)	Improved safety and resilience - Enhanced early warning systems - Upgraded flood protection infrastructure ⁸⁸ .
Gender Inclusion	National Climate Change Gender Action Plan (CCGAP), National Gender Policy Framework (2022), National Policy for Development and Empowerment of Women (2002), Protection against Harassment of Women at the Workplace Act (2010), National Commission on the Status of Women 2012	Ehsaas Kafalat, Kamyab Jawan ⁸⁹ , and Ehsaas Nashonuma, Protection Against Harassment of Women at the Workplace (Amendment) Act, 2022, National Action Plan on Population and Population Welfare Programme, USAID ⁹⁰ and UN Women initiatives, Benazir Income Support Programme (2008)	- National Financial Inclusion Strategy (NFIS)- Ehsaas Programme targets - Literacy ratios tracking
Biodiversity & Ecosystems	National Climate Change Policy (NCCP) (2012), National Biodiversity Strategy and Action Plan 2015 ⁹¹ , National Forest Policy 2015, National Biodiversity Strategy and Action Plan (NBSAP) 2017-2030, Prevention of Cruelty to Animals Act (1890)	Clean Green Pakistan Movement, Animal Protection Index ⁹² , Halal Authority Act ⁹³ , Ecosystem services efforts, Dog population management in Karachi, Marine protected areas, Living Indus initiative, INBAR membership, Bio-safety Clearing House and National Bio-safety Centre, Payment for Ecosystem Services for Mangroves and temperate forests, Eco-System Restoration Initiative (ESRI), Man-made forests	- Protected natural forests - Artificially managed forests - Improved natural resource management - Increased carbon sequestration - Enhanced ecosystem services
Urban Resilience	NCCP (2012), Framework for Economic Growth 2011, Vision 2025 ⁹⁴ , Electric Vehicle Policy 2019, National Hazardous Waste Management Policy (2022)	Clean Green Pakistan Movement, Recharge Pakistan Initiative, Transition towards Renewable Energy, Ban on Polythene Bags, BRT system, Sindh Resilience Project ⁹⁵ , Karachi Heat Wave Management Plan, national hydro-meteorological upgrades, various PSDP (2023) programs	- Socio-economic planning, community involvement, energy efficiency, renewable energy development

2.5 Developing Adaptation Priorities:

This section aligns Pakistan's medium to long-term adaptation priorities with successful interventions and measures identified across vulnerable sectors. The information from the primary and secondary sources drawing from websites of the relevant federal and provincial government entities and other sources such as national literature, ministerial documents, expert analysis, and international reports, helps formulate thematic adaptation priorities for each sector. The stakeholder consultations validate the information for the synthesis of these priorities.

2.5.1 Prioritization Criteria:

The stakeholder inputs were used to develop comprehensive prioritization criteria for adaptation priorities. The major criteria are guided by a systematic approach that takes into account various factors as identified during stakeholder consultations. Table – 3 shows criteria factors below;

Table 3: Major Criteria for Prioritization

Criteria	Description
1. Needs and Vulnerability Assessment	– Prioritize strategies based on needs and vulnerabilities assessment, focusing on the most affected sectors, regions, and populations. – Evaluate the vulnerability of different sectors and regions.
2. Magnitude of Impact	– Prioritize strategies based on the potential magnitude of climate change impacts, focusing on addressing significant threats⁹⁶.
3. Emergency Response and Preparedness	– Prioritize strategies that include emergency response and preparedness measures to address sudden climate-related disasters.
4. Risk Reduction	– Prioritize strategies that reduce climate-related risks and enhance resilience to extreme events.
5. Ecosystem Services	– Prioritize strategies that protect and restore ecosystem services, recognizing the value of healthy ecosystems for adaptation.
6. Political Will and Leadership	– Prioritize strategies with strong government backing and support, considering the level of political will and leadership.
7. Cost-effectiveness and Feasibility	– Prioritize cost-effective strategies that provide significant benefits relative to their costs and are feasible within the local context⁹⁷. – Evaluate the feasibility of implementation⁹⁸.
8. Cross-Sectoral Synergies	– Identify strategies with co-benefits across multiple sectors, considering co-benefits and trade-offs for development, poverty reduction, and environmental sustainability.
9. Policy Alignment	– Prioritize strategies that align with national and provincial policies, including climate action plans and development agendas.
10. Adaptive Capacity	– Consider the adaptive capacity of communities and institutions in different regions. – Prioritize strategies that build on existing capacity and strengthen resilience.
11. Stakeholder Participation	– Prioritize strategies that increase ownership of the adaptation process, involving local communities and stakeholders.
12. Monitoring and Evaluation	– Develop a robust monitoring and evaluation framework to track the progress and effectiveness of adaptation strategies over time.
13. Capacity Building	– Prioritize strategies that include capacity-building initiatives to empower local communities and institutions.
14. Equity	– Prioritize strategies that assess the social and equity implications of each strategy and promote women's inclusion, benefiting marginalized communities.

15. Community Involvement	– Align strategies with the needs, preferences, and involvement of local communities.
16. Public Awareness and Education	– Prioritize strategies that include public awareness and education campaigns to enhance understanding and support for adaptation efforts.
17. Research and Knowledge Sharing	– Promote strategies based on the latest scientific findings, emphasizing research and knowledge sharing to continuously improve adaptation.
18. International Commitments	– Prioritize strategies that align with international commitments and agreements, such as the Paris Agreement and Sustainable Development Goals.
19. Innovation and Technology	– Explore innovative and technology-driven processes to enhance resilience and sustainability.
20. Long-Term Sustainability	– Prioritize strategies that have long-term sustainability and can adapt to changing climate conditions ⁹⁹ .

2.5.2 Sector-specific Priorities:

These prioritization criteria leverage proven strategies addressing sector-specific challenges that aim to enhance the country's resilience to climate change in medium to long term. The consultations with stakeholders help identify and validate adaptation priorities in respective sectors.

