PAKISTAN'S BIENNIAL TRANSPARENCY REPORT (BTR)

To the United Nations Framework Convention on Climate Change (UNFCCC)

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Foreword

Climate change represents one of the defining global challenges of our era, affecting ecosystems, economies and communities with increasing frequency and severity. As the Secretary for Climate Change and Environmental Coordination, I am honoured to present Pakistan's First Biennial Transparency Report, a critical milestone in our continued commitment to transparency, accountability and global cooperation under the Paris Agreement.

This report underscores Pakistan's comprehensive climate action strategy, from quantifying national greenhouse gas emissions to detailing the ambitious targets outlined in our updated Nationally Determined Contributions. With national emissions reaching 521.46 MtCO2e in 2021, primarily driven by the agriculture and energy sectors, Pakistan is steadfastly pursuing policies aimed at significantly reducing our carbon footprint, despite contributing less than 1% to global emissions.

The challenges before us are formidable. Pakistan has been ranked as the most climate-vulnerable country globally in 2025, bearing immense social and economic costs from recurring climate-induced disasters such as the devastating floods of 2022, which led to loss and damage exceeding USD 30 billion.

Recognising the urgency, our adaptation initiatives focus on building resilience of water resources, promoting climate-smart agriculture, investing in disaster-resilient infrastructure and restoring critical ecosystems through flagship initiatives like the Green Pakistan Upscaling Programme.

Equally crucial is our commitment to inclusive and equitable climate action. Pakistan's Climate Change Gender Action Plan, launched in 2022, aims to ensure the active participation and empowerment of women, recognising their pivotal role in resilience-building and sustainable development.

To realise mitigation and adaptation goals, Pakistan requires an investment of more than USD 300 billion until 2030, but domestic resource constraints limit the actualisation of critical climate actions. Funding inflows received from financial mechanisms under the UNFCCC, including special funds and operating entities like the GCF and GEF, are paltry and inadequate to meet the massive climate investment needs of Pakistan. The principle of "Common But Differentiated Responsibilities and Respective Capabilities" (CBDR-RC), formalised in the UNFCCC, recognises the responsibility of industrialised economies to provide financial support to climate vulnerable countries, especially in the form of concessional loans and grants, commensurate with investments required to mitigate risks and build resilient societies.

As we present this BTR, we reaffirm our dedication to collective global efforts in tackling climate change. Pakistan stands committed to transparent reporting, ambitious action and international cooperation, calling on all stakeholders, both domestic and international, to strengthen collaborative efforts in safeguarding our shared future.

Aisha Humera Ch.
Secretary
Ministry of Climate Change and Environmental Coordination
Government of Pakistan

Executive summary

Pakistan's First Biennial Transparency Report highlights the country's climate commitments and actions, emphasising both ambition and urgency. In 2021, national greenhouse gas emissions reached approximately 521.5 MtCO2e, dominated by the agriculture, forestry and land-use (46.8%) and energy (40.9%) sectors. Despite contributing less than 1% of global emissions, Pakistan is acutely vulnerable to climate impacts, ranking first among climate-affected nations globally in 2025.

To meet its climate commitments, Pakistan has pledged a bold emissions reduction of 50% from business-as-usual levels by 2030, aiming to decrease anticipated emissions from around 1,603 MtCO2e to roughly 802 MtCO2e. Achieving this ambitious target involves scaling renewable energy sources to 60% of national electricity production by 2030, promoting the widespread adoption of electric vehicles (targeting 30% of new sales by 2030), and a transformative afforestation drive under the Green Pakistan Upscaling Programme.

For Pakistan, climate vulnerability is a profound challenge. Over the last decade alone, repeated extreme weather events have caused significant economic damage. Most recently, the catastrophic floods of 2022 led to estimated losses exceeding USD 30 billion. Pakistan's adaptation strategies prioritise water security, climate-smart agriculture and resilient infrastructure, integrating advanced early warning systems, sustainable agricultural practices and large-scale ecosystem restoration efforts to build resilience.

Delivering on these ambitious climate goals requires substantial international assistance. By 2030, the country estimates needing around USD 200 billion to fully implement mitigation actions alone, with broader climate-resilient development requirements of USD 348 billion. However, climate finance received so far, primarily through the Green Climate Fund, Global Environment Facility and Adaptation Fund, remains insufficient, underscoring a critical gap between support needed and received.

Recognising that climate impacts disproportionately affect women and girls, Pakistan has integrated gender-responsive approaches within its national climate frameworks. The Climate Change Gender Action Plan, launched in 2022, aims to ensure participation, equitable resource access and empowerment, making social inclusivity integral to the nation's climate response.

While Pakistan undertakes ambitious climate action, significant external support and cooperation are essential to achieve these critical goals and safeguard the country's sustainable future.

Acronyms and abbreviations

ADB	Asian Development Bank
AF	Adaptation Fund
AFOLU	agriculture, forestry and other land use
AJK	Azad Jammu and Kashmir
AR5	IPCC Fifth Assessment Report
ARE	alternative and renewable energy
ASAD	Applied System Analysis Division
AWD	alternate wetting and drying
AWG	Adaptation Working Group
BAU	business as usual
BESS	battery energy storage systems
BRT	bus rapid transit
BTR	Biennial Transparency Report
BUR	Pakistan's First Biennial Update Report
CBAM	Carbon Border Adjustment Mechanism
CBDR-RC	Common But Differentiated Responsibilities and Respective Capabilities
CCUS	carbon capture, utilisation and storage
CDA	Capital Development Authority
CEN	China Economic Net
CER	certified emission reduction
CH4	methane
CIF	Climate Investment Funds
CITEPA	Centre Interprofessionnel Technique d'Études de la Pollution Atmosphérique (Interprofessional Technical Centre for Studies on Air Pollution)
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO2	carbon dioxide
COP	Conference of the Parties
CPEC	China-Pakistan Economic Corridor
CTF	common tabular format
DAE	direct access entity
DDMA	district disaster management authority
DISCO	distribution company
DRR	disaster risk reduction
EAD	Economic Affairs Division
EDB	Engineering Development Board
EPA	environmental protection agency
ETF	Enhanced Transparency Framework
EV	electric vehicle
EWS	early warning system
FAO	Food and Agriculture Organisation
FFC	Federal Flood Commission
FREL	Forest Reference Emission Level
FTC	finance, technology and capacity-building
GB	Gilgit Baltistan
GCF	Green Climate Fund
GCISC	Global Climate-Change Impact Studies Centre
GEF	Global Environment Facility
GHG	greenhouse gas
GHG-MI	Greenhouse Gas Management Institute
GIS	geographic information systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
GLOF	glacial lake outburst flood
GoP	Government of Pakistan
GoS	Government of Sindh
GST	Global Stocktake

GWP	global warming potential
ha	hectare
HDIP	Hydrocarbon Development Institute of Pakistan
HEC	Higher Education Commission
ICIMOD	International Centre for Integrated Mountain Development
ICT	Islamabad Capital Territory
IFC	International Finance Corporation
IFRC	International Federation of Red Cross and Red Crescent Societies
ILO	International Labour Organisation
IoT	internet of things
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IPPU	industrial processes and product use
LNG	liquefied natural gas
IRSA	Indus River System Authority
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
km	kilometre
KOICA	Korean International Cooperation Agency
KP	Khyber Pakhtunkhwa
LI	Living Indus
LUCF	land use change and forestry
m	metre
m3	cubic metre
MDB	multilateral development bank
MIS	mitigation scenario
MoC	Ministry of Communications
MoCC	Ministry of Climate Change and Environmental Coordination
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoFA	Ministry of Foreign Affairs
MoFEPT	Ministry of Federal Education and Professional Training
MoNFSR	Ministry of National Food Security and Research
MoNHSR&C	Ministry of National Health Services, Regulations and Coordination
MoPDSI	Ministry of Planning, Development and Special Initiatives
MoST	Ministry of Science and Technology
MoWR	Ministry of Water Resources
MPGs	modalities, procedures and guidelines
MRV	measurement, reporting and verification
MSW	municipal solid waste
MtCO2e	million tons of carbon dioxide equivalent
MW	megawatt
N2O	nitrous oxide
Mt	million tons
NAP	National Adaptation Plan
NCCC	National Climate Change Council
NCCP	National Climate Change Policy
NCFS	National Climate Finance Strategy
NDC	Nationally Determined Contributions
NDMA	National Disaster Management Authority
NDRMF	National Disaster Risk Management Fund
NEECA	National Energy Efficiency and Conservation Authority
NEECAP	National Energy Efficiency and Conservation Action Plan
NEPRA	National Electric Power Regulatory Authority
NFC	National Finance Commission
NGO	non-governmental organisation
NRSP	National Rural Support Programme
P&D	planning and development
WHO	World Health Organisation

IBRD	International Bank for Reconstruction and Development
IFI	international financial institution
IGES	Institute for Global Environmental Strategies
PAEC	Pakistan Atomic Energy Commission
Pak-EPA	Pakistan Environmental Protection Agency
PBS	Pakistan Bureau of Statistics
PCCA	Pakistan Climate Change Authority
PCCC	Pakistan Climate Change Council
PCCF	Pakistan Climate Change Fund
PDMA	provincial disaster management authority
PFI	Pakistan Forest Institute
PKR	Pakistan rupee
PMD	Pakistan Meteorological Department
PPIB	Private Power and Infrastructure Board
PPP	public-private partnership
PRB	Population Reference Bureau
PRCS	Pakistan Red Crescent Society
PSDP	Public Sector Development Programme
PSPA	Punjab Saaf Pani Authority
PV	photo voltaic
REDD	Reducing Emissions from Deforestation and Forest Degradation
RSF	Resilience and Sustainability Facility
SACAN	South Asian Climate Change Adaptation Network
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDG	Sustainable Development Goal
SI	Spotlight Initiative
SME	small and medium enterprise
SOP	standard operating procedure
SPS	stated policies scenario
sq km	square kilometre
SUPARCO	Space and Upper Atmosphere Research Commission
SWDS	solid waste disposal site
TNA	Technology Needs Assessment
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNIDO	United Nations Industrial Development Organization
USD	US dollar
WAPDA	Water and Power Development Authority
WB	World Bank
WEF	World Economic Forum
WWA	World Weather Attribution
WWF	World Wide Fund for Nature
ZBTL	Zarai Taraqiati Bank

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National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases

1. National inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases

Pakistan's greenhouse gas (GHG) inventory for 2020-21 has been prepared using the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines for national GHG inventories (IPCC, 2006). It provides emissions information for carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) from anthropogenic sources. The inventory was compiled using IPCC Inventory Software (Version 2.69) in line with IPCC Guidelines and the Katowice Decision (2018) which requires all parties to use the IPCC 2006 Guidelines.

1.1 Pakistan's greenhouse gas inventory preparation process

Pakistan's first GHG inventory, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) as part of the country's Initial National Communication on Climate Change (GoP, 2003), was compiled by M/s Hagler Bailly between 1999 and 2003. The project was supported by the Global Environment Facility (GEF) through the United Nations Environment Programme (UNEP). The inventory covered the fiscal year 1993-94 (referred to as 1994) and was compiled in accordance with the IPCC 1996 Guidelines. Total estimated GHG emissions in the 1994 inventory amounted to 181.7 million tons of carbon dioxide equivalent (MtCO2e) (GoP, 2010). Sector-specific emissions in the 1994 inventory were as follows: energy 47.2%, agriculture 39.4%, industrial processes and product use (IPPU) 7.3%, land use change and forestry (LUCF) 3.6%, and waste 2.5% (GoP, 2010).

The second GHG inventory, for the year 2007-08 (referred to as 2008), was compiled in 2009 by the Applied System Analysis Division (ASAD) of the Pakistan Atomic Energy Commission (PAEC) (Ahmad et al., 2009). This inventory also used the 2006 IPCC Guidelines. The draft report was not formally submitted to the UNFCCC but is available. The 2008 inventory estimates GHG emissions at 309.4 MtCO2e, with sectoral contributions as follows: energy 50.7%, agriculture 38.8%, IPPU 5.8%, LUCF 2.9%, and waste 1.8% (Ahmad et al., 2009).

ASAD subsequently revised the 2008 inventory, using the Revised 1996 IPCC Guidelines. In the revised 2008 inventory, prepared in 2016, estimated GHG emissions total 329.5 MtCO2e, with sectoral contributions as follows: energy 51.1%, agriculture 38.2%, IPPU 5.6%, LUCF 2.8%, and waste 2.2% (Ahmad et al., 2016; GoP, 2022e).

In the absence of an established institutional mechanism for GHG inventory preparation, the Global Climate-Change Impact Studies Centre (GCISC) took the lead in 2014, using indigenous capabilities. GCISC's first inventory, for the year 2011-12 (referred to as 2012), was prepared in 2014-15 based on the Revised 1996 IPCC Guidelines. It was published as a research report in 2016 (GCISC, 2016). Total estimated GHG emissions in the 2012 inventory amount to 374.1 MtCO2e, with contributions by sector as follows: energy 45.8%, agriculture 43.5%, IPPU 5.2%, LUCF 2.6% and waste 2.8% (Mir and Ijaz, 2016).

In 2016, GCISC compiled the GHG inventory for the year 2014-15 (referred to as 2015) using the UNFCCC Non-Annex I National GHG Inventory Software (Version 1.3.2). This inventory was developed in accordance with the Revised 1996 IPCC Guidelines, employing a tier-1 approach that relies on default emission factors depending on national circumstances and data availability.

According to the 2015 inventory, Pakistan's total estimated GHG emissions for the year 2014-15 amounted to 408.1 MtCO2e, with the following sectoral contributions: energy 45.5%, agriculture 42.7%, IPPU 5.4%, LUCF 2.5% and waste 3.8%.

It is worth noting that initial calculations for this inventory reported total emissions at 405 MtCO2e, and this figure was used in Pakistan's First Nationally Determined Contributions (NDC) document, submitted to the UNFCCC in November 2016. After stakeholder consultations and revisions to emissions data based on their feedback, an updated figure of 408.1 MtCO2e was calculated, and this was the figure reported in Pakistan's Second National Communication to the UNFCCC (GoP, 2018b).

The next GHG inventory, for the year 2017-18 (referred to as 2018), was compiled by GCISC in 2020 using IPCC Inventory Software (Version 2.69), in line with IPCC 2006 Guidelines. According to the 2018 inventory, total estimated GHG emissions for the year 2018 stood at 489.87 MtCO2e, with sectoral contributions as follows: energy 44.7%, agriculture 40.4%, IPPU 5.3%, LUCF 5.2% and waste 4.4%. This inventory formed the basis for Pakistan's First Biennial Update Report (BUR), submitted to UNFCCC in April 2022 (GoP, 2022e). Pakistan's GHG inventory development process and findings are summarised in Table 1.1.

1.2 Activity data, emission factors and methodological tier

Following the Katowice and Sharm El-Sheikh decisions, GCISC has prepared Pakistan's latest national GHG inventory using the most current datasets, based on the IPCC 2006 Guidelines and IPCC's Fifth Assessment Report (AR5) Global Warming Potential (GWP). This report presents Pakistan's 2020-21 inventory (referred to as 2021), marking GCISC's fourth inventory compilation.

Table 1.1: GHG inventory development and findings

Year	Developed by	Total	GHG emissions by sector (%)				
		MtCO2e	Energy	Agriculture	Industrial processes	LUCF	Waste
1994	M/s Hagler Bailly (based on 1996 IPCC Guidelines)	181.7	47.2	39.4	7.3	3.6	2.5
2008	ASAD/PAEC (Revised 1996 IPCC Guidelines)	329.5	51.1	38.2	5.6	2.8	2.2
2008	ASAD/PAEC (2006 IPCC Guidelines)	309.4	50.7	38.8	5.8	2.9	1.8
2012	GCISC (Revised 1996 IPCC Guidelines)	374.1	45.8	43.5	5.2	2.6	2.8
2015	GCISC (Revised 1996 IPCC Guidelines)	408.1	45.5	42.7	5.4	2.5	3.8
2018	GCISC (Revised IPCC 2006 Guidelines)	489.87	44.7	40.4	5.3	5.2	4.4

The 2021 GHG inventory has been prepared using the 2006 IPCC Guidelines, employing a tier-1 methodological approach with default emission factors (IPCC, 2002). The inventory covers four key sectors:

- Energy (including transport)
- Industrial processes and product use (IPPU)
- Agriculture, forestry and other land use (AFOLU)
- Waste.

1.2.1 Data collection procedures and arrangements

A systematic approach was employed for data collection, engaging relevant stakeholders at both the federal and provincial levels. Capacity building sessions were conducted with stakeholders to enhance their understanding of data requirements, reporting standards and management practices. Engagement was conducted through field visits, formal correspondence and online meetings.

1.2.2 Data sources

Data on activities contributing to GHG emissions and removals by sinks was primarily sourced from national studies, reports and online databases published by government ministries, departments and agencies. Sector-specific data was also collected through desk review of published documents, and expert opinions were obtained through stakeholder consultations. Data sources used to compile the 2021 GHG inventory are shown in Table 1.2.

Activity data for various sectors focused on the following processes and/or activities:

- Energy: fuel combustion, fugitive emissions
- IPPU: emissions from industries such as minerals, chemicals, metals and electronics
- AFOLU: livestock, manure management, forestland, cropland, grasslands, wetlands and rice cultivation (data sources were supplemented by expert judgments)
- Waste: solid and liquid waste generation, collection and management (compiled through stakeholder engagement and report analysis).

1.2.3 Stakeholder consultations for data gaps

Available data sources in Pakistan do not fully meet the requirements of the GHG inventory. Where data was unavailable or incomplete, consultations were held with federal and provincial ministries, departments and agencies, as well as universities and research institutions. In some cases consultations were held with the parent organisations responsible for various publications to address data gaps and obtain expert judgments on missing information.

Pakistan is in the process of establishing a GHG inventory management system. Once the necessary institutional arrangements are in place, it is expected that many of these data gaps will be covered in upcoming GHG inventory compilations.

1.2.4 Methods for GHG emissions and removals estimation

GHG emissions and removals were estimated using the 2006 IPCC Guidelines, following a tier-1 methodological approach. Collected data, expert inputs, and judgments were systematically processed to meet inventory requirements. To address data gaps, IPCC-recommended data splicing techniques were applied. The estimates provide a comprehensive account of emissions and removals across all sectors. Sector-specific methodological notes are included within the relevant sections below.

Table 1.2: Data sources for GHG inventory preparation

Sector	Documents	Stakeholder consultations
Energy	- Pakistan Energy Yearbook 2018 (HDIP, 2018) - Pakistan Energy Yearbook 2021-22 (HDIP, 2021) - Pakistan Economic Survey (GoP, 2021c) - State of Industries Report (NEPRA, 2021)	- Federal ministries and provincial departments (energy, commerce, planning and development, etc.) - Pakistan Bureau of Statistics - Hydrocarbon Development Institute of Pakistan - AJK Power Development Organisation
IPPU	- Pakistan Economic Survey (GoP, 2021c)	- Federal ministries (commerce, industries and production, planning and development, defence production, etc.) - Provincial departments (industries, commerce, skills development, etc.) - Pakistan Industrial Technical Assistance Centre - AJK Public Procurement Regulatory Authority - AJK Small Industries Corporation
AFOLU	- Agriculture Statistics of Pakistan 2020-21 (PBS, 2022a) - Pakistan Economic Survey (GoP, 2021c) - FAO Statistics (FAO, 2021) - National Forest and Rangeland Resource Assessment Study (PFI, 2004) - FRELs, National Forest Monitoring System, MRV system for REDD+ (GoP, 2019b) - Forestrypedia of Pakistan (Forestrypedia, 2021)	- National Fertiliser Development Centre - Pakistan Agriculture Research Council - Livestock and Dairy Development Board - Urban Resource Centre, Sindh - Federal ministries (food security, finance, inter-provincial coordination, etc.) - Provincial agriculture and forestry departments - The Urban Unit, Lahore - Rice Research Institute, Kala Shah Kaku
Waste	- Pakistan Economic Survey (GoP, 2021c) - Pakistan's First Biennial Update Report (GoP, 2022e) - Solid Waste Management Sector in Pakistan (ADB, 2022) - Compendium on Environment Statistics of Pakistan (2020)	- University environmental departments (Allam Iqbal Open University, National University of Sciences & Technology, etc.) - Ministry of Climate Change, Pak-EPA - Provincial environmental departments, EPAs - Provincial waste management companies

1.3 Summary of 2021 GHG inventory results

Total estimated GHG emissions for 2021 demonstrate a notable increase compared to inventories for 1994, 2008, 2012, 2015 and 2018. In 2021, total emissions stood at 521.46 MtCO2e, up 31.6 MtCO2e from the last reporting period (2018).

This upward trend is predominantly driven by sectors that are key to economic development: energy, agriculture, industry and waste management. This highlights the challenge for countries like Pakistan of cutting emissions without adversely affecting economic activities.

In the 2021 inventory, the AFOLU sector emerged as the largest emitter, accounting for 46.75% of total emissions, followed by energy at 40.90%. The waste sector was responsible for 6.22% of emissions, while the IPPU sector accounted for 6.13% (see Tables 1.3 and 1.4).

1.4 Energy

Rising energy demand, driven by industrial expansion, urbanisation and population growth, remains a major concern. A mix of energy sources including fossil fuels (natural gas, coal, oil) and hydroelectric power dominate electricity generation. Pakistan has made significant

Table 1.3: Summary of GHG emissions 2021				
Sector	Sub-sector	Emissions (MtCO2e)		Percentage of total emissions
		Sub-sector	Sector total	
Energy	Energy industries	48.87	213.28	40.90%
	Manufacturing industries and construction	72.23		
	Transport	51.01		
	Other (commercial, residential, agricultural)	36.80		
	Fugitive fuel emissions	4.37		
Industrial processes and product use	Mineral industry	27.39	31.98	6.13%
	Chemical industry	3.02		
	Non-energy fuel and solvent use	0.22		
	Other (paper and pulp, food and beverages)	1.35		
AFOLU	Livestock	130.14	243.76	46.75%
	Land	34.82		
	Managed soils	66.80		
	Rice cultivation	12.00		
Waste	Solid waste disposal	17.52	32.44	6.22%
	Waste incineration and open burning	0.31		
	Wastewater treatment and discharge	14.61		
Total emissions			**521.46**	**100%**

Table 1.4: National GHG inventory 2021 (MtCO2e)				
Categories	**Million tons**			
	Net CO2 emissions/ removals	**Emissions**		
		CH4	**N2O**	**Total**
Pakistan total	**273.24**	**173.90**	**74.32**	**521.46**
1 - Energy	**206.68**	**5.34**	**1.26**	**213.28**
1.A - Fuel combustion activities	**206.66**	**0.98**	**1.27**	**208.91**
1.A.1 - Energy industries	48.68	0.04	0.14	48.87
1.A.2 - Manufacturing industries and construction	71.84	0.16	0.23	72.23
1.A.3 - Transport	49.50	0.66	0.85	51.01
1.A.4 - Other sectors	36.64	0.12	0.05	36.80
1.A.5 - Non-specified	0	0	0	0
1.B - Fugitive emissions from fuels	**0.01**	**4.36**	**0.00001**	**4.37**
1.B.1 - Solid fuels	0.001	0.73		0.73
1.B.2 - Oil and natural gas	0.009	3.63	0.00001	3.64
1.B.3 - Other emissions from energy production				0
1.C - Carbon dioxide transport and storage	**0**			**0**
1.C.1 - Transport of CO2	0			0
1.C.2 - Injection and storage	0			0
1.C.3 - Other	0			0
2 - Industrial processes and product use	**30.68**	**1.30**		**31.98**
2.A - Mineral industry	**27.39**	**0**	**0**	**27.39**
2.A.1 - Cement production	25.76			25.76

Categories	Million tons			
	Net CO2 emissions/ removals	Emissions		
		CH4	N2O	Total
2.A.2 - Lime production	1.33			1.33
2.A.3 - Glass production	0.03			0.03
2.A.4 - Other process uses of carbonates	0.27	0		0.27
2.B - Chemical industry	**3.02**	**0**		**3.02**
2.B.1 - Ammonia production	3.02			3.02
2.C - Metal industry	**0**	**0**		**0**
2.D - Non-energy products from fuels and solvent use	**0.22**	**0**		**0.22**
2.D.1 - Lubricant use	0.22			0.22
2.E - Electronics industry	**0**	**0**		**0**
2.F - Product uses as substitutes for ozone depleting substances	**0**	**0**		**0**
2.G - Other product manufacture and use	**0**	**0**		**0**
2.H - Other	**0.05**	**1.30**	**0.00**	**1.35**
2.H.1 - Pulp and paper industry	0.0001	0.02		0.02
2.H.2 - Food and beverages industry	0.05	1.28		1.33
3 - Agriculture, forestry and other land use	**35.77**	**137.23**	**70.76**	**243.76**
3.A - Livestock	**0**	**122.54**	**7.60**	**130.14**
3.A.1 - Enteric fermentation	0	112.83	0	112.83
3.A.2 - Manure management	0	9.71	7.60	17.31
3.B - Land	**31.35**	**2.69**	**0.78**	**34.82**
3.B.1 - Forest land	28.44	0.13	0.07	28.64
3.B.2 - Cropland	2.50	2.54	0.62	5.67
3.B.3 - Grassland	0	0.02	0.01	0.03
3.B.4 - Wetlands	0.41	0	0.08	0.48
3.C - Managed soils	**4.43**		**62.37**	**66.80**
3.C.2 - Urea application	4.43			4.43
3.C.3 - Direct N2O emissions from managed soils			40.50	40.50
3.C.4 - Indirect N2O emissions from managed soils			17.55	17.55
3.C.5 - Indirect N2O emissions from manure management			4.32	4.32
3.D - Rice Cultivation		**12.00**		**12.00**
4 - Waste	**0.11**	**30.03**	**2.30**	**32.44**
4.A - Solid waste disposal	**0**	**17.52**	**0**	**17.52**
4.A.1 - Managed waste disposal sites				
4.A.2 - Unmanaged waste disposal sites				
4.A.3 - Uncategorised waste disposal sites				
4.B - Biological treatment of solid waste				
4.C - Incineration and open burning of waste	0.11	0.15	0.04	**0.31**
4.C.1 - Waste incineration	0.08	0.01	0.02	0.11
4.C.2 - Open burning of waste	0.03	0.14	0.02	0.20
4.D - Wastewater treatment and discharge		**12.36**	**2.25**	**14.61**
4.D.1 - Domestic wastewater treatment and discharge		10.14	2.25	12.39

progress in expanding renewable energy capacity, focusing on wind, solar and biomass. To support renewable energy, the government has introduced policies and provided incentives, such as net metering for solar installations. The China-Pakistan Economic Corridor (CPEC) initiative remains instrumental in improving infrastructure and addressing energy shortages. The country also continues to import electricity from Iran and Tajikistan.

Despite these efforts, energy shortages and load shedding continue. Infrastructure challenges also persist, such as distribution losses, circular debt and outdated transmission systems.

To address these issues, energy conservation and efficiency initiatives have gained attention, alongside commitments to reduce reliance on fossil fuels and increase the share of clean energy. The government continues to encourage private sector participation in energy projects through incentives and public-private partnerships. Reforms aimed at improving efficiency and transparency are also underway, with international collaboration supporting the effort.

1.4.1 Overview of energy sector emissions

The energy sector is the second-largest contributor to GHG emissions, with fossil fuel combustion accounting for 97.95% of CO2e emissions from the sector. Emissions from fuel combustion are categorised as stationary or mobile sources. Stationary combustion includes activities in energy industries (extraction, production, electricity generation), manufacturing industries (iron and steel production, chemical manufacturing) and residential, commercial and institutional sectors. Mobile combustion covers road transport (cars, trucks, buses), rail transport, domestic aviation, national navigation and gas pipeline transport. Emissions from international transport using bunker fuels are reported separately as per IPCC guidelines and excluded from national totals.

In 2021, the main sources of thermal power generation in Pakistan were furnace oil, natural gas, high-speed diesel and coal (GoP, 2021c). A summary of GHG emissions from various categories within the energy sector is provided in Table 1.5.