The synthesis in table – 4 presents and describe all such priorities thematically under each vulnerable sector.

Table 4: Adaptation Priorities in Medium to Long Term

Sector	Responsible Entities	Medium to Long Term Priorities
Water Adaptation Priorities	Ministry of Water Resources, Ministry of Climate Change, Ministry of Planning, Development, and Special Initiatives	1. Constructing and improving water storage facilities to mitigate water scarcity. 2. Modernizing canals to reduce water losses and enhance water use efficiency ¹⁰⁰ . 3. Incorporating water-related adaptation and resilience measures ¹⁰¹ into climate change policies. 4. Promoting sustainable water management practices to address changing hydrological patterns.
	Provincial Water and Irrigation Departments	Enhancing irrigation efficiency, addressing water scarcity challenges, sustainable water management, investing in water infrastructure, adapting to climate change impacts
Agriculture Adaptation Priorities	Ministry of National Food Security and Research, provincial agriculture departments	1. Developing and promoting climate-resilient crop varieties ¹⁰² . 2. Implementing water-efficient irrigation systems to optimize water usage ¹⁰³ . 3. Introducing agroforestry and soil conservation practices to improve soil fertility. 4. Enhancing soil health through cover cropping and organic farming methods. 5. Promoting integrated pest management practices to reduce reliance on chemical pesticides ¹⁰⁴ .
	Provincial Agriculture, Food, Storage Departments	Improving water management, diversifying crops, adopting modern farming technologies, supporting small scale farmers, ensuring food safety and quality, and enhancing women role ¹⁰⁵ .

Health Adaptation Priorities	Ministry of Health, National Disaster Management Authority	1. Improving healthcare infrastructure to withstand extreme weather events. 2. Developing early warning systems for climate-related health risks. 3. Promoting public awareness about climate-sensitive health issues. 4. Strengthening healthcare systems to handle potential surges in medical needs during disasters.
	Provincial health Departments, WASAs, PDMAAs, PHED - WASH	Embedding climate considerations in healthcare planning, fostering awareness of climate-linked health risks, reinforcing disease monitoring and response capacities, fortifying healthcare systems and workforce, building rural healthcare infrastructure, expanding universal health coverage, advancing research for prevention and care, and forging partnerships
Forestry Adaptation Priorities	Ministry of Climate Change, provincial forest departments	1. Large-scale reforestation and afforestation initiatives ¹⁰⁶ . 2. Implementing sustainable forest management practices. 3. Creating firebreaks and early warning systems to manage forest fires. 4. Promoting community-based forest management and awareness.
	Provincial Forest Departments	Expanding forest cover through afforestation and reforestation, conserving biodiversity and ecosystems, preventing deforestation, promoting sustainable logging practices, engaging local communities in forest management, mitigating GHG impacts, enforcing responsible forestry policies
Disaster Preparedness Priorities	National Disaster Management Authority (NDMA), Provincial Disaster Management Authorities (PMDAs), Provincial Meteorological Departments (PMD)	1. Conducting risk assessment and mapping exercises for disaster-prone areas. 2. Designing disaster-resistant infrastructure and early warning systems. 3. Strengthening healthcare systems and stockpiling medical supplies for emergencies. 4. Promoting community-based disaster risk reduction programs.
	PDMAAs, PMDs	Robust early warning systems, enhanced coordination among agencies, regular drills and simulations, strengthened emergency response capacities, resilient infrastructure development
Gender Inclusion Sector Priorities	The Ministry of Climate Change, National Commission of Women Status, The Ministry of Planning, Development & Special Initiatives	1. Integrating gender considerations into climate change adaptation strategies. 2. Empowering women through education, training, and access to resources. 3. Recognizing women's roles in various sectors. 4. Collecting and managing disaggregated gender data for policy-making ¹⁰⁷ .
	Provincial Women Welfare Departments, NGOs, international organizations	women's economic participation, green economy integration, education and employment disparities, gender security, women's health, financial inclusion, digital empowerment, women's livelihoods, decision-making participation, climate adaptation based on women's knowledge and experiences, leadership in

		sustainable practices, addressing gender-specific vulnerabilities, equitable opportunities for women
Biodiversity Adaptation Priorities	Ministry of Climate Change, Forestry Wing	1. Establishing and conserving protected areas and promoting sustainable land-use practices ¹⁰⁸ . 2. Enhancing the capacity of local communities and research institutions ¹⁰⁹ . 3. Improving climate data collection and analysis for informed decision-making. 4. Collaborating with international organizations and neighboring countries.
	Provincial Forest, Wildlife, and Fisheries Departments, local communities, research institutions, international organizations	Biodiversity conservation, Ecosystem preservation, Sustainable resource use, animal protection, glacier impact studies, coastal adaptation, cooperative conservation, community engagement and empowerment, sustainable fishing practices, solid waste management, ecosystem preservation
Urban Resilience Sector Priorities	The Ministry of Climate Change, Pak-EPA, The Ministry of Planning, Development & Special Initiatives, WAPDA	1. Implementing urban planning and zoning to manage rapid urbanization ¹¹⁰ . 2. Developing disaster preparedness plans and early warning systems. 3. Improving water management and sanitation infrastructure. 4. Creating and preserving green spaces and urban forests ¹¹¹ . 5. Upgrading urban infrastructure to withstand environmental stressors and disasters.
	Planning and Development Department, HUD, WAPDAs, WASA, LGRD	Climate change vulnerabilities, community participation, energy efficiency, renewable energy, emissions reduction, sustainable growth

2.6 Strategic Framework Proposal

2.6.1 Adaptation Funding:

To achieve national climate adaptation goals, it's crucial to recognize the substantial gap between projected global adaptation costs and available financial resources¹¹². Estimated annual adaptation costs, averaging \$10.70 billion over the next 30 years¹¹³, underline a growing deficit. Recent projections suggest a requirement of USD 160-340 billion by 2030 and USD 315-565 billion by 2050, emphasizing the necessity for increased global funding for vulnerable countries like Pakistan¹¹⁴.