The energy sector contributed 213.28 MtCO2e, accounting for 40.90% of Pakistan's total GHG emissions. The bulk of emissions from the energy sector come from CO2 (96.90%), followed by CH4 (2.50%) and N2O (0.59%). Within the energy industry category, which includes emissions from fossil fuels used in power generation and petroleum refining, emissions totalled 48.87 MtCO2e. Manufacturing industries

Table 1.5: Summary of GHG emissions from the energy sector

Category	Emissions (MtCO2e)			
	CO2	CH4	N2O	Total
Energy industries	48.68	0.04	0.14	48.87
Manufacturing industries and construction	71.84	0.16	0.23	72.23
Transport	49.50	0.66	0.85	51.01
Other sectors	36.64	0.12	0.05	36.80
Fugitive emissions from fuels	0.01	4.36	0.00001	4.37
Total	**206.67**	**5.34**	**1.27**	**213.28**

and construction, covering activities like iron and steel production, chemical manufacturing, food processing and building, emitted 72.23 MtCO2e. This consists of 71.84 MtCO2e of CO2, 0.16 MtCO2e of CH4 and 0.23 MtCO2e of N2O. The transport sector produced 51.01 MtCO2e, while other sectors and fugitive emissions contributed 36.80 MtCO2e and 4.37 MtCO2e, respectively.

1.4.2 Energy industries

The energy sector contributes to emissions primarily through the burning of fossil fuels for electricity generation and solid fuel manufacturing. Emissions from natural gas used in gas processing plants are included under the electricity generation category. Specific data on fossil fuel use for solid fuel manufacturing (e.g. coal carbonisation) is currently unavailable, so this category is not included in national emission totals. In 2021, emissions from the energy industries category, which covers fossil fuels used in power generation and petroleum refining, amounted to 48.87 MtCO2e, accounting for 22.91% of energy sector emissions.

1.4.3 Manufacturing industries and construction

This category covers GHG emissions from the combustion of fossil fuels in industries such as cement, iron and steel, chemicals, brick kilns and other sectors. Total emissions from manufacturing industries and construction, at 72.23 MtCO2e, make up 33.87% of total energy sector emissions.

1.4.4 Transport

Transport is one of the largest sectors of the economy, accounting for 13% of GDP (GoP, 2021c). Data for this sector includes all GHG emissions resulting from the combustion of fossil fuels in road transport, aviation, railways and water-borne navigation. Over the last two decades, the demand for road transport has grown significantly. The number of registered road vehicles has risen from 9.66 million in 2011 to 32.38 million in 2021 (GoP, 2021c). In 2021, emissions from the transport sector, at 51.01 MtCO2e, represented 23.92% of energy sector emissions.

1.4.5 Emissions from other sectors

Emissions from energy use in other sectors, including commercial, residential and agricultural activities, are associated with processes such as cooking, lighting, space heating/cooling and refrigeration. Fuels used for these purposes include electricity (lighting, heating/cooling, refrigeration), LPG (cooking), kerosene (lighting, cooking), diesel (power generation, lighting), and coal/charcoal and fuelwood (used in areas without grid electricity). Collectively, these sectors are responsible for 36.80 MtCO2e, amounting to 17.25% of energy sector emissions.

1.4.6 Fugitive emissions

Fugitive emissions in the energy sector are divided into two subcategories: (i) solid fuels (primarily coal mining) and (ii) oil and natural gas systems. CH4 is the main GHG emitted from these fugitive source categories. For solid fuels, the main source of fugitive emissions is the venting and disposal of coal-bed CH4, with most emissions occurring at the mine and some residual emissions arising from post-mining handling and processing activities. Extraction, production, processing and transportation of coal and other fuels contribute significantly to CH4 emissions. Oil and natural gas systems, which are complex and varied, face two major challenges in reporting fugitive emissions:

- Poor quality and incomplete data on venting and flaring
- Lack of statistics for many minor facilities

(e.g., well sites, field facilities) that contribute to equipment leaks.

While CH4 is the primary emission from fugitive sources, CO2 is also released from coal mines. Emissions from oil and gas activities, including production, processing, transmission and distribution, were an estimated 4.37 MtCO2e, accounting for 2.05% of energy sector emissions.

1.5 Industrial processes and product use

This category includes emissions arising from various industrial activities. Emissions directly linked to energy consumption are not classified under IPPU but are instead categorised under 'manufacturing industries and construction' within the energy sector to avoid duplication in emissions reporting. Non-energy use emissions in industrial processes primarily result from the use of reducing agents, particularly in metal production-related source categories.

Source categories responsible for CO2 emissions in the IPPU sector consist of:

- Mineral industry: cement, lime, limestone, dolomite use, soda ash production, glass
- Chemical industry: ammonia, nitric acid production, carbide production, titanium dioxide production, methanol production, ethylene oxide
- Metal industry: iron and steel, ferro-alloys production, aluminium, lead, zinc, copper, magnesium
- Other: pulp and paper industry, food and beverages industry.

1.5.1 Overview of IPPU emissions

IPPU is the smallest contributor to GHG emissions among all sectors of the economy. Emissions from various categories within the IPPU sector are shown in Table 1.6. In 2021, the IPPU sector emitted a total of 31.98 MtCO2e, representing 6.13% of the country's overall emissions, of which 30.68 Mt are CO2 emissions and 1.30 Mt are CH4 emissions. The mineral sector, with 27.39 MtCO2e emissions, was the largest contributor, responsible for 85.65% of total IPPU emissions. Within the mineral sector, cement, lime and glass production emitted 27.39 MtCO2, with cement contributing the largest share at 25.76 MtCO2.

The chemical industry emitted 3.02 MtCO2e (9.44%), mainly from processes like ammonia production, followed by the 'other' category (pulp and paper, food and beverages) and non-energy products (from fuels and solvent use) with 1.35 MtCO2e (4.22%) and 0.22MtCOe (0.69%) emissions, respectively.

Table 1.6: Summary of GHG emissions from the IPPU sector

Category	Emissions (MtCO2e)		
	CO2	CH4	Total
Mineral industry	27.39		27.39
Chemical industry	3.02		3.02
Non-energy products from fuels and solvent use	0.22		0.22
Other (pulp and paper, food and beverages)	0.05	1.30	1.35
Total	**30.68**	**1.30**	**31.98**

1.5.2 Mineral industry

This category primarily addresses CO2 emissions from the calcination of carbonate materials during the production and use of various mineral industry products. CO2 is released from carbonates through two main processes: (i) calcination and (ii) acid-induced CO2 release. The primary source of CO2 emissions is the calcination of carbonate compounds, a thermal process that produces metallic oxides. Activities included in this category are cement manufacturing, the use of limestone and dolomite, and the use of asphalt in road construction.

Of the 27.39 MtCO2e emissions from the mineral industry, cement production is a major contributor. In 2021, cement production accounted for 80.55% of all IPPU emissions. Pakistan's cement industry is a significant part of the economy, producing over 57.43 million tons of cement annually (GoP, 2021c). The cement manufacturing process relies heavily on imported coal to meet the energy needs of production facilities.

1.5.3 Chemical industry

This category includes the production of a wide range of chemicals, such as ammonia, nitric acid, carbide, titanium dioxide, methanol and ethylene. Ammonia is a key chemical in this sector, serving as a primary nitrogenous compound and playing a crucial role in various industrial processes. It is used in the production of fertilisers, in heat treatment and paper pulping, and in the manufacture of nitric acid, nitrates, esters, nitro compounds and refrigeration systems. In 2021, emissions from the chemical sector, at 3.02 MtCO2e, made up 9.44% of all emissions from the IPPU sector.

1.5.4 Non-energy products from fuels and solvent use

In addition to fuels, refineries and coke ovens produce non-energy products that are used directly for their physical or diluent properties or sold to the chemical industry as intermediates. Examples include lubricants and greases, which are used in engines; paraffin waxes, which are used for candles or paper coating; and bitumen, which is applied on roofs and roads for its waterproofing and wear-resistant qualities. Refineries also produce white spirits, which are valued for their solvent properties.

The calculation of CO2 emissions from non-energy product use generally follows a basic formula, where the emission factor includes a carbon content factor and a factor representing the portion of fossil fuel carbon that is oxidised during use, such as the combustion of lubricants that enter the combustion chamber of an engine. This oxidation concept applies only to the first use of lubricants and paraffin waxes, not to subsequent uses. In the 1996 IPCC Guidelines, lubricants were categorised under the energy sector but in the 2006 IPCC Guidelines, non-energy products from fuels and solvents are included in the IPPU sector. In 2021, the use of lubricants contributed 0.22 MtCO2 of emissions, which accounted for 0.69% of IPPU sector emissions.

1.5.5 Other

This category primarily covers GHG emissions from two key industries: (i) pulp and paper, and (ii) food and beverages. The evaluation of carbon emissions from the pulp and paper industry in developing countries is an area that has not been well explored. In 2021, the 'other' category was responsible for 1.35 MtCO2e (4.22% of total IPPU emissions).

In the food and beverages industry, GHG emissions are generated by facilities involved in transforming livestock or agricultural products into food products for both intermediate and final human consumption.

1.6 Agriculture, forestry and other land use

The AFOLU sector encompasses both emissions and removals from agriculture, forestry and other land uses. This approach acknowledges that the processes driving GHG emissions and removals, as well as different forms of terrestrial carbon stocks, can take place on all types of land. By using this integrated method, consistency and completeness are maintained in estimating and reporting GHG emissions and removals (IPCC, 2006).

AFOLU emissions consist of all 3 GHGs. The exchange of CO_2 between the atmosphere and ecosystems is mainly regulated through its uptake by plants during photosynthesis and its release through processes such as plant respiration, decomposition and the combustion of organic matter (IPCC, 2006). N_2O emissions arise primarily from nitrification and denitrification processes in ecosystems, while CH_4 emissions come from several sources, including anaerobic methanogenesis in soil, manure management by methanogenic bacteria, enteric fermentation in livestock and the incomplete combustion of organic matter (IPCC, 2006).

Both CO_2 and non-CO_2 emissions and removals from AFOLU are assessed separately for each of four land use classes: forestland, cropland, grasslands and wetlands. Other emission categories, such as those related to livestock and managed soils, are estimated at the national level using aggregated national data.

It is worth noting that emissions from other categories, such as livestock (manure management) and managed soils, are estimated using aggregated national data rather than being broken down by land classes or climate zones. Reporting based on specific land classes or climate zones requires detailed data, which is not available for Pakistan.

1.6.1 Overview of AFOLU sector emissions

Overall, AFOLU is the largest contributor to GHG emissions, responsible for 243.76 $MtCO_2e$ of emissions, or 46.75% of total emissions (Table 1.7). GHG emissions from the AFOLU sector are summarised in Table 1.8. Within the sector, livestock was the largest contributor, emitting 130.14 $MtCO_2e$, which accounts for 53.39% of AFOLU emissions. This was followed by managed soils at 66.80 Mt (27.40%), land at 34.82 Mt (14.28%) and rice cultivation at 12.00 Mt (4.92%).

Table 1.7: AFOLU emissions as a percentage of total emissions

Category	Million tons			
	Net CO_2 emissions/ removals	Emissions		
		CH_4	N_2O	Total
Pakistan total	273.24	173.90	74.32	521.46
AFOLU	35.77	137.23	70.76	243.76
AFOLU (% of total emissions)	13.09%	78.91%	95.21%	46.75%

Table 1.8: Summary of GHG emissions from the AFOLU sector

Category	Emissions ($MtCO_2e$)			
	CO_2	CH_4	N_2O	Total
AFOLU total	35.77	137.23	70.76	243.76
Livestock	0	122.54	7.60	130.14
Land	31.35	2.69	0.78	34.82
Managed soils	4.43	0	62.37	66.80
Rice cultivation	0	12.00	0	12.00

1.6.2 Livestock

GHG emissions from enteric fermentation are estimated for the following livestock types: cows, buffaloes, sheep, goats, camels, horses, mules and donkeys. Poultry emissions are assessed separately under manure management. The livestock sector contributed 130.14 MtCO2e, which represents 53.39% of AFOLU emissions. Of the total emissions from livestock, 112.83 MtCO2e (86.70%) came from enteric fermentation and 17.31 MtCO2e (13.30%) from manure management.

Enteric fermentation. The livestock population and corresponding enteric CH4 emissions are shown in Table 2.9. Total enteric CH4 emissions amounted to 112.83 MtCO2e, making up 86.70% of all emissions from the livestock sector.

Manure management. The livestock population and associated CH4 emissions from manure are shown in Table 1.9. Emissions from manure management amounted to 17.31 MtCO2e, accounting for 13.30% of total emissions from the livestock sector.

1.6.3 Land

The methodology outlined in the 2006 IPCC Guidelines for National GHG Inventories (IPCC, 2006) classifies land according to use and management practices as well as climate, soil and other environmental factors. Under IPCC Guidelines, land types are classified into six main categories: forestland, cropland, grassland, wetlands, settlements and other lands. However, for the purposes of this inventory all CO2 and non-CO2 emissions from the land sector are sourced from four land-use categories: forestland, cropland, grassland and wetlands. This is because emissions from settlements and other lands are insignificant.

Under the IPCC Guidelines, each category is further divided into two groups: (i) land that remains in the same category (e.g., forestland remaining forestland) and (ii) land that has been converted from one category to another (e.g., forestland converted to cropland). For the purposes of this inventory, emissions were estimated only from land remaining within the same land use category. Emissions from land conversion between categories are not included.

Table 1.9: Summary of GHG emissions from livestock (MtCO2e)

Category	Population (000 heads)	Emissions		Total
		Enteric fermentation (CH4)	Manure management (CH4 + N2O)	
Dairy cows	15,192	24.67	4.50	29.17
Other cattle	27,511	20.80	3.43	24.23
Buffalo	31,450	48.43	6.39	54.82
Sheep	31,595	4.42	0.67	5.09
Goats	80,326	11.25	0.88	12.13
Camels	1,119	1.44	0.08	1.52
Horses	375	0.19	0.02	0.21
Mules and donkeys	5,823	1.63	0.20	1.83
Poultry	1,577,670	-	1.14	1.14
Total		**112.83**	**17.31**	**130.14**

With that in mind, GHG emissions and removals, covering both CO2 and non-CO2 emissions, are evaluated for each land-use category included in this inventory. CO2 emissions are estimated based on variations in carbon stocks from biomass, dead organic matter and soils, while non-CO2 emissions are mainly attributed to biomass burning. CO2 emissions from wildfires (in case of forestland) or controlled fires (in case of grasslands or cropland) are considered as net zero because CO2 emissions from burning in one year are assumed to be sequestered through regeneration in the following year (IPCC, 2006).

Overview of land sector emissions. The land sector contributed 34.82 MtCO2e in emissions, representing 14.28% of total AFOLU emissions. Of this, net CO2 emissions were 31.35 Mt, CH4 emissions totalled 2.69 Mt and N2O emissions were 0.78 MtCO2e (Table 1.10). Forestland is the largest emitter of all land use categories, producing 28.64 MtCO2e, which accounts for 82.25% of total land emissions. Cropland is the second largest emitter, with 5.67 Mt (16.28%), while wetlands and grassland contributed 0.48 Mt (1.38%) and 0.03 Mt (0.09%) of CO2e emissions, respectively. All CO2 and non-CO2 emissions from the land sector by land class are discussed in the sections that follow.

Table 1.10: Summary of GHG emissions from land sector

Land class	Emissions (MtCO2e)			
	CO2	CH4	N2O	Total
Total	**31.35**	**2.69**	**0.78**	**34.82**
Forestland	28.44	0.13	0.07	28.64
Cropland	2.50	2.54	0.62	5.67
Grassland	0	0.02	0.01	0.03
Wetlands	0.41	0	0.08	0.48

Forestland

For the purposes of this inventory, Pakistan's forests are categorised according to the classification system provided by the Forestrypedia of Pakistan (Forestrypedia, 2021). National definitions for managed forests are also incorporated. To assess carbon stocks and GHG emissions and removals from forestland, data used includes classification/type, area/cover, climatic region, soil type, ecosystem type, plantation type, stage of stand development and management practices.

The IPCC suggests three general approaches based on the collected data:

- Approach 1 classifies the total area of each land use category within a country but does not track specific conversions between land uses
- Approach 2 introduces tracking of land use conversions
- Approach 3 allows for spatially explicit tracking of land use conversions (IPCC, 2006).

Parties have the flexibility to apply any combination of these approaches for different regions and over time. In Pakistan's case, Approach 1 is used to maximise the available data while minimising overlaps and omissions in estimation and reporting.

Overview of forestland emissions. Forestland contributed 28.64 MtCO2e, accounting for 82.25% of total land emissions. Gross CO2 emissions totalled 43.55 Mt, with removals of 15.11 MtCO2, resulting in net CO2 emissions of 28.44 Mt, along with CH4 emissions of 0.13 MtCO2e and N2O emissions of 0.07 MtCO2e (Table 1.11).

Forestland CO2 emissions and removals. Total CO2 emissions across all forest types amounted to 43.55 Mt, with removals estimated at 15.11 Mt, resulting in net emissions of 28.44 Mt (Table 2.11). Riverain forests were the largest emitter, responsible for 13.56 MtCO2e, or 47.35% of total forestland emissions. Irrigated plantations were the second-largest emitter, contributing 12.92 MtCO2e (45.11%), while tropical thorn forests emitted 10.59 MtCO2e (36.98%) and alpine scrub forests accounted for 6.60 MtCO2e (23.04%).

Total CO2 removals from forestland amounted to 15.11 Mt. Himalayan dry temperate forests were the largest carbon sinks, absorbing 8.12 MtCO2e, making up 53.74% of total forestland removals. This was followed by Himalayan moist temperate forests at 3.21 MtCO2e (21.24%), sub-tropical pine forests at 2.33 MtCO2e (15.42%), mangrove forests at 0.98 MtCO2e (6.49%), linear plantations at 0.32 MtCO2e (2.12%) and sub-alpine forests at 0.15 MtCO2e (0.99%).

Forestland non-CO2 emissions. Combined CH4 and N2O emissions amounting to 0.20 MtCO2e were estimated from biomass burning across various forest types (Table 2.11). Apart from mangroves, all other forest types contributed to non-CO2 emissions through biomass burning. Alpine scrub forests were the largest emitters in this category, with non-CO2 emissions of 0.085 MtCO2e, or 42.50% of total non-CO2 emissions. This was followed by Himalayan dry temperate forests with 0.038 MtCO2e (19.00%), tropical thorn forests at 0.021 MtCO2e (10.50%), sub-tropical pine forests at 0.018 MtCO2e (9.00%) and Himalayan moist temperate forests with 0.017 MtCO2e (8.50%). Irrigated plantations emitted 0.014 MtCO2e (7.00%). The remaining 0.007 MtCO2e (3.5%) came from linear, sub-alpine and riverain forests.

Cropland

To estimate carbon stocks and the associated GHG emissions and removals from cropland activities, Pakistan's cropland is categorised into various types based on factors such as climatic region, soil type, ecosystem type, plantation type, stage of stand development and management practices. Crop-related data, including classification/types and area information, are used in conjunction with climatic, soil and ecosystem data for the GHG estimation process.

Table 1.11: Summary of GHG emissions and removals from forest land

Forest type	Emissions (MtCO2e)		
	CO2	CH4 + N2O	Total
Alpine scrub forests	6.51	0.085	6.60
Himalayan dry temperate forests	-8.12	0.038	-8.08
Himalayan moist temperate forests	-3.21	0.017	-3.19
Irrigated plantations	12.91	0.014	12.92
Linear plantations	-0.32	0.003	-0.32
Mangrove forests	-0.98	0	-0.98
Riverain forests	13.56	0.001	13.56
Sub-alpine forests	-0.15	0.003	-0.15
Sub-tropical pine forests	-2.33	0.018	-2.31
Tropical thorn forests	10.57	0.02	10.59
Forestland total	28.44	0.199	28.64

Overview of cropland emissions. Cropland emissions totalled 5.85 MtCO2e, with CO2 removals amounting to 0.18 Mt, resulting in net emissions of 5.67 MtCO2e. Net emissions from croplands represent 16.28% of total land-related emissions. Of total emissions, CH4 contributed 2.54 Mt, CO2 accounted for 2.50 Mt and N2O emissions were 0.62 MtCO2e (Table 1.12).

The largest source of emissions from cropland is crop residue burning, which released 3.16 MtCO2e, making up 55.73% of total cropland emissions. Fruit orchards were the second-largest emitter, contributing 2.49 MtCO2e (43.92%), followed by agroforestry systems at 0.20 MtCO2e (3.53%) and tea plantations at 0.004 MtCO2e (0.07%). In contrast, banana plantations helped remove 0.18 MtCO2 from the atmosphere.

Cropland CO2 emissions. Total CO2 emissions from cropland, based on carbon stock changes, were estimated at 2.69 MtCO2, with 0.18 MtCO2 removed by banana plantations. This results in net CO2 emissions of 2.50 Mt. Fruit orchards were the largest contributor, accounting for 99.60% of total CO2 emissions from cropland, followed by agroforestry systems (8.0%) and tea plantations (0.16%) (Table 1.12).

Table 1.12: Summary of GHG emissions and removals from cropland

Crop type/category	Emissions (MtCO2e)			
	CO2	CH4	N2O	Total
Agroforestry systems	0.20	-	-	0.20
Banana plantation	-0.18	-	-	-0.18
Crop residue burning	-	2.54	0.62	3.16
Fruit orchards	2.49	-	-	2.49
Tea plantation	0.004	-	-	0.004
Total	**2.514**	**2.54**	**0.62**	**5.674**

Cropland non-CO2 emissions. Non-CO2 emissions, amounting to 3.16 MtCO2e (CH4 and N2O), were estimated from residue burning of four crop types (wheat, rice, maize, sugarcane) on cropland (Table 1.13). Wheat was the largest emitter from residue burning, releasing 1.55 MtCO2e, or 48.90% of the total emissions from crop burning. Rice was the second-largest contributor, emitting 1.12 MtCO2e (35.33%), with sugarcane at 0.36 MtCO2e (11.35%) and maize at 0.13 MtCO2e (4.10%).

Table 1.13: Summary of non-CO2 emissions from cropland

Crop type	Non-CO2 emissions (MtCO2e)
Wheat	1.55
Rice	1.12
Maize	0.13
Sugarcane	0.36
Total	**3.16**

Grassland

For the purposes of this inventory, Pakistan's grasslands are categorised based on climatic region, soil type, vegetation type and management practices. Key rangelands and pastures are further classified as degraded or non-degraded. This includes alpine pastures, and degraded and non-degraded rangelands in Balochistan, Khyber Pakhtunkhwa (KP), Punjab, Sindh, Azad Jammu and Kashmir (AJK), and Gilgit Baltistan (GB). The GHG estimation uses data on grassland classification, climatic region, soil type, vegetation type and management practices along with area and biomass burning.

Overview of grassland emissions. Grasslands contributed 0.03 MtCO2e in emissions, accounting for only 0.09% of total land emissions. These emissions are entirely non-CO2, comprising 0.02 Mt of CH4 and 0.01 Mt of

N2O in CO2e (Table 1.14). Net CO2 emissions from grasslands are essentially zero, as the CO2 released from grass cutting in one year is offset by the CO2 absorbed from growth in the subsequent year.

All non-CO2 emissions are estimated based on biomass burned from wildfires in different grassland types. In temperate regions, for the GHG inventory year the burned area is evenly distributed between three grassland types: alpine pasture, KP degraded rangeland, and AJK and GB degraded rangeland. As a result, each of these grassland types emitted an equal amount of non-CO2 GHGs, contributing 0.0002 MtCO2e each, totalling 0.0006 MtCO2e, which represents 1.74% of total grassland emissions.

In tropical and subtropical regions, including Balochistan, Punjab and Sindh, the burned area of savanna, open shrubland, closed shrubland and woody savanna is evenly distributed between degraded rangelands in Balochistan, Punjab and Sindh. Each of these grassland types emitted 0.009 MtCO2e, resulting in a total of 0.029 MtCO2e, which accounts for 98.26% of total grassland emissions.

Wetlands

Pakistan's wetlands are classified according to Ramsar Convention classifications (Ramsar, 1996). These categories are inland waters (85%), lakes and reservoirs (5%), fish farms and ponds (4%), delta marshes (3%), and swamps (3%).

Overview of wetlands emissions. Wetlands emitted 0.48 MtCO2e, accounting for 1.38% of total land emissions. This includes 0.41 Mt of CO2 and 0.07 MtCO2e of N2O (Table 1.15). Lakes and reservoirs were the main contributor, emitting 0.17 MtCO2e (35.42% of total wetland emissions). Fish farms and ponds were the second largest emitters at 0.12 MtCO2e (25%), delta marshes contributed 0.11 MtCO2e (22.92%) and swamps accounted for 0.08 MtCO2e (16.67%).

Wetlands CO2 emissions. Wetlands emitted a total of 0.41 MtCO2. Lakes and reservoirs were the main contributor at 0.14 MtCO2 (34.15% of total wetland CO2 emissions). Fish farms and ponds were the second largest emitters at 0.10 MtCO2 (24.39%), followed by delta marshes at 0.09 MtCO2 (21.95%) and swamps at 0.08 MtCO2 (19.51%). Inland waters classified as flood lands did not contribute to emissions.

Table 1.14: Summary of GHG emissions from grassland

Grassland type	Emissions (MtCO2e)		
	CH4	N2O	Total
Alpine pasture	0.00009	0.00008	0.0002
AJK and GB degraded rangeland	0.00009	0.00008	0.0002
Balochistan degraded rangeland	0.00513	0.00443	0.0096
KP degraded rangeland	0.00009	0.00008	0.0002
Punjab degraded rangeland	0.00513	0.00443	0.0096
Sindh degraded rangeland	0.00513	0.00443	0.0096
Total	**0.01566**	**0.01353**	**0.0294**

Table 1.15: Summary of GHG emissions from wetlands			
Wetland type	Emissions (MtCO2e)		
	CO2	N2O	Total
Wetlands total	0.41	0.07	0.48
Lakes and reservoirs	0.14	0.03	0.17
Fish farms and ponds	0.10	0.02	0.12
Delta marshes	0.09	0.02	0.11
Swamp	0.08	0.004	0.08
Inland Waters	0.00	0.00	0.00

Wetlands non-CO2 emissions. Non-CO2 emissions from various types of wetlands were estimated at 0.07 MtCO2e. For non-CO2 emissions, lakes and reservoirs remained the main contributor at 0.03 Mt CO2e (42.86% of N2O emissions from wetlands). Fish farms and ponds, and delta marshes each contributed 0.02 MtCO2e (28.57%), with swamps at 0.004 Mt (5.71%).

1.6.4 Managed soils

Only national aggregate data is available for managed soils in Pakistan. Therefore, a methodology based on generic national-level information is used to estimate GHG emissions, relying on aggregated national data including quantities of lime and dolomite, urea application, and synthetic fertiliser consumption.

Overview of managed soils emissions. Emissions from managed soils amounted to 66.80 MtCO2e, or 27.40% of total emissions from the AFOLU sector. Within this, CO2 emissions were estimated at 4.43 Mt, while N2O emissions at 62.37 Mt (Table 1.16). Direct N2O emissions were 40.50 MtCO2e (60.63% of total emissions from managed soils), followed by indirect N2O emissions at 21.87 (32.74%) Mt, with 4.43 (6.63%) MtCO2 emissions attributed to urea application.

Table 1.16: Summary of GHG emissions from managed soils			
Source/emission Type	Emissions (MtCO2e)		
	CO2	N2O	Total
Total	**4.43**	**62.37**	**66.80**
Urea	4.43	0	4.43
Direct N2O emissions	0	40.50	40.50
Indirect N2O emissions	0	21.87	21.87

Non-CO2 emissions from managed soils. Managed soils are significant sources of non-CO2 emissions, including both direct and indirect N2O emissions.

Direct N2O emissions from managed soils. Direct N2O emissions from managed soils stood at 40.5 MtCO2e, accounting for 60.63% of total soil emissions. These emissions primarily result from nitrogen application, including inorganic nitrogen from synthetic fertilisers, organic nitrogen from manure, and animal nitrogen from pasture, range and paddocks, as well as nitrogen from crop residues on managed soils.

Synthetic nitrogen fertilisers were the largest source of direct N2O emissions from managed soils, emitting 15.45 Mt N2O, or 38.15% of total direct emissions. The second-largest contributors were organic nitrogen fertilisers from grazing animals on pastures, with emissions of 11.92 Mt N2O (29.43%). Organic nitrogen from animal manure followed, contributing 8.44 Mt N2O (20.84%). The remaining 4.69 Mt N2O (11.58%) emissions came from the application of synthetic nitrogen fertilisers and crop residues in rice fields and other managed soils.

Indirect N2O emissions from manure management and managed soils. Indirect N2O emissions from managed soils due to manure management and other sources totalled 21.87 MtCO2e, representing 32.74% of total soil

emissions. These emissions occur through two primary pathways:

- Atmospheric deposition: Nitrogen volatilised from managed soils due to agricultural inputs, including synthetic nitrogen fertilisers, organic nitrogen applied as fertiliser, and urine and dung deposited by grazing animals.
- Leaching/runoff: Nitrogen leaching and runoff from managed soils, including from synthetic nitrogen fertilisers, organic nitrogen applied as fertiliser, urine and dung from grazing animals, crop residues, and nitrogen mineralisation/immobilisation associated with changes in soil organic matter due to land use or management practices.