2.6.2 Pakistan's Funding Needs:

Pakistan requires significant financial resources to address climate change. Mitigation costs till 2050 are estimated at \$17 billion, while annual adaptation costs range from \$7 to \$14 billion. The current climate expenditure is about \$5 billion, approximately 6% of the federal budget¹¹⁵.

1. Climate Expense - Climate-related expenses vary from 25% to 60% of the climate-relevant budget at the national level, and 5.8% to 8.1% of total federal expenditure. National adaptation requirements are estimated at 1.5% to 3.0% of GDP. Despite these financial commitments, implementation faces challenges, including insufficient international climate finance inflows, which are less than \$500 million¹¹⁶.

2. Expenditure Tracking - Climate change expenditure tracking efforts in Pakistan have been limited. Between 2012-2015, climate-related expenditures, including federal, provincial, and regional contributions, grew at an annual rate of 20.1%, reaching Rs 572.5 billion. As a percentage of GDP, these expenditures ranged from 1.52% to 2.08% over four years, with an average of around 7% of the national budget, rising to 8.5% in 2014-15¹¹⁷. Table - 5 shows results of the federal government for Fiscal Year 15-16 generated from Expenditure Coding and Tracking System. The provincial government results have been generated partially by the CPEIR methodology.

Table 5: Pakistan's climate change expenditure (2011-16)

	2011-12	2012-13	2013-14	2014-15	2015-16
Federal	6.5%	5.8%	6.2%	8.1%	6.5
Khyber Pakhtunkhwa	7.2%	5.3%	7.1%	9.7%	8.9
Balochistan	7.3%	10.4%	11.1%	11.3%	11.9
Punjab	6.2%	7.1%	8.2%	9.3%	13.7
Sindh	5.7%	4.2%	4.3%	6.9%	7.2%
FATA	13.1%	12.5%	11.6%	11.9%	10.2%
Gilgit Baltistan	16%	19%	20%	28%	25.6%
Azad Jammu & Kashmir	9.2%	14.0%	12.5%	16.9%	14.3%
National	6.7%	6.1%	6.7%	8.5%	8.4%

3. Funds Management - A stronger linkage among various national implementing entities (departments) is needed for accessing sustained finances. To implement the mandate, Ministry of Climate Change needs a long-term plan to further guide other line Ministries and national implementing entities at federal, provincial and local levels.

2.6.3 Climate Finance Landscape:

1. Current Sources - The current sources of climate change financing for Pakistan include the Global Climate Fund (GCF) and Global Environmental Fund (GEF), along with random financial support from donors like UK Aid, the World Bank, and UNDP, Pakistan. However, Pakistan has not been able to effectively secure or efficiently use global climate finance compared to its regional counterparts.

2. Availing Global Funds - To realize the full potential of available global adaptation funding, the Government of Pakistan needs to establish concrete planning and coordination within existing government entities and new institutions. A well-designed engagement strategy alongside an effective communication plan can bring all stakeholders on board to propel the NAP process and engagement with global climate change funds.

3. NRSP - The accreditation of the National Rural Support Programme (NRSP) by the Green Climate Fund (GCF) significantly bolsters climate financing within the national adaptation planning process. NRSP accreditation allows it to access and manage GCF resources, facilitating the implementation of climate change adaptation projects at the local level. As an accredited entity, NRSP can channel GCF funds toward initiatives aligned with national adaptation priorities across

various sectors. This collaboration strengthens the reach of climate financing into localized adaptation efforts¹¹⁸.

4. PIMA and Climate PIMA - IMF Public Investment Management Assessment (PIMA) and Climate PIMA (CPIMA) framework (November 17, 2023) includes the Climate-PIMA module encompassing; sectoral and centralized planning, developing national and sectoral coordination mechanisms, conducting climate analysis and appraisal, framework for climate risk analysis, climate considerations in projects, budgetary tagging and asset management, disaster risk management strategy, ex-post reviews, ex-ante financing mechanisms and fiscal risk analysis¹¹⁹.

2.6.4 Framework Aim:

The strategic framework aims to bridge the financing gap for climate change adaptation in Pakistan by leveraging international funding, strengthening institutional capacity, and engaging stakeholders across sectors to effectively implement adaptation initiatives.

2.6.5 Framework Elements:

The country program sets the basis for the strategic framework by focusing on two key aspects: the implementation of international standards and human resource development. These factors play key role in enhancing country strategic framework by reinforcing various elements of the NAP process. These elements cover broad range of financial arrangements the country is seeking and foreseeing as future funding opportunities.

2.6.6 GCF Engagement Overview:

The GCF engagement with the country's strategic framework for climate change support and funding has evolved through various phases, including NCCP implementation framework, country program on engagement with GCF, supporting stakeholder consultations, climate change readiness, and preparatory support, human resource development, and assessments of national entities responsible for taking action on climate change¹²⁰.

2.6.7 The NCCP Implementation:

The NCCP Implementation Framework (2021) outlines alignment criteria for acquiring climate change financial support in line with the National Climate Change Policy (NCCP 2012) and other policy objectives and adaptation priorities. The framework emphasizes stakeholder engagement and establishes a country programme to identify roles, responsibilities, priorities, and entry points¹²¹.

2.6.8 Country Programme Development:

The strategic framework for Pakistan suggests developing a country programme to outline climate change initiatives and priorities for engagement with the GCF. This program involved stock-taking of existing strategies, policies, and need assessments, extensive consultations, and mapping investment priorities to GCF's impact areas.

2.6.9 Stakeholder Consultations:

Stakeholder consultations engage federal and provincial government departments, ministries, and other development organizations to gather valuable inputs and finalize the strategic framework.