Indirect emissions from manure management specifically result from nitrogen losses due to volatilisation, leaching and runoff in manure management systems.

N2O emissions from managed soils due to nitrogen leaching and runoff were the largest source of indirect emissions, amounting to 10.93 MtCO2e (49.98% of total indirect emissions). This was followed by atmospheric deposition of nitrogen at 6.62 MtCO2e (30.27%). For manure management, nitrogen volatilisation was the primary source of N2O emissions at 3.31 MtCO2e (15.13%), while leaching and runoff from manure management contributed 1.01 MtCO2e (4.62%).

1.6.5 Rice cultivation

Rice cultivation contributes to CH4 emissions through the anaerobic decomposition of organic matter in flooded rice fields, a process called methanogenesis. The CH4 produced during this process primarily escapes into the atmosphere via rice plants through diffusion, while some is released directly from the flooded water in the fields. The amount of CH4 emitted annually from a given rice cultivation area depends on various factors including the number and duration of crops, water management practices, soil amendments, soil type, temperature and rice variety.

In Pakistan, CH4 emissions from rice cultivation are estimated by applying the seasonally integrated emission factor for continuously flooded rice fields without organic amendments to the annual harvested rice area, as specified in the 2006 IPCC Guidelines. During the inventory year, rice was grown on 3.33 million hectares (PBS, 2022a) with water management practices that include intermittent flooding and aeration. This resulted in CH4 emissions of 12.0 MtCO2e, or 4.92% of total emissions from the AFOLU sector.

1.7 Waste

The waste sector is responsible for emissions of CO2, CH4 and N2O from the following activities:

- Solid waste disposal
- Biological treatment of solid waste
- Incineration and open burning of waste
- Wastewater treatment and discharge.

Among emissions from the waste sector, typically the most significant are CH4 emissions from solid waste disposal sites (SWDSs), wastewater treatment and discharge, and incineration and open burning of waste. Incineration and open burning of waste produce not only CH4 and N2O but also CO2, especially when waste containing fossil carbon, such as plastics, is burned. Other CO2 emissions may arise from SWDSs, wastewater treatment and the burning of non-fossil waste, although CO2 from these sources is generally not reported due to its biogenic origin. N2O emissions mainly occur

during the treatment of solid waste and wastewater, with the amount depending on the type and conditions of the treatment process.

For the purposes of this inventory, emissions from the waste sector, including CO2 and non-CO2 GHGs, are assessed at the national level, focusing on (i) solid waste disposal, (ii) waste incineration and open burning, and (iii) wastewater treatment and discharge. Activity data for waste source categories is derived from factors such as waste generation rates, waste deposition rates to SWDSs and the urban population.

In Pakistan, for the inventory year, solid waste generation totalled 18,811,550 tons calculated at the average rate of 0.65 kg/capita/day (Kawai and Tasaki, 2016). Of this total, 11,286,930 tons (60% of the generated waste) was deposited in SWDSs (GoP, 2022d).

1.7.1 Overview of waste sector emissions

The waste sector generated 32.44 MtCO2e of emissions, representing 6.22% of total national emissions. This included 30.03 Mt of CH4, 2.30 Mt of N2O and 0.11 Mt of CO2 (Table 1.17). Solid waste disposal was the largest emitter in this sector, producing 17.52 MtCO2e, or 54.00% of total waste emissions. This was followed by wastewater treatment and discharge, contributing 14.61 Mt (45.04%), while the remaining 0.31 MtCO2e (0.92%) came from waste incineration and open burning.

1.7.2 Solid waste disposal

This section pertains to the solid waste deposited at SWDSs, which serve as the primary source of CH4 production and emission through the anaerobic decomposition of solid waste.

In Pakistan, municipal corporations collect around 60% of urban waste (GoP, 2022d), referred to as municipal solid waste (MSW), and dispose of it at SWDSs where its breakdown via anaerobic reactions leads to CH4 emissions. The rate of MSW generation and disposal varies across different cities. Estimates of CH4 emissions from MSW at the national level are uncertain due to the absence of annual data on MSW generation. For the current GHG estimation, total annual MSW generation is assessed by multiplying the MSW generation rate of 0.65 kg/capita/day (GoP, 2022d) by the 79.29 million urban population (GoP, 2021c).

1.7.3 Incineration and open burning of waste

The main GHGs produced in the incineration process are:

- CO2 from burned waste with fossil carbon (plastics)
- CH4 from incomplete combustion process
- N2O produced indirectly at low combustion temperatures.

When quantifying GHG emissions from waste incineration and open burning, it is estimated that

Table 1.17: Summary of GHG emissions from the waste sector

Source category	Emissions (MtCO2e)			
	CO2	CH4	N2O	Total
Total	**0.11**	**30.03**	**2.30**	**32.44**
Solid waste disposal	0	17.52	0	17.52
Waste incineration and open burning	0.11	0.15	0.04	0.31
Wastewater treatment and discharge	0	12.36	2.25	14.61

10% (998,332.41 tons) of the waste generated by nine major cities in Pakistan (Bahawalpur, Faisalabad, Gujranwala, Hyderabad, Karachi, Lahore, Multan, Rawalpindi and Sialkot, where waste is collected and managed by waste management companies) is incinerated. Similarly, for open burning, it is estimated that 10% of uncollected urban waste is openly burned.

Overview of emissions from incineration and open burning of waste. Emissions from incineration and open burning of waste amounted to 0.30 MtCO2e, or 0.96% of total emissions from the waste sector. These emissions consisted of 0.11 Mt of CO2, 0.15 Mt of CH4 and 0.04 Mt N2O (Table 1.18). Open burning was the primary source of emissions, generating 0.20 MtCO2e (66.64% of total emissions from incineration and open burning of waste), followed by 0.10 MtCO2e (33.16%) from waste incineration.

Table 1.18: Summary of GHG emissions from waste incineration and open burning

Source category	Emissions (MtCO2e)			
	CO2	CH4	N2O	Total
Total	**0.112**	**0.1496**	**0.040**	**0.3016**
Waste incineration	0.078	0.0066	0.016	0.1006
Waste open burning	0.034	0.1430	0.024	0.201

Within the 0.20 Mt of emissions from open burning, CH4 was the predominant GHG, accounting for 0.14 Mt of total emissions, followed by CO2 at 0.03 Mt and N2O at 0.02 MtCO2e. For waste incineration, which contributed 0.10 Mt of emissions, the majority was CO2 at 0.08 Mt, followed by N2O with 0.02 Mt and CH4 with 0.01 Mt.

1.7.4 Wastewater treatment and discharge

Domestic, commercial and industrial activities generate a significant volume of wastewater daily. This wastewater can undergo various treatments: it may be treated on-site without collection, gathered at a centralised facility for treatment or left untreated. When wastewater undergoes anaerobic treatment or disposal, it generates CH4. For the purposes of this inventory, the following estimates have been compiled:

- CH4 and N2O emissions from domestic wastewater
- CH4 emissions from industrial wastewater.

Overview of GHG emissions from wastewater. Wastewater treatment and discharge contributed 14.61 MtCO2e of emissions, amounting to 45.04% of total emissions from the waste sector. Within this category, 12.36 Mt was CH4, while 2.25 Mt consisted of indirect N2O emissions arising from wastewater containing human sewage (Table 1.19). The bulk of emissions in this category, totalling 12.39 MtCO2e (84.80%), came from domestic wastewater and discharge, with industrial wastewater and discharge contributing 2.22 MtCO2e (15.20%). The majority of CH4 emissions (10.14 MtCO2e) arose from domestic wastewater and discharge, while industrial wastewater and discharge accounted for 2.22 MtCO2e of CH4.

Table 1.19: Summary of GHG emissions from wastewater

Activity	Emissions (MtCO2e)		
	CH4	N2O	Total
Total	12.36	2.25	14.61
Domestic wastewater and discharge	10.14	2.25	12.39
Industrial wastewater and discharge	2.22	0	2.22

1.8 Looking ahead

Pakistan lacks an institutionalised system for GHG inventory preparation, although inventories have been compiled since 1994. Pakistan is working to develop a more structured national GHG inventory system, in accordance with the 'Modalities, procedures and guidelines (MPGs) for the transparency framework for action and support referred to in Article 13 of the Paris Agreement' (Decision 18/CMA.1). Paragraph 18 highlights the importance for each Party to establish a national system for GHG inventory preparation, including institutional, legal and procedural arrangements for ongoing estimation, compilation and timely reporting.

To properly fulfil its reporting obligations, Pakistan's GHG inventory development needs to transition from a project-based approach to a more institutionalised arrangement, with tailored procedures for the systematic collection, processing and archiving of GHG data. Improved coordination between federal and provincial authorities, academic institutions and stakeholders is essential, along with measures and safeguards to ensure data quality and transparency.

1.8.1 Emission factors (switching to tier 2 and tier 3)

Pakistan's current GHG inventory follows the IPCC 2006 Guidelines and the Katowice Climate Package decisions. Challenges remain in ensuring data accuracy and completeness. A major limitation is the absence of country-specific tier 2 and tier 3 emission factors, which are crucial for accurate reporting, particularly in sectors such as rice cultivation and livestock.

Efforts to address these gaps include submitting Forest Reference Emission Levels (FRELs) to the UNFCCC and prioritising research on CH4 emissions in agriculture. These initiatives aim to improve the precision of Pakistan's GHG inventory.

1.8.2 GHG inventory management and MRV system

A measurement, reporting and verification (MRV) system is essential to ensure accuracy in reporting. The GCISC has developed an Enhanced Transparency Framework (ETF) system in collaboration with the MoCC, the German Corporation for International Cooperation (GIZ) and the Interprofessional Technical Centre for Studies on Air Pollution (CITEPA). This initiative aims to align Pakistan's inventory with international standards, covering legal, institutional and procedural frameworks for data estimation, reporting and archiving.

A key component of this initiative is the establishment of national GHG inventory institutional arrangement, which has been approved and is now ready for implementation (see Figure 2.1). The MoCC will serve as the national implementing entity, while the GCISC will act as the Secretariat and will oversee the coordination of operations. This structure has been developed through comprehensive stakeholder consultations and aims to institutionalise the GHG inventory system to ensure sustainability. By engaging federal and provincial ministries, the private sector and academic institutions as data providers and reviewers, the system promotes ownership and transparency.

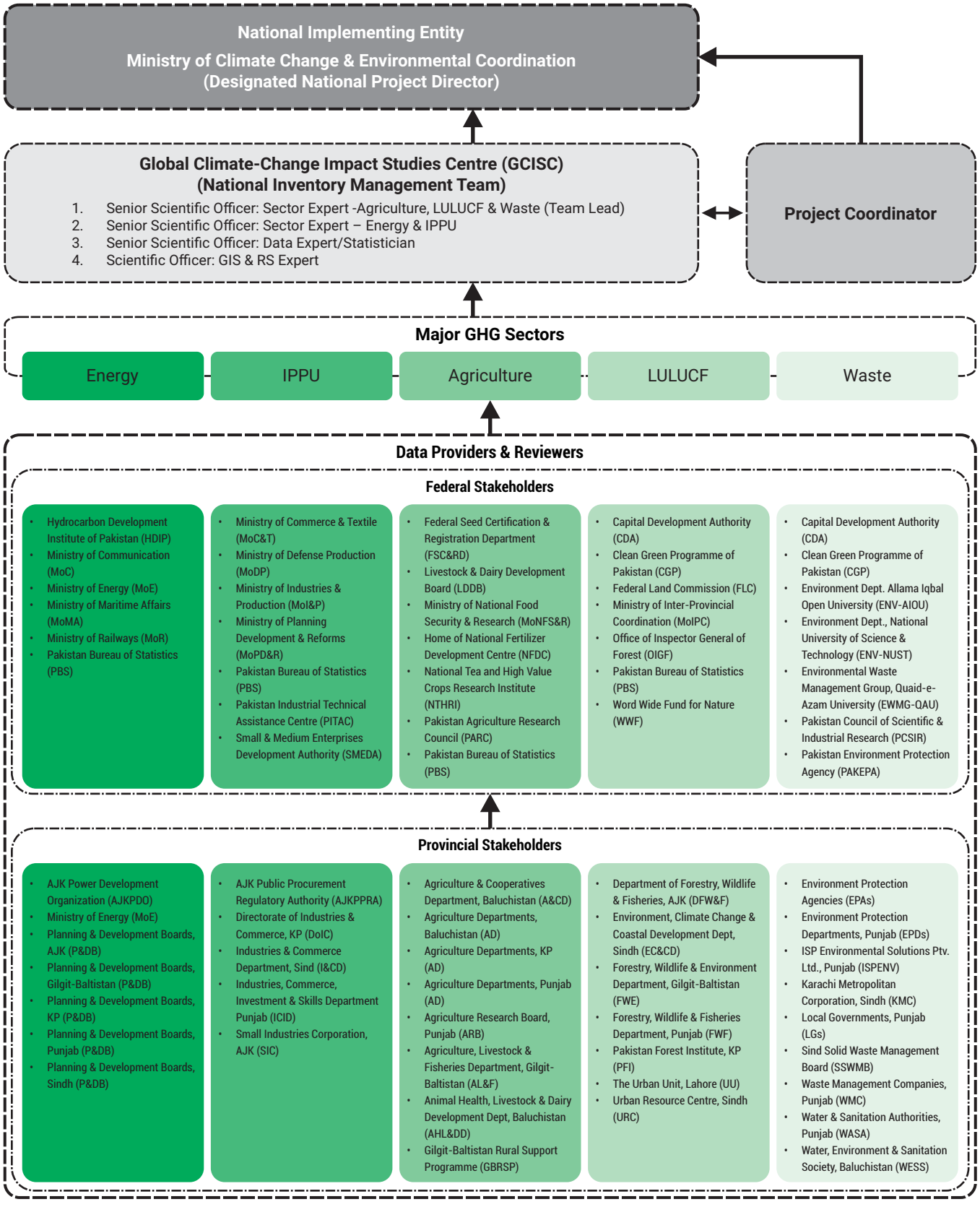
1.8.3 Capacity building

Pakistan has a limited pool of professionals proficient in inventory compilation. Recent capacity building initiatives led by GCISC, in collaboration with partners such as the UNFCCC and GIZ, have focused on enhancing technical knowledge based on the IPCC 2006 Guidelines. By providing training across sectors at both the national and provincial levels, these efforts aim to ensure more accurate data collection, and to strengthen provincial roles in data validation and reporting. Capacity development has also included advanced training in the updated IPCC Guidelines, documentation, and quality assurance/quality control to meet ETF reporting standards.

1.8.4 Strengthening national climate action

An institutionalised GHG inventory system will allow Pakistan to meet its Paris Agreement commitments. It will strengthen national climate governance, enable more informed decision making across sectors and support regular updates to Pakistan's NDC, based on improved emissions data. The system will also ease Pakistan's integration into international mechanisms such as carbon markets, climate financing and technology transfer programmes, and strengthen its position in global climate negotiations.

Figure 1.1: National GHG inventory institutional arrangements



Chapter

2

Progress made in implementing and achieving Nationally Determined Contributions under Article 4 of the Paris Agreement

2. Progress made in implementing and achieving Nationally Determined Contributions under Article 4 of the Paris Agreement

2.1 Pakistan's Nationally Determined Contributions

Pakistan's Updated Nationally Determined Contributions (NDC), submitted in 2021, presents a framework to tackle climate change challenges while balancing national socioeconomic priorities. The NDC sets ambitious targets, outlines adaptation measures and identifies implementation mechanisms, focusing on sectors with the highest emissions.

2.1.1 Key elements of the NDC

The NDC presents a comprehensive approach to mitigating GHG emissions while addressing climate adaptation needs. The NDC s encompass three key elements:

- **Emission reduction targets**: Pakistan has committed to reducing its GHG emissions by 50% below business as usual (BAU) levels by 2030. Of this, 15% is unconditional (dependent on domestic resources) while the remaining 35% is conditional on international climate finance, technology transfer and capacity-building support (see Table 2.1).
- **Adaptation actions**: As the world's most vulnerable country to the impacts of climate change (Germanwatch, 2025), Pakistan prioritises adaptation, focusing on water security, agriculture, disaster risk management and urban resilience. The NDC outlines adaptation actions such as sustainable land management, water conservation and early warning systems.
- **Means of implementation**: For Pakistan, success in achieving NDC targets depends on international support, particularly for finance, technology transfer and capacity building. The NDC estimates that a total of USD 101 billion will be required by 2030 to meet these targets and stresses the importance of international partnerships and cooperation to mobilise financing.

Table 2.1: NDC targets

Target	Details
Reduction relative to base year (%)	50% reduction in projected BAU emissions by 2030: - 15% from the country's own resources (unconditional) - 35% subject to international financial support (conditional)
Emissions reduction (MtCO2e)	Projected 2030 BAU emissions of 1,603 MtCO2e - Voluntary reduction 240.45 MtCO2e (unconditional) - Additional 561.05 MtCO2e (conditional)
Other	Expansion of protected areas from 12% to 15%

2.1.2 NDC targets

The NDC states that Pakistan's 2016 GHG emissions amounted to 405.1 MtCO2e and estimates emissions to rise to 1,603 MtCO2e by

2030 under the BAU scenario. It aims to achieve a 50% reduction in emissions overall, down to 801.8 MtCO2e (Figure 2.1). The NDC also notes that between 2016 and 2018, mitigation efforts led to an 8.7% reduction compared to projected emissions.

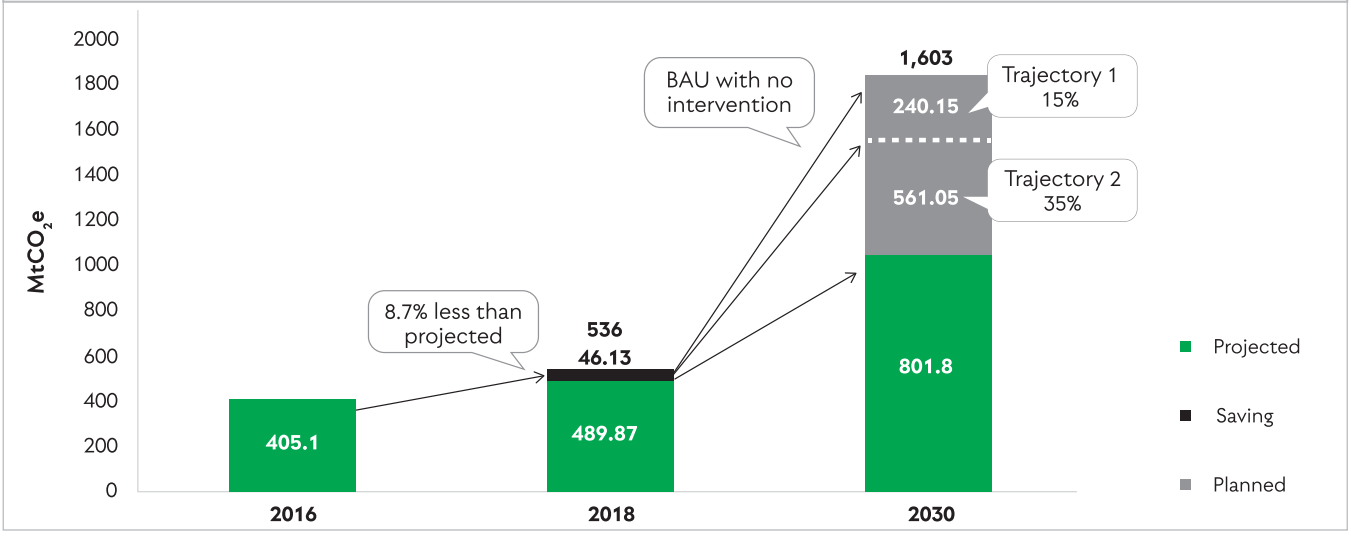
These targets cannot be achieved entirely through domestic sources. Of the NDC target, 15% is in the form of unconditional reductions that will be met through domestic resources. The remaining 35% is conditional on international assistance, pursuant to Article 9 of the Paris Agreement, which states that developed countries "shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation".

Target sectors

Under the NDC, interventions are planned for sectors with the highest emissions, as follows:

- **Energy**. Pakistan has committed to increasing the share of renewables in the energy mix. By 2030, the country aims for a 60% share for renewable energy in the total energy mix. This will largely be driven by scaling up investment in hydropower, solar and wind projects while phasing out new coal plants relying on imported coal. Expanding decentralised energy systems, such as mini-grids, is a part of this transition.
- **Transport**. The NDC target for this sector is for 30% of new vehicle sales to be electric vehicles (EVs) by 2030. Pakistan is providing incentives for EV manufacturers and consumers, and plans to develop a national EV charging infrastructure. It also intends to introduce fuel efficiency standards and promote public transportation systems powered by renewable energy.
- **Land use, land-use change and forestry**. Forestry initiatives under the Green Pakistan Upscaling Programme (formerly known as the Ten Billion Tree Tsunami Programme) aim to sequester 148.76 MtCO2e by 2030. For agriculture, efforts include promoting climate-smart practices to mitigate CH4 emissions and enhance resilience.
- **Industry and waste management**. For these sectors, Pakistan is focusing on clean technologies and decarbonisation, promoting energy efficiency and establishing waste-to-energy plants. The shift to clean production methods includes cutting down on the use of coal.

Figure 2.1: Voluntary and conditional reductions under the NDC



2.1.3 Adaptation priorities

The NDC recognises that although Pakistan is highly vulnerable to the impacts of climate change, its contribution to global emissions is minimal, at less than 1%. As such, for Pakistan the priority is adaptation. Three main areas of action are identified for this purpose, as follows:

- **Nature-based solutions** to reclaim degraded land and promote the conservation of critical ecosystems that support the livelihoods of a significant proportion of the population.
- **Land use change and forestry** interventions to increase forest cover, introduce sustainable land management practices and curb emissions from agriculture.
- **Resilient community infrastructure** to help communities withstand the impacts of climate change on their livelihoods, and to mitigate loss and damage in the wake of extreme weather events.

2.1.4 Means of implementation

Pakistan will require robust financial, technological and capacity-building support to achieve NDC targets. The energy transition alone is estimated to cost USD 101 billion by 2030, underscoring the importance of mobilising both domestic and international financial and technical resources. Key strategies for implementation are as follows:

- **Climate finance** will be pursued through international finance mechanisms and carbon markets. Innovative financial instruments, such as green bonds and blended finance, will be offered to attract private investment. Institutional capacity will be strengthened to facilitate access to global financing mechanisms, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF).
- **Transparency in reporting** will be a key priority, to build investor confidence and ensure that resources are deployed effectively. A robust and transparent MRV system is being developed to allow accurate tracking of emissions and reporting on progress.
- **Technological solutions** are essential to implement mitigation and adaptation measures at the scale that is required. Pakistan will seek access to the latest technologies for renewable energy, climate-resilient agriculture, green transport and clean industry, to scale up climate action.
- **Capacity for implementation** is another priority, across the board, from planning and implementation to monitoring. Pakistan will seek capacity development support to train sector experts, policy makers and stakeholders responsible for implementation. Capacities for data collection and analysis will also be strengthened, particularly for GHG tracking and inventory preparation.
- **Governance systems** will be strengthened, using a whole-of-government approach. This will include streamlining planning and oversight mechanisms, improving coordination between agencies and authorities responsible for climate-vulnerable sectors, and decentralising implementation and monitoring.
- **Policy coherence** will be ensured, mainstreaming climate change considerations into decision making at all levels to ensure that development planning is aligned with Pakistan's climate change mitigation and adaptation priorities. Integrating climate goals into provincial and sectoral strategies will ensure coherence and sustainability.

Key messages

The NDC addresses issues of relevance to national stakeholders as well as the international community. For domestic audiences, the NDC provides a roadmap for reducing emissions and highlights the co-benefits that will accrue from achieving targets. These include creating green job opportunities, promoting eco-friendly business and industries, and securing the livelihoods of vulnerable communities through locally relevant adaptation and resilience measures.

For international audiences, the NDC emphasises Pakistan's commitment to good global citizenship, even as it faces extreme vulnerability to the impacts of climate change. While setting ambitious emission reduction targets, it also signals that Pakistan cannot achieve these targets without international support, in line with Paris Agreement obligations for developing nations to provide assistance.

Alignment with international guidance and best practice

Pakistan's NDC is aligned with international climate frameworks and best practices. This includes the ETF, which ensures accountability, and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, which improves accuracy and consistency in Pakistan's GHG reporting. The NDC is also aligned with global financing mechanisms like the GCF and the GEF, enabling access to international climate finance.

2.1.5 Review and updates

The NDC is intended to be a living document, able to respond to new data, changing socioeconomic conditions and emerging technologies. A review is to be conducted every two years, led by the Ministry of Climate Change and Environmental Coordination (MoCC) and involving consultations with a broad range of stakeholders, including federal and provincial agencies, the private sector and civil society organisations.

The review will incorporate insights from GHG inventories, sectoral performance metrics and advancements in international reporting standards. It will also take into consideration changes in Pakistan's climate risk profile. This iterative approach will ensure that Pakistan's NDC implementation, and climate action more broadly, can take into account evolving challenges while remaining aligned with national development goals and international climate obligations.

2.2 National circumstances and implementation framework

This section presents an overview of national circumstances relevant to NDC implementation and the institutional arrangements in place for NDC tracking and reporting.

2.2.1 National circumstances

Pakistan is among the most climate-vulnerable nations in the world. Its diverse geography, with glacial highlands, fertile plains, vast deserts and coastal areas, exposes the country to a range of climate-related risks, which include accelerated glacial melt in the north, prolonged drought in the southwest, erratic monsoons across the Indus Basin and rising sea levels along the coast.

The climate is highly variable, with fluctuations in rainfall leading to recurring droughts and floods. This variability is increasingly influenced by climate change. Average temperatures have increased at an alarming rate, while rainfall patterns have become erratic. Flooding is a persistent threat, droughts are becoming more frequent, and the country is also experiencing

heatwaves more regularly, with record-breaking temperatures.

Loss and damage. Until recently, Pakistan was ranked as the 8th most vulnerable nation globally to the impacts of climate change (Germanwatch, 2025). This was according to the Climate Risk Index, which was revised in 2025. Pakistan is now ranked 1st in the list of countries most affected by climate change (Germanwatch, 2025). As the index notes, Pakistan ranks highest because of the exceptionally high economic losses it has suffered as a result of climate-related disasters and the number of people affected.

The devastating floods of 2022 displaced 8 million people, with estimated losses exceeding USD 30 billion (USD 14.9 billion in damage and around USD 15.2 billion in loss to GDP). Sectors that were worst affected were housing (USD 5.6 billion); agriculture, food, livestock and fisheries (USD 3.7 billion); and transport and communications (USD 3.3 billion). The cost of reconstruction and rehabilitation is estimated at USD 16.3 billion.

A decade earlier, in 2010, severe flooding affected around 20 million people, with an estimated USD 10 billion in losses (NDMA, 2011). Other major floods occurred in 2011 and 2012, affecting approximately 9.6 million people and 5.0 million people, respectively, with cumulative losses estimated to be more than USD 30 billion (ADB and WB, 2011).

Socioeconomic impacts. Pakistan's economy relies heavily on agriculture, which accounts for 24% of GDP and employs 37.4% of the labour force (GoP, 2022d). The sector is extremely vulnerable to climate impacts, affected by water scarcity as well as rising temperatures. At the same time, more than 61% of the population lives in rural areas (PBS, 2023b), with rural livelihoods highly dependent on agriculture and natural resources. As of 2023, approximately 37% of the population is estimated to live below the poverty line, defined as earning less than USD 3.65 per day (WB, 2023). Climate change will exacerbate poverty and have a devastating impact on the economy.

2.2.2 National policy framework for NDC implementation

Pakistan has long understood the importance of building climate resilience across sectors, with a robust policy framework in place to address climate challenges. At the federal level, several policy initiatives have been introduced to create an enabling environment for emission reductions, particularly in NDC priority sectors of energy and transport.

National Climate Change Policy 2021

The National Climate Change Policy seeks to build climate resilience by addressing vulnerabilities across key economic sectors. It provides a framework to guide adaptation and mitigation efforts, and sets out strategic measures to mobilise climate finance, adopt innovative technologies, build institutional and technical capacity, raise public awareness and foster international cooperation. With the goal of mainstreaming climate considerations across all sectors of the economy, it emphasises the need to transition towards clean and sustainable production methods.

National Adaptation Plan 2023

The National Adaptation Plan (NAP) sets out a comprehensive framework to strengthen adaptation efforts. It places an emphasis on addressing localised risks, empowering communities and leveraging nature-based solutions. It sets out critical interventions for

each priority sector, along with timeframes and the authorities responsible. Key provisions of the NAP are summarised in Table 2.2.