2.6.10 NAP Process Support:

The GCF readiness support is focused on human resource development to efficiently implement future resources and funds from GCF. Training and capacity building were conducted to prepare key staff for GCF coordination¹²².

2.6.11 National Implementation Entities Assessment:

Efforts are made to prepare potential National Implementation Entities (NIEs) for GCF accreditation, aligning with institutional standards.

2.6.12 Proposed Engagement with Fund:

The proposed engagement includes establishing a national Climate Change Adaptation Fund (CCAF), co-financed by the government and donors.

- 1. Funding Accreditations** - It will channel all climate related funding accreditations like NRSP, and other available sources such as; allocating funding from the PSDP adaptation-related projects, accessing international organizations for co-financing, and leveraging the private sector for creating markets for adaptation-relevant products and services.
- 2. Financing Opportunities** - It can avail financing opportunities for implementing adaptive social protection programs to build resilience among vulnerable households.
- 3. Provincial Considerations** - Other national and provincial considerations need to collude all such adaptation efforts into the climate change funding. In this, MoCC is receiving proposals from KPK government which are right now in assessment phase, that can later serve the NAP process.

Conclusion:

1. Overview of Climate Adverse Impacts:

- Rising temperatures, altered precipitation patterns, and extreme events contribute to adverse consequences.
- Impacts include heat-related illnesses, water scarcity, prolonged droughts, disruptions in agriculture, and diminished food security.
- Glacial melting and inadequate water management intensify water insecurity and flash flood risks.

2. Coping Efforts:

- Efforts exerted by GoP cover various measures to protect, conserve and manage natural resources and crucial vulnerable sector.

3. Water Sector:

- Focus on improving water resource management, building reservoirs, and constructing new dams.
- Emphasis on enhancing water-use efficiency for agriculture, livestock, and domestic use under WASH programs.

4. Agriculture and Livestock:

- Promotion of climate-resilient crops and efficient irrigation techniques.
- Implementation of early warning systems to mitigate impacts of changing weather patterns.

5. Health Sector:

- Addressing changing disease patterns, heat stress, and extreme weather events.

- Strengthening health infrastructure, training healthcare workers, and developing early warning systems.
- 6. Forestry and Biodiversity:**
 - Initiatives include reforestation, afforestation, and sustainable forest management.
 - Biodiversity conservation strategies involve protected areas, habitat restoration, and sustainable wildlife management.
- 7. Land and Marine Ecosystems:**
 - Using measures such as protected areas, species conservation, and sustainable land use.
 - Enhancing disaster preparedness with early warning systems, marine protected areas, and climate information monitoring.
- 8. Disaster Preparedness:**
 - Involving inclusive commitment of government bodies, civil society, international partners, and the general population.
 - Using proactive measures like awareness, community engagement, and climate-resilient infrastructure for disaster management.
- 9. Gender Inclusion:**
 - Addressing gender-specific vulnerabilities and ensuring women's participation in decision-making.
 - Empowering women to actively participate in adaptation efforts and promoting equitable outcomes.
- 10. Urban Resilience:**
 - Focusing on resilient infrastructure, early warning systems, and efficient waste management.
 - Coping strategies encompassing risk assessments, evacuation procedures, and post-disaster recovery.
- 11. Alignment with International Frameworks:**
 - Integration with global sustainable development goals and poverty reduction strategies.
- 12. Adaptation Gaps and Challenges:**
 - Identified gaps include insufficient water-efficient technologies, inadequate climate-resilient crop varieties, and lack of preparedness plans.
 - Challenges include deforestation, declining biodiversity, urban planning, gender equity, cross-sectoral coordination, and limited access to climate data.
 - Weak collaborations exist among governments, NGOs, international organizations, private sector, and local communities.
 - Inefficiencies in systems and processes include insufficient integration and coordination among sectors, limited scaling-up of successful initiatives, inadequate local-level engagement, a lack of comprehensive data and research, insufficient financial resources, and the need for further gender equity mainstreaming.
 - Insufficient mobilization of financial support from international sources, limited implementation of initiatives, and underutilization of public-private partnerships for innovative financing models persist as challenges.
- 13. Strategic Imperative:**
 - A comprehensive strategy aligned with Pakistan's development priorities and international climate agreements is crucial for long-term adaptation and resilience.

Need Gaps:

Based on premise of primary information gathered from key stakeholders during needs assessment consultations and available secondary national literature analyzed in this report, several need gaps emerge in Government of Pakistan's approach to addressing climate change impacts. These gaps highlight areas where further actions are needed to enhance the country's adaptive capacity. Here are the identified gaps and corresponding needs as a way forward;

1. Lacking Integration and Coordination Mechanism - There are beneficial coping strategies in place, but there is need for better integration and coordination among different sectors and responsible provincial governments. Many strategies are sector-specific, and a more holistic, cross-sectoral approach is required.

2. Lacking Implementation and Scaling-up Efforts - There are successful pilot projects and initiatives, but many have not been scaled up to address the broader climate change challenges across the country. There's a need for scaling up successful practices to achieve a meaningful result.

3. Lacking Local-Level Engagement - Despite efforts to involve local communities, low improvement in ensuring meaningful participation and ownership of adaptation initiatives at the community level persists.

4. Lacking Meaningful Data and Research - While there have been efforts to gather data and research, there's a lack of comprehensive and up-to-date information on climate impacts and meaningful contemplation to assess vulnerabilities and risks, and hence devise effective adaptation strategies. More research and data collection are needed to inform evidence-based decision-making.

5. Lacking Financial Resources - Adequate funding is essential for implementing effective adaptation measures. However, there is a gap in the availability of sufficient financial resources to support large-scale adaptation projects.