Clean energy transition

Pakistan is creating a policy framework that promotes clean energy and provides incentives for individuals, industries and government agencies to transition to green energy and renewables. Key policy initiatives include:

- **Alternate and Renewable Energy Policy 2019**. Promotes renewable energy development, aiming to achieve at least 20% of domestic generation capacity from alternative and renewable energy (ARE) technologies by 2025 and 30% by 2030 (referred to as the 20X25 and 30X30 targets) (GoP, 2019a).
- **National Electricity Policy 2021**. Aims to increase the share of renewable energy in the national energy mix, reduce dependence on fossil fuels and strengthen local capacity for the development of a renewable energy market (GoP, 2021b).
- **Fast Track Solar PV Initiatives 2022**. This framework was developed to facilitate the scaling of solar photo voltaic (PV) systems in the country (GoP, 2022a). Planned interventions focus on reducing reliance on imported fossil fuels by substitution with solar PV energy. Key initiatives include deploying solar PV systems on 11 kV feeders to allow for renewable energy integration, and solarising public buildings to cut energy costs and demonstrate the feasibility of clean energy solutions.
- **National Electricity Plan 2023**. Provides a framework for development of the energy sector for a five-year period. Includes provisions to scale up renewable energy (including hydropower) to make up 40% of total power generation capacity by 2025 and 60% of total power generation capacity by 2030 (GoP, 2023c).

Table 2.2: Key provisions of the NAP

Sector	Initiatives
Agriculture-water nexus	- Incentivising farmers to transition to climate-smart water and land management practices - Modernising surface and groundwater irrigation services to support transitions to climate-smart agriculture - Developing a long-term agriculture growth strategy, with a focus on productivity improvement, climate resilience and physical expansion - Developing a plan for managing projected river flow and rainfall variability under different climate scenarios.
Natural capital	- Mainstreaming sustainable land management into ecosystem resilience - Promoting integrated watershed management - Improving water quality through better wastewater management - Investing in coastal and marine resources - Investing in the air pollution-climate change nexus.
Urban resilience	- Mainstreaming climate adaptation across federal, provincial and local governments - Improving land regulation and land-use planning to bolster resilient service provision - Bolstering climate-smart municipal services - Leveraging nature-based solutions to manage climate risks - Developing financing instruments to ensure sustainable revenue streams for green and resilient urbanisation.
Human capital	- Mainstreaming climate adaptation in health and education policies - Enhancing climate resilience through disaster emergency preparedness and response - Building workforce capacities to address and adapt to climate risks.

Sustainable transport

Transport is another key sector where government policy is focused on sustainability and cutting emissions, providing incentives for the adoption of EVs and improving efficiency.

- **National Transport Policy 2018**. Envisions the deployment of low-carbon and EVs while phasing out internal combustion engines.
- **National Electric Vehicle Policy 2019**. Sets ambitious targets for EV adoption, aiming for a 30% share of passenger vehicle sales by 2030 and a 90% share of heavy-duty truck sales by 2040 (GoP, 2019c). Provides for lower customs duties and sales taxes for locally manufactured hybrid EVs.
- **National Freight and Logistics Policy 2020**. Aims to improve efficiency of the freight and logistics sector, while generating mitigation co-benefits, with interventions that include improving fuel quality, encouraging the use of low-emission delivery vehicles in urban areas, and exploring cleaner alternatives for last mile logistics and courier services.
- **Auto Industry Development and Export Policy 2021**. Provides financial incentives for the uptake of EVs and hybrid vehicles, including lower taxes and customs duties, and calls for the development of EV infrastructure.

2.2.3 Provincial policy framework

Under the Constitution of Pakistan, all matters related to the environment, including climate mitigation and adaptation measures, fall within the jurisdiction of the federating units. At the provincial level, climate change policies and strategies acknowledge the importance of emissions reduction across sectors.

Provincial and regional policies set objectives and recommend interventions for adaptation and mitigation. They reflect local contexts and climate impacts, identify mitigation opportunities and highlight resilience needs, offering valuable insights into on-ground realities, priorities, capacities and opportunities. However, objectives are broad and overarching for the most part, with the Punjab Climate Change Policy the only one to include specific targets. The subnational policy landscape reflects the urgent need for sector-specific mitigation planning at the local level.

Provincial and regional policies and their objectives are summarised in Table 2.3.

2.2.4 Institutional arrangements for NDC tracking

This section presents an overview of the institutional arrangements in place for NDC implementation, including the roles and responsibilities of the many government entities that are involved in Pakistan's climate change mitigation and adaptation efforts.

The **Ministry of Climate Change and Environmental Coordination** (MoCC) is the lead institution responsible for coordinating climate action at the national level. With respect to the NDC, its responsibilities include:

- Leading the formulation and monitoring of national climate policies
- Preparing GHG inventories
- Overseeing NDC reporting.

The Pakistan Climate Change Act establishes the **Pakistan Climate Change Authority** and **Pakistan Climate Change Council**, which have oversight functions.

The MoCC works with provincial governments as well as other federal ministries and agencies, each with its own responsibilities, as summarised in Table 2.4.

Table 2.3: Provincial policies supporting NDC objectives and mitigation targets

Policy	Objectives/targets
Azad Jammu and Kashmir Climate Change Policy 2017	- Increase share of renewable technologies in energy mix, particularly hydro-electric power - Promote low-carbon transport technologies
Balochistan Climate Change Policy 2024	- Develop and expand electric/hybrid bus-based mass transit system infrastructure - Bank leases for EVs - Promote and establish renewable energy systems across different sectors (e.g., agriculture, industries, transport) - Restore degraded habitats - Afforestation - Establish and manage protected areas
Gilgit Baltistan Climate Change Strategy and Action Plan 2017 Gilgit Baltistan Climate Change Adaptation Action Plan 2023	- Promote development of renewable energy resources and technologies (e.g., small hydropower, solar, biofuel) - Incorporate renewable energy requirements building laws - Strengthen management of protected areas, introduce collaborative management regimes
Khyber Pakhtunkhwa Climate Change Policy 2022	- Promote and facilitate enable renewable energy generation - Promote uptake of EVs - Establish and manage protected areas
Punjab Climate Change Policy and Action Plan 2024	- 30% share of renewables in energy generation by 2035 (e.g., solar, wind, biomass) - 20% share of EVs in new car sales by 2035 - 15% increase in protected areas by 2035
Sindh Climate Change Policy 2022	- Encourage efficient and green transportation modes, and reduce emissions in railway and aviation transport

Table 2.4: Institutional framework for NDC implementation

Institution	Role
Climate Finance Wing	Established within the MoCC, focuses on project development, the Country Readiness Programme and accreditation of national entities
Global Climate-Change Impact Study Centre	Research arm of the MoCC, responsible for developing Pakistan's GHG inventory
Ministry of Agriculture	Responsible for tracking and reporting on agricultural emissions
Ministry of Communications	Gathers data on transport sector emissions
Ministry of Economic Affairs	Facilitates economic policies that support climate-resilient development
Ministry of Energy	Focuses on emissions from energy production and consumption, with an emphasis on renewable energy and energy efficiency programmes; responsible for tracking emissions from the energy sector
Ministry of Finance	Leads Pakistan's efforts to access international climate finance
Ministry of Foreign Affairs	Participates in climate related negotiations, advancing the country's position on climate finance and international commitments
Ministry of Planning, Development and Special Initiatives	Primarily national authority responsible for development planning, including integration of climate considerations into national development plans
Ministry of Science and Technology	Promotes research and innovation, facilitates the transfer of technology for climate adaptation and mitigation initiatives

Institution	Role
National Energy Efficiency and Conservation Authority	Responsible for implementing energy efficiency and conservation initiatives, including standards for energy conservation
Pakistan Environmental Protection Agency	Plays a key role in environmental data collection
Provincial climate change and environment departments	Responsible for implementing climate policies and strategies within their respective jurisdictions
Provincial planning departments	Similar to the MoPDSI at the federal level, responsible for planning, implementation and monitoring of climate action at the provincial level

Civil society stakeholders

There are many other organisations and bodies that have a role to play in NDC tracking and implementation. These include specialised research institutions, chambers of commerce and industry, professional organisations and industrial associations.

2.2.5 Capacity for NDC implementation

The NDC recognises the need for a nationwide capacity-building programme that focuses on improving data collection systems, strengthening MRV capabilities and training personnel in climate reporting methodologies. Despite efforts to strengthen capacity for NDC implementation, challenges remain, including:

- **Data collection**: Inconsistent data collection across provinces and sectors, particularly in agriculture, land use and forestry
- **Coordination**: Weak coordination between federal and provincial governments, as well as between different ministries involved in NDC tracking
- **Technical skills**: Shortage of skilled professionals in GHG inventory preparation and climate data analysis, especially at the provincial level.

As the NDC notes, Pakistan requires support in multiple areas in order to meet its emission reduction targets.

Technical support. The NDC highlights the need to strengthen technical expertise, including for data collection and management, GHG inventory preparation, climate risk assessments and the development of climate-friendly solutions tailored to Pakistan's context.

Financial support. The NDC emphasises the need for international financial support in addition to domestic finance mobilisation. Specifically, Pakistan requires greater access to climate finance through mechanisms such as the GCF, the GEF and other bilateral and multilateral funds. The NDC also underscores the need for private sector financing.

Technology development and transfer support. The NDC notes the importance of accessing clean and climate-resilient technologies, particularly in sectors such as renewable energy, water management and agriculture. Pakistan requires technology transfer and innovation to ensure that climate solutions are scalable, affordable and effective. Details of the support required and received are discussed in Chapter 4.

2.3 Tracking progress made in NDC implementation

This section presents information necessary to track progress made in implementing and achieving Pakistan's NDC under Article 4 of the Paris Agreement. It describes the methodology employed for reporting on GHG emissions,

including data sources and definitions used. The section then provides a summary of key achievements in NDC implementation.

2.3.1 Pakistan's 2021 GHG inventory

Pakistan's GHG inventory for 2020-21, referred to as the 2021 inventory, was compiled according to the **IPCC 2006 Guidelines** for National Greenhouse Gas Inventories. It uses the **IPCC Inventory Software Version 2.69** to ensure consistency with global reporting requirements, as outlined in the Katowice Climate Package (2018). The inventory employs a **tier 1 approach**, which relies on **default emission factors and activity data** to calculate emissions from key anthropogenic sources.

The 2021 inventory reports emissions of **carbon dioxide** (CO_2), **methane** (CH_4) and **nitrous oxide** (N_2O), incorporating **Global Warming Potentials** (GWPs) from the IPCC AR5 for an updated perspective on the relative impacts of these gases. Emissions are reported in million tons of carbon dioxide equivalent ($MtCO_2e$).

The inventory covers emissions from four key sectors, as well as sub-sectors within each key sector:

- Energy (including transport)
- Agriculture, forestry, and other land use (AFOLU)
- Industrial processes and product use (IPPU)
- Waste.

Within these categories, major emission sources are thoroughly documented, ensuring alignment with the IPCC 2006 Guidelines.

Data sources

A range of data sources were used, including government databases and statistical publications, supplemented by reports and studies from research institutions and international agencies. (See Table 1.2 in the previous chapter.)

Methodology

The methodology used to calculate emissions is described in the sections that follow.

Energy. GHG emissions were estimated using a tier 1 methodology, as outlined in the 2006 IPCC Guidelines. Activity data on fossil fuel consumption was derived from the Pakistan Energy Year Book (HDIP, 2021). Default emission factors, reflecting national circumstances, were obtained from the IPCC Emission Factor Database (IPCC, 2002) and applied to the relevant source categories and subcategories.

IPPU. GHG emissions were estimated using a tier 1 methodology. Activity data for industrial processes was sourced from the Pakistan Economic Survey (GoP, 2021c), which provides production figures for the mineral and chemical industries. The mineral industry encompasses limestone, cement and dolomite production, while the chemical industry includes ammonia, urea and iron production.

AFOLU. GHG emissions for the AFOLU sector were estimated using a tier 1 methodology. Emissions and removals are assessed separately for six land use categories, while emissions from livestock, nitrogen management, and lime and urea application are calculated at the national level using aggregated data. Key data sources include the Agriculture Statistics of Pakistan 2020-21 (PBS, 2022a) and the Pakistan Economic Survey 2020-21 (GoP, 2021c) for livestock, fertiliser use and paddy cultivation. Data on forestland was sourced from FAOSTAT (FAO, 2021), the FAO Forestry Sector Review (FAO, 2020), Pakistan's FRELs (GoP, 2019b), the

National Forest Monitoring System, and the MRV System for REDD+. To improve accuracy in estimating carbon stocks and GHG fluxes from forestland, data on forest classification, area, climatic region, soil type, ecosystem type, plantation types, stand development and management practices was used.

Waste. GHG emissions from the waste sector, including both CO2 and non-CO2 gases, were estimated using the tier 1 methodology. These emissions are assessed separately at the national level, covering solid waste disposal, waste incineration and open burning, as well as wastewater treatment and discharge.

Activity data for waste sources was derived from factors such as waste generation rates, the proportion of waste deposited in SWDSs and urban population figures. In Pakistan, total solid waste generation for the inventory year was 18,811,550 tons, with an average production rate of 0.65 kg/capita/day. Of this, approximately 11,286,930 tons (60%) was deposited in SWDSs, based on estimates from recent studies (Kawai and Tasaki, 2016).

2.3.2 Achievements in NDC Implementation

Pakistan has made good progress in implementing policies and projects that align with its NDC commitments. These include investments in renewable energy, energy efficiency, sustainable transport, reforestation and green finance. Key initiatives are summarised in Table 2.5.