6. Inadequate Resource Allocation - Major drawbacks and gaps in climate change adaptation within Pakistan funding arrangements include inadequate allocation of resources for adaptation measures in the United Nations Sustainable Development Cooperation Framework (UNSDCF), Poverty Reduction Strategy Papers (PRSP), Public Sector Development Program (PSDP), and Provincial Annual Development Programs (ADPs).

7. Lacking Integration - Additionally, there is a lack of robust integration of climate change adaptation priorities across these frameworks, resulting in fragmented efforts. Incomplete alignment of funding mechanisms with long-term climate resilience goals and limited coordination among various stakeholders further hinder effective adaptation strategies. These drawbacks underscore the need for enhanced funding allocation, improved integration, and stronger collaboration to address the challenges posed by climate change in Pakistan.

8. Lacking Gender Equity - Despite implementation of gender-sensitive strategies and their mentioning in policies and incorporation in various climate change programs, there's a need to further mainstream gender considerations across all adaptation efforts and ensure that women role and other vulnerable groups are adequately represented and supported.

Recommendations:

Based on findings in conclusion and identified adaptation gaps, the following recommended actions are needed to be set to address adaptation gaps in Pakistan;

1. **Mainstreaming Climate Change** - Integrate climate considerations into sectors like agriculture, water management, urban planning, and disaster management.
2. **Policy Reforms** - Update policies and regulations to align with adaptation goals and incentivize sustainable practices.
3. **Mainstreaming Adaptation** - Integrate climate adaptation into policies and plans across all sectors, ensuring climate risks are considered in decision-making processes.
4. **National Adaptation Strategy** - Develop a holistic National Adaptation Strategy that aligns with development goals, integrates adaptation measures, and prioritizes cross-sectoral collaboration.
5. **Integrated Climate Action Plans** - Develop tailored climate action plans for each province, emphasizing specific strategies and goals to address local climate challenges.
6. **Research and Data Collection** - Invest in climate research and data collection to understand evolving climate patterns and inform policy decisions. Establish a robust climate data repository and support research to inform evidence-based adaptation strategies and address data gaps. Support research and data collection on climate change impacts, vulnerabilities, and adaptation strategies to inform evidence-based policy decisions.
7. **Collaboration and Coordination** - Foster collaboration among ministries, departments, and NGOs to ensure a holistic approach to adaptation and ensure coordinated and integrated efforts in addressing climate change impacts across various sectors. Establish inter-provincial platforms for knowledge sharing and best practice exchange to enhance adaptive capacity and resilience.
8. **Capacity Building** - Invest in building capacity at all levels, from government officials to local communities, to effectively implement adaptation initiatives and monitor progress. Invest in capacity building for government officials, local communities, and relevant stakeholders to effectively implement climate adaptation and mitigation strategies.
9. **Gender Inclusion** - Ensure gender considerations are integrated into all stages of adaptation planning and implementation, empowering women and vulnerable groups. Develop gender-sensitive climate adaptation strategies that address the unique vulnerabilities of women, considering their roles in agriculture, water management, and household resilience. Empower women by providing them with training and resources to actively participate in climate resilience efforts and decision-making processes.
10. **Early Warning Systems** - Strengthen early warning systems to provide timely alerts for extreme weather events, while improving disaster preparedness. Invest in advanced meteorological and early warning systems to provide timely alerts to communities at risk, allowing them to take necessary precautions.
11. **Water Resource Management** - Collaborate on efficient water resource management, promoting water conservation, irrigation improvements, and sustainable urban water use. Strengthen water management systems, including the maintenance and expansion of irrigation infrastructure, to enhance water efficiency and adapt to changing precipitation patterns.
12. **Climate-Resilient Agriculture** - Promote resilient farming practices such as crop diversification, drought-resistant varieties, and efficient irrigation techniques. Promote sustainable agricultural practices such as precision farming, crop rotation, and agroforestry to mitigate the impacts of climate change on crop yields. Invest in research and development of drought-resistant crop varieties that can withstand changing climate conditions.
13. **Health and Public Awareness** - Develop and implement heatwave preparedness plans to mitigate health risks associated with rising temperatures, focusing on vulnerable populations

such as the elderly, women, children, and laborers. Raise public awareness about the health risks posed by climate change and the importance of preventive measures, such as staying hydrated and seeking medical attention during heatwaves.

- 14. Forestry and Biodiversity & Ecosystems Conservation** - Launch large-scale tree planting initiatives to mitigate climate impacts, enhance soil stability, and conserve biodiversity. Scale up afforestation and reforestation initiatives to restore degraded ecosystems and enhance carbon sequestration, contributing to climate change mitigation. Establish protected areas and wildlife corridors to safeguard biodiversity and ensure ecosystem resilience in the face of changing climate conditions.
- 15. Disaster Preparedness** - Strengthen disaster preparedness with advanced meteorological and early warning systems, investing in community resilience. Strengthen disaster preparedness and response mechanisms to effectively manage extreme weather events, including floods, storms, and landslides.
- 16. Urban Resilience and Infrastructure Development** - Integrate climate resilience into urban planning by promoting green infrastructure, sustainable urban drainage systems, and energy-efficient buildings. Enhance urban disaster preparedness through improved zoning regulations, evacuation plans, and infrastructure design that can withstand extreme weather events.
- 17. Community Engagement** - Raise awareness through educational programs about climate impacts and adaptation strategies. Empower local communities by involving them in designing, implementing, and monitoring adaptation projects tailored to their needs.
- 18. Knowledge Sharing** - Establish platforms for provinces and sectors to share best practices, experiences, and challenges to foster learning and collaboration.
- 19. Community Resilience Building:** Empower local communities with disaster preparedness training, livelihood diversification, and sustainable resource management. Involve local communities in the design and implementation of climate resilience strategies, recognizing their unique knowledge and perspectives. Encourage community-based initiatives that promote sustainable agriculture, water management, and disaster preparedness at the grassroots level.
- 20. Renewable Energy Promotion** - Incentivize renewable energy adoption through policies, funding, and streamlined regulations.
- 21. Funding and Resource Allocation** - Allocate adequate funds for research, infrastructure, capacity building, and public awareness campaigns. Allocate sufficient financial resources to support climate adaptation and mitigation projects across sectors, including agriculture, water management, health, and disaster preparedness.
- 22. Innovative Financing** - Explore innovative funding mechanisms like climate bonds and public-private partnerships to secure resources for large-scale adaptation projects. Engage the private sector in climate adaptation and mitigation efforts through partnerships that leverage technological expertise, financial resources, and innovation. Explore public-private partnerships and international climate finance, to fund large-scale climate resilience initiatives.
- 23. Monitoring and Evaluation** - Set up a rigorous monitoring and evaluation framework to assess the effectiveness of adaptation projects and make necessary adjustments. Continuously assess adaptation strategies' effectiveness and make necessary improvements.
- 24. International Collaboration** - Collaborate with international organizations and experts to access global knowledge, expertise, and additional resources for adaptation efforts. Engage in partnerships to access global knowledge, technology, and financial support for adaptation efforts.

References:

- ¹ <https://dailytimes.com.pk/377839/greenhouse-gas-emission-in-pakistan/>
- ² Climate Risk Assessment, 2022, State Bank of Pakistan, <https://www.sbp.org.pk/FSR/2022/Box-4.1.pdf>
- ³ National Action Programme to Combat Desertification in Pakistan. MoCC/IUCN Pakistan, Pakistan. 87 pp. URL: https://www.iucn.org/sites/dev/files/pk_nap_desertification_report.pdf
- ⁴ https://www.pmd.gov.pk/rnd/rndweb/rnd_new/journal/vol14_issue27_files/5_Estimation_of_Greenhouse_Gas_Emissions_by_Household%20Energy_Consumption_Lahore_Pakistan.pdf
- ⁵ <https://www.worldometers.info/co2-emissions/pakistan-co2-emissions/>
- ⁶ Climate Risk Country Profile: Pakistan (2021): The World Bank Group and the Asian Development, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ⁷ <https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-historical>
- ⁸ <https://tradingeconomics.com/pakistan/precipitation>
- ⁹ <https://edition.cnn.com/2022/08/30/asia/pakistan-climate-crisis-floods-justice-intl/index.html>
- ¹⁰ Spatio-Temporal Variability of Drought in Pakistan Using Standardized Precipitation Evapotranspiration, 2019, <https://www.mdpi.com/2076-3417/9/21/4588>
- ¹¹ <https://edition.cnn.com/2022/08/30/asia/pakistan-climate-crisis-floods-justice-intl/index.html>
- ¹² Project Launch report, Building Capacity to advance the NAP process in Pakistan, 2021, MCC
- ¹³ <https://www.sciencedirect.com/science/article/pii/S2667010021004078>
- ¹⁴ Impacts of climate change on water resources and agriculture in Pakistan: A review, 2019
- ¹⁵ Notre-Dame GAIN Index Ranking (2019), <https://gain.nd.edu/our-work/country-index/rankings/>
- ¹⁶ Food and Agriculture Organization 2020
- ¹⁷ World Bank 2019
- ¹⁸ United Nations Department of Economic and Social Affairs-UNDESA 2020
- ¹⁹ Central Intelligence Agency 2020
- ²⁰ Asian Development Bank-ADB 2020
- ²¹ https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ²² Climate Risk Country Profile-Pakistan, 2021, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ²³ Pakistan District Level Climate Risk and Hazard Assessment Classification, Country Profile of Pakistan 2017, ADB, <https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf>
- ²⁴ Impact of climate change on agriculture in North West Pakistan and adaptation strategies of farming community: a case study of Kaghan Valley, https://www.academia.edu/download/37879275/Umar-Climate_Change_2014.pdf
- ²⁵ Climate change impacts on agriculture sector: A case study of Pakistan, 2021, <https://www.scielo.br/j/cr/a/6q6m6Hd7kMMZ8rz45GQDSKx/?format=pdf&lang=en>
- ²⁶ Climate Impacts on the agricultural sector of Pakistan: Risks and solutions, 2014, <https://www.sciencedirect.com/science/article/pii/S2667010021004078>
- ²⁷ Ministry of Climate Change. (2021). National Climate Change Policy 2012
- ²⁸ Regional and sectoral assessment on climate-change in Pakistan: Social norms and indigenous perceptions on climate-change adaptation and mitigation in relation to global context, 2018, <https://www.sciencedirect.com/science/article/abs/pii/S0959652618322613>
- ²⁹ Climate Change Profile of Pakistan, 2017, Asian Development Bank
- ³⁰ Climate Change in Pakistan: Focused on Sindh Province, 2012, https://www.pmd.gov.pk/report_rnd.pdf
- ³¹ https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ³² <https://www.frontiersin.org/articles/10.3389/feart.2023.1113554/full>
- ³³ Spatio-temporal variability of drought characteristics across Pakistan, 2022, <https://link.springer.com/article/10.1007/s10333-021-00881-4>
- ³⁴ GOP's updated NDCs, 2021, Ministry of Climate Change
- ³⁵ Climate-resilient pathways, 2023, <https://www.brecorder.com/news/40260951>

-
- ³⁶ <https://www.unep.org/news-and-stories/story/pakistan-ramps-protected-areas>, May, 2021
- ³⁷ Climate Risk Country Profile Pakistan, 2021, The World Bank, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ³⁸ Mapping agricultural vulnerability to impacts of climate events of Punjab, Pakistan, 2022, <https://link.springer.com/article/10.1007/s10113-022-01918-y>
- ³⁹ The use of climate information to estimate future mortality from high ambient temperature: A systematic literature review, 2017, <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0180369>
- ⁴⁰ A Spatial-temporal Study for the Spread of Dengue Depending on Climate Factors in Pakistan (2006–2017), 2020, <https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08846-8>
- ⁴¹ Impacts of Climate Change on Biodiversity: A review of the recent scientific literature, 2008, <https://wedocs.unep.org/bitstream/handle/20.500.11822/8629/Impacts-climate-change-biodiversity.pdf?sequence=3&%3BisAllowed=>
- ⁴² Need for Sustainable Management of Forests underscored by Experts, 2018, IUCN, <https://www.iucn.org/news/pakistan/201809/need-sustainable-management-forests-underscored-experts>
- ⁴³ Pakistan: Flood Damages and Economic Losses Over USD 30 billion and Reconstruction Needs Over USD 16 billion, 28th October, 2022, the World Bank Press Release, How Pakistan floods are linked to climate change, article published by BBC News 2nd September 2022
- ⁴⁴ Climate Change 2022: Impacts, adaptation and vulnerability, IPCC Report, <https://www.ipcc.ch/report/ar6/wg2/>
- ⁴⁵ IUCN and MoCC launch Pakistan's First-ever Climate Change Gender Action Plan, 21st July, 2022, <https://www.iucn.org/news/202207/iucn-and-mocc-launch-pakistans-first-ever-climate-change-gender-action-plan>
- ⁴⁶ Pakistan to launch first ever National Climate Change Gender Action Plan (ccGAP), 19 July, 2022 Daily Times Press Release
- ⁴⁷ Barriers to Climate Change Adaptation in Developing Countries, 2006
- ⁴⁸ Pakistan Country Climate and Development Report (November 2022), the World Bank
- ⁴⁹ Pakistan Country Profile, https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15078-WB_Pakistan%20Country%20Profile-WEB.pdf
- ⁵⁰ Global Climate-Change Impact Studies Centre, <http://www.gcisc.org.pk/>
- ⁵¹ https://www.wwfpak.org/knowledge_hub/_natura/_natura__volume_4_issue_2___2020/is_pakistan_s_water_crisis_a_natural_calamity_or_man_made_/
- ⁵² <https://thediplomat.com/2022/06/pakistans-water-crisis/>
- ⁵³ <https://dailytimes.com.pk/466856/future-of-water-in-pakistan/>
- ⁵⁴ Modelling temperature and precipitation variabilities over semi-arid region of Pakistan under RCP 4.5 and 8.5 emission scenarios, 2023, <https://link.springer.com/article/10.1007/s40808-023-01776-5>
- ⁵⁵ An Investigation Standardized Precipitation Index Trend in Arid and Semi-arid Region of Pakistan Applying the Innovative Trend Analysis (ITA) Technique, 2021, https://link.springer.com/chapter/10.1007/978-3-030-67028-3_9
- ⁵⁶ GCISC CMIP5 and CMIP6 projections
- ⁵⁷ Progress Report Regarding Implementation of National Climate Change Policy (NCCP) and its Implementation Framework, January 2021, MCC
- ⁵⁸ Progress Report of NCCP Implementation Framework, 2021
- ⁵⁹ Ministry of Climate Change , (<https://mocc.gov.pk/Projects>)
- ⁶⁰ PCRWR, (<https://pcrwr.gov.pk/completed-projects/>)
- ⁶¹ Progress Report Regarding Implementation of National Climate Change Policy (NCCP) and its Implementation Framework, January 2021, MCC
- ⁶² Progress Report on NCCP framework, 2021, MCC
- ⁶³ Planning Commission PC-I for TBTP (2019-23), approved by Ministry of Planning, Development and Special Initiatives
- ⁶⁴ <https://nrsp.org.pk/>
- ⁶⁵ Ministry of Economic Affairs, Economic Affairs Division, 2022, (<https://www.ead.gov.pk/>)
- ⁶⁶ Annual PRSP Progress Report FY2012/13, IMF: <https://www.imf.org/external/np/prsp/prsp.aspx>
- ⁶⁷ https://www.finance.gov.pk/prsp_report_arc.html
- ⁶⁸ PRSP Budgetary Expenditures of FY 2019-20 and FY 2020-21, https://www.finance.gov.pk/prsp_report_arc.html

-
- ⁶⁹ National Water Policy 2018, https://ffc.gov.pk/wp-content/uploads/2018/12/National-Water-Policy-April-2018-FINAL_3.pdf
- ⁷⁰ Ministry of Water Resources, <https://mowr.gov.pk/SiteImage/Misc/files/Pakistan-Water-Sector-Strategy-Vol-2.pdf>
- ⁷¹ <https://irrigation.sindh.gov.pk/Content/Departments/SindhWaterPolicy/SWP.pdf>
- ⁷² https://www.pc.gov.pk/uploads/downloads/Final_4RF.pdf
- ⁷³ Pakistan : Getting More from Water, 2019, WBG
- ⁷⁴ Impact of water sector interventions on economy, equity, and environment in the rainfed region of Punjab, Pakistan, 2021
- ⁷⁵ www.oliveoiltimes.com/
- ⁷⁶ Impact of water sector interventions on economy, equity, and environment in the rainfed region of Punjab, Pakistan, 2021
- ⁷⁷ Restoring Subsistence and Commercial Agriculture in FATA, USAID 2020
- ⁷⁸ National Health Vision 2016-2025, <https://phkh.nhsr.pak/sites/default/files/2019-10/National%20Health%20Vision%202016-2025.pdf>
- ⁷⁹ https://en.wikipedia.org/wiki/Health_in_Pakistan
- ⁸⁰ https://www.finance.gov.pk/survey/chapter_22/PES11-HEALTH.pdf
- ⁸¹ Sehat Sahulat Program, Government of Pakistan, <https://www.pmhealthprogram.gov.pk/>
- ⁸² https://www.forestcarbonpartnership.org/system/files/documents/pc30_2b._pakistan-r-package_0.pdf
- ⁸³ <https://mocc.gov.pk/ProjectDetail/M2QzOWJmMjUzTU3MC00NmFkLWE4YmMtZDFhMmRlOGU2NGRh>
- ⁸⁴ <https://tribune.com.pk/story/2379619/rawalpindi-to-have-largest-miyawaki-forest>
- ⁸⁵ National Forest Policy 2015,
- ⁸⁶ [https://mocc.gov.pk/SiteImage/Policy/National Forest Policy 2015 \(9-1-17\).pdf](https://mocc.gov.pk/SiteImage/Policy/National Forest Policy 2015 (9-1-17).pdf)
- ⁸⁷ <https://ndrmf.pk/>
- ⁸⁸ Annual flood report, 2018 Federal Flood Commission, Ministry of Water Resources, Islamabad
- ⁸⁹ <https://www.pc.gov.pk/web/gender>
- ⁹⁰ Pakistan - Gender Fact Sheet December 2020, USAID, <https://www.usaid.gov/pakistan/our-work/gender-equality-and-female-empowerment>
- ⁹¹ National Biodiversity Strategy and Action Plan (NBSAP). | UNEP Law and Environment Assistance Platform, <https://faolex.fao.org/docs/pdf/pak176756.pdf>
- ⁹² <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC176756/>
- ⁹³ https://www.wfpak.org/our_work/forests/
- ⁹⁴ The World Bank Group's Country Climate and Development Report (CCDR) for Pakistan, November 2022, <https://openknowledge.worldbank.org/server/api/core/bitstreams/2d1af64a-8d35-5946-a047-17dc143797ad/content>
- ⁹⁵ <https://thedocs.worldbank.org/en/doc/481871542124415043-0310022018/original/AbdulFattahTunioPAKISTANUrbanResilienceKarachi.pdf>
- ⁹⁶ Various Approaches to Long term Adaptation Planning, 2019, <https://unfccc.int/sites/default/files/resource/variousapproaches%20.pdf>
- ⁹⁷ The Adaptation Principles: 6 Ways to Build Resilience to Climate Change, 2020, <https://www.worldbank.org/en/news/feature/2020/11/17/the-adaptation-principles-6-ways-to-build-resilience-to-climate-change>
- ⁹⁸ Assessing the feasibility of adaptation options: methodological advancements and directions for climate adaptation research and practice, 2020, <https://link.springer.com/article/10.1007/s10584-020-02762-x>
- ⁹⁹ National Adaptation Plans, UN Environment Programme, 2021, <https://www.unep.org/explore-topics/climate-action/what-we-do/climate-adaptation/national-adaptation-plans>
- ¹⁰⁰ Ministry of Water Resources, <https://mowr.gov.pk/SiteImage/Misc/files/Pakistan-Water-Sector-Strategy-Vol-2.pdf>
- ¹⁰¹ https://www.pc.gov.pk/uploads/downloads/Final_4RF.pdf
- ¹⁰² Resilience Through Crop Diversification in Pakistan, 2021, https://link.springer.com/chapter/10.1007/978-981-16-0680-9_28
- ¹⁰³ <https://mowr.gov.pk/SiteImage/Misc/files/Pakistan-Water-Sector-Strategy-Vol-2.pdf>
- ¹⁰⁴ Rearing natural enemies to control crop pests in Pakistan, CABI, <https://www.cabi.org/projects/rearing-natural-enemies-to-control-crop-pests-in-pakistan/>
- ¹⁰⁵ https://sedc.lums.edu.pk/sites/default/files/user376/women_and_agriculture_in_pakistan.pdf
- ¹⁰⁶ https://redd.unfccc.int/files/pakistan_redd_strategy_final-oct_2_2021.pdf

- https://www.pbs.gov.pk/sites/default/files/social_statistics/publications/Compendium_of_Gender_Statistics_2019.pdf
- ¹⁰⁸ <https://www.envpk.com/ endangered-and-critically-endangered-bird-species-of-pakistan/>
- ¹⁰⁹ <https://www.cbd.int/doc/world/pk/pk-nbsap-01-en.pdf>
- ¹¹⁰ Urban Risk and Reduction Approaches in Pakistan, <https://pubdocs.worldbank.org/en/481871542124415043/AbdulFattahTunio-PAKISTAN-UrbanResilienceKarachi.pdf>, 2018
- ¹¹¹ Disaster resilience in Pakistan: A comprehensive multi-dimensional spatial profiling, 2021
- ¹¹² <https://www.worldbank.org/en/news/press-release/2022/11/10/pakistan-urgently-needs-significant-investments-in-climate-resilience-to-secure-its-economy-and-reduce-poverty>
- ¹¹³ <https://www.elibrary.imf.org/view/journals/066/2022/002/article-A001-en.xml>
- ¹¹⁴ Adaptation Gap Report 2022, <https://www.unep.org/resources/adaptation-gap-report-2022>
- ¹¹⁵ Pakistan's NDCs to UNFCCC, 2019
- ¹¹⁶ Based on discussion sessions with MCC FP and GCISC FP
- ¹¹⁷ Pakistan Climate Public Expenditure and Institutional Review (CPEIR)
- ¹¹⁸ Accreditation Master Agreement, 2019, <https://www.greenclimate.fund/document/ama-nrsp>
- ¹¹⁹ <https://www.imf.org/en/Publications/CR/Issues/2023/11/17/Pakistan-Technical-Assistance-ReportPublic-Investment-Management-AssessmentPIMA-and-Climate-541586>
- ¹²⁰ <http://www.nrsp.org.pk/gcf/>, <https://www.greenclimate.fund/document/readiness-grant-agreement-pakistan-pak-rs-001>
- ¹²¹ Progress Report of NCCP Implementation Framework Page 24
- ¹²² Interim Progress Report Building Capacity to Advance national Adaptation Plan Process in Pakistan, UNEP, 29th July 2022



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