Challenges encountered

Despite these achievements, Pakistan faces several challenges in NDC implementation:

- **Financial constraints**: A significant gap exists between available funding and the investment needed to achieve climate goals. Securing international climate finance remains a challenge.
- **Limited direct access to climate finance**: Pakistan faces challenges in securing climate funds due to complex accreditation processes, institutional capacity constraints and the lack of nationally accredited entities to directly access international climate finance mechanisms.
- **Institutional and policy coordination**: Effective collaboration between various government and private entities is often hindered by multiple inefficiencies and overlapping mandates.
- **Technological and infrastructure limitations**: The adoption of renewable energy, energy-efficient technologies and EV infrastructure requires substantial investment in infrastructure, which is currently limited.
- **Capacity building and awareness**: Many stakeholders, including industry, policymakers and the public, require greater awareness and training on climate-friendly practices.
- **Regulatory and implementation barriers**: Enforcement of environmental regulations and compliance with green policies remain weak, affecting the effectiveness of climate action plans.
- **Climate vulnerability and natural disasters**: Pakistan's high susceptibility to climate-induced disasters creates additional hurdles in sustaining long-term climate initiatives.
- **Market readiness for carbon trading**: While carbon market mechanisms are being developed, successful implementation requires better market readiness, policy clarity and investment incentives.
- **Debt payment and recommendations for debt swapping**: Pakistan faces the significant financial burden of debt repayment, which affects its ability to allocate sufficient resources for climate

Table 2.5: Key achievements in NDC implementation

Goal	Initiative	Details
Energy transition and renewable energy	Renewable energy transition	Ambitious target to achieve 60% share of renewables in energy mix by 2030 Significant investments made in solar, wind and hydroelectric power
	Moratorium on new coal power plants	Landmark decision to halt new coal power plants
Energy efficiency and sustainable practices	Revised building codes	Updated green building codes to ensure energy-efficient construction
	Minimum Energy Performance Standards (MEPS)	Enforcing MEPS across appliances and industrial equipment to improve energy efficiency
	Energy efficiency in industries	Programmes and incentives for businesses to adopt energy-saving technologies
Sustainable transport initiatives	Bus rapid transit (BRT) systems	BRT systems established in five major cities
	National Electric Vehicle Policy	Target to shift 30% of transportation sector to EVs by 2030 Incentives for EV adoption and infrastructure development
Environmental conservation and carbon sequestration	Green Pakistan Upscaling Programme (formerly Ten Billion Tree Tsunami Programme)	Flagship afforestation initiative contributing to large-scale carbon sequestration
Climate finance and green investments	10-year green bonds	Launched to finance sustainable development projects, attract investment in clean energy, transportation and climate adaptation
	Green Banking Guidelines	Guidelines to promote environmentally sustainable financial practices in the banking sector
	National Guidelines for Green Bonds	Guidelines to support climate finance, ensuring transparent and effective utilisation of funds raised through green bonds
Carbon market and sustainable development	Pakistan Policy Guidelines for Trading in Carbon Markets	Guidelines to facilitate carbon trading, enabling businesses and industries to engage in emission reduction mechanisms while attracting global investment
	National Action Plan on Sustainable Development Goal-12	Focus on responsible consumption and production patterns, promoting sustainability in key economic sectors

action. To address this issue, the country is exploring debt-for-climate swaps, where international creditors convert outstanding debt into funding for environmental and climate-related projects.

Lessons learned

The NDC implementation process to date provides important lessons to guide future efforts:

- **Integration with national development plans**: There is a need to better integrate the NDC with national development strategies and sectoral policies to ensure that climate action is embedded in all sectors.
- **Enhanced data collection and monitoring systems**: Accurate and comprehensive data on emissions, energy consumption and climate impacts is essential to track progress. Robust MRV systems are critical to ensuring transparency.
- **Stakeholder engagement and collaboration**:

Successful NDC implementation requires broad stakeholder involvement, including government agencies, the private sector, civil society and communities. Early and sustained engagement is needed to ensure support for climate initiatives.

- **Capacity building and institutional strengthening**: Pakistan lacks technical and institutional capacity, particularly at the provincial and local levels. Strengthening capacity through training and resource allocation is essential for effective implementation.
- **Financial and technical support**: Climate action often requires substantial financial investment and technical resources, posing a significant barrier to achieving NDC targets. Mobilising domestic and international financing is essential to support ambitious climate goals.
- **Policy coherence and long-term vision**: Short-term policy decisions that fail to consider long-term climate goals may undermine progress. Ensuring that climate objectives are embedded in long-term national strategies, with the flexibility to adapt to changing conditions, is crucial for success.
- **Adaptation and resilience building**: While mitigation efforts are important, Pakistan's vulnerability to climate impacts underscores the need to integrate adaptation strategies into the NDC. Strengthening resilience in vulnerable sectors such as agriculture and water is necessary to protect communities.
- **Public awareness and advocacy**: Public awareness and understanding of climate change is limited. Increasing awareness on climate change issues is essential to build support for climate policies and encourage behaviour change at both individual and community levels.
- **Private sector involvement**: The private sector has an important role to play in achieving NDC targets, particularly in terms of innovation, investment and technology transfer. Creating an enabling environment for private sector participation, including through incentives and public-private partnerships, can accelerate climate action.
- **Climate justice and equity**: Climate change disproportionately affects marginalised groups, including women, indigenous peoples and low-income communities. Ensuring that climate actions are equitable and inclusive is crucial to ensure equity in NDC implementation.

2.4 Mitigation measures and actions for NDC implementation

A key pillar of Pakistan's mitigation strategy is the transition to a low-carbon economy, with the goal of transitioning to clean energy sources and deploying climate-smart solutions. This section describes the measures and initiatives being implemented to support this goal, focusing on sectors that are responsible for the largest share of national GHG emissions. The section then discusses key mitigation co-benefits resulting from adaptation actions.

2.4.1 Energy

Pakistan is making progress in integrating renewable energy into the national energy mix. Between 2021 and 2024, the proportion of renewable energy in total installed capacity has been fairly stable at around 7% (see Table 2.6). During the same period, the share of renewable energy generation has gradually increased, from 3% to 4.26%.

By March 2024, Pakistan's total installed electricity generation capacity reached 42,131 MW. The energy mix comprised hydel (25.4%), nuclear (8.4%), renewables (6.8%) and thermal (59.5%), reflecting the country's continued

reliance on thermal power while gradually expanding its renewable and alternative energy capacities.

Growing the share of renewables

Between 2021 and 2024, Pakistan has seen a gradual increase in renewable energy generation. This includes the expansion of solar and wind energy projects in Balochistan, Punjab and Sindh, the commissioning of additional hydropower projects to increase clean energy output, and strengthening of grid infrastructure to accommodate variable renewable energy sources.

Policy and regulatory measures for renewable energy expansion have supported these efforts, including the Alternative and Renewable Energy (ARE) Policy 2019, which targets a 30% share of renewable energy in the power generation mix by 2030. The government has also introduced net metering and feed-in tariff mechanisms to encourage distributed solar PV adoption.

Measures have also been taken to increase investment and financing for clean energy. These include efforts to increased foreign direct investment in renewable energy projects, promoting public-private partnerships to accelerate the energy transition, and providing financial incentives for green energy projects under the Pakistan Climate Finance Strategy.

Several renewable energy power projects currently under development will be completed by 2030, and will generate approximately 2,046 MW of energy (HDIP, 2021).

Table 2.6: Energy mix in installed and generation capacity (2021-24)

Year	Source	Installed capacity		Generation	
		MW	Share (%)	GWh	Share (%)
2021-22 (July-April)	Thermal	24,710	59.46	29,181	60.9
	Hydel	10,251	24.68	74,862	23.7
	Nuclear	3,647	8.77	15,182	12.4
	Renewable	2,949	7.09	3,709	3.0
	Total	41,557	100	122,934	100
2022-23 (July-March)	Thermal	24,095	58.8	43,526	46.2
	Hydel	10,592	25.8	26,937	28.6
	Nuclear	3,530	8.6	19,739	21.0
	Renewable	2,783	6.8	3,919	4.2
	Total	41,000	100	94,121	100
2023-24 (July-March)	Thermal	25,046	59.45	42,249.20	45.88
	Hydel	10,681	25.35	29,167.10	31.67
	Nuclear	3,545	8.41	16,753.70	18.19
	Renewable	2,859	6.79	3,921.00	4.26
	Total	42,131	100	92,091	100

Source: GoP, 2021 c; GoP, 2022d, GoP, 2023e.

Hydropower expansion is a key component of renewable energy growth. Pakistan is scaling up investments in hydropower. Between 2021 and 2024, there were notable improvements in both installed hydropower capacity and electricity generation (Table 2.7). Key achievements include an increase in the share of total electricity generation, from 28.6% in 2022-23 to 31.67% in 2023-24. New hydropower projects (Dasu Hydropower Phase 1, Tarbela Dam expansion) contributed to this expansion, along with modernisation and rehabilitation of existing hydropower plants to enhance efficiency and extend operational lifespan.

As of 2024, the Private Power and Infrastructure Board (PPIB) is developing new hydropower projects with a combined capacity of 7,460 MW, which are expected to be operational by 2032. The dominance of hydropower in upcoming projects underscores Pakistan's long-term vision to increase the share of renewables and reduce dependence on imported coal.

Promoting solar adoption is part of the clean energy transition. The government has launched several high-impact initiatives to encourage the adoption of solar power. The net metering policy, allowing solar users to sell surplus electricity back to the grid, has created strong incentives for adopting solar energy. This has led to substantial growth in solar installations, with Pakistan seeing a surge in solar panel imports in 2024, expected to produce 17 GW of electricity (Mangi, 2024; Renewables First, 2024). As of March 2024, 117,807 solar installations across Pakistan employed net metering, with a combined capacity of 1,822 MW.

Key initiatives to accelerate the pace of solar adoption are summarised in Table 2.8.

Wind power is increasingly becoming an integral part of the energy mix. Wind energy projects have also seen substantial growth, with large-scale wind farms in Balochistan and Sindh now contributing significantly to the renewable energy mix. Multiple wind projects are under development by the PPIB. Key measures include:

- Strategic feasibility studies and development plans underway along coastal wind corridors of Balochistan and Sindh, where wind potential is among the highest in South Asia
- Ongoing scaling-up of wind energy to further diversify Pakistan's renewable energy portfolio, helping to achieve NDC targets and reducing reliance on fossil fuels.

Reducing reliance on fossil fuels

The NDC acknowledges that, as a developing economy, Pakistan will continue to rely on fossil fuels in the short term. However, a key aspect of Pakistan's climate mitigation strategy is to gradually reduce dependence on thermal power and imported coal, while scaling up renewable energy production.

Table 2.7: Improvements in hydropower installed capacity and generation (2021-24)

Year	Installed capacity		Generation	
	MW	Share (%)	GWh	Share (%)
2021-22	10,251	24.68	74,862	23.7
2022-23	10,592	25.8	26,937	28.6
2023-24	10,681	25.35	29,167.10	31.67

Source: GoP, 2021 c; GoP, 2022d, 2023e.

Reducing the share of thermal energy will support the clean energy transition. While installed capacity remained more or less the same, the share of thermal power in total generation declined between 2021 and 2024 (see Table 2.9). Key measures to reduce reliance on thermal energy are summarised in Table 2.10.

Shifting from imported coal to indigenous sources will improve cost efficiency. While measures are being taken to phase out coal, this is not a target that can be achieved in the short term. In light of the high cost of imported coal, the government has prioritised the use of indigenous coal resources. The PPIB has placed strong emphasis on leveraging coal reserves in Thar, Sindh. Advanced coal gasification and liquefaction technologies are being deployed to make Thar coal a cleaner and more efficient energy source.

Focusing on renewables in independent power production

The government is promoting renewable energy development in the private sector. There are 12 projects under development by independent power producers (IPPs), with a total capacity of 1,563 MW, which are expected to be completed between 2024 and 2026 (Table 2.11). The focus on renewables is evident from the fact that 80.81% of combined capacity (1,263 MW) will come from hydro, solar, wind and bagasse, and only 19.19% (300 MW) involves coal.

Table 2.8: Key initiatives for solar power expansion

Initiative	Details
Fast Track Solar PV Programme	The government has prioritised the rapid deployment of solar PV systems, targeting large-scale solar farms and distributed solar solutions across urban and rural areas The programme aims to streamline approvals, financing mechanisms and grid connectivity to ensure the swift integration of new solar projects
Solarisation of public buildings	Government institutions, educational facilities and healthcare centres are being solarised to promote clean energy adoption and reduce electricity costs The initiative serves as a model for energy efficiency, demonstrating cost savings and environmental benefits to encourage further solar investments in the private sector
Strengthened net-metering systems	Pakistan has made substantial progress in expanding net-metering, allowing residential, commercial and industrial consumers to sell excess solar energy to the grid As of 2024, net-metering-based solar installations have reached 117,807, with a cumulative capacity of 1,822 MW, facilitated by over 400 certified installers The adoption of net-metering has incentivised households and businesses to shift towards solar power, reducing dependence on grid electricity
Moratorium on new fossil fuel-based power plants	Since 2016, the Private Power and Infrastructure Board (PPIB) has enforced a moratorium on new power projects based on imported fuels This policy shift aims to reduce foreign exchange outflows and promote indigenous energy sources, particularly solar and wind
Planned expansion of solar PV capacity	A key initiative involves adding 6,000 MW of solar PV capacity through competitive bidding This strategy is designed to reduce overall generation costs by substituting daytime fossil fuel consumption with solar energy while utilising thermal generation capacity at night to meet peak demand By optimising the use of renewable resources, the initiative aims to enhance grid stability and energy security while ensuring cost-effective electricity generation

Table 2.9: Reduction in share of thermal energy (2021-24)

Year	Source	Installed capacity		Generation	
		MW	Share (%)	GWh	Share (%)
2021-22	Thermal	24,710	59.46	29,181	60.9
2022-23	Thermal	24,095	58.8	43,526	46.2
2023-24	Thermal	25,046	59.45	42,249.20	45.88

Source: GoP, 2021 c; GoP, 2022d, GoP, 2023e.

Table 2.10: Key measures to reduce the share of thermal energy

Initiative	Details
Retirement of aging thermal plants	- Decommissioning of inefficient fossil fuel-based power plants, particularly older oil- and coal-fired plants - Reduction in dependence on imported fossil fuels, easing pressure on foreign exchange reserves
Increased focus on renewable and cleaner energy sources	- Expansion of wind and solar farms, especially in Punjab and Sindh, to replace fossil fuel-based generation - Development of hydrogen and hybrid energy projects, supporting cleaner fuel alternatives - Implementation of energy storage solutions to improve renewable energy integration
Government policies supporting thermal reduction	- Gradual phase-out of coal-based independent power producers (IPPs) in favour of green alternatives - Incentives for renewable energy investors through net metering, tariff adjustments and tax exemptions - Strengthened commitments under the Pakistan Climate Change Policy and Energy Transition Roadmap

Table 2.11: Ongoing IPPs renewable energy projects by independent power producers

Year	Capacity (MW)					
	Wind	Solar	Bagasse	Hydro	Imported coal	Total
2024	-	100	32	884	-	1,016
2025	-	132	-	7	300	439
2026	100	-	-	8	-	108
Total	**100**	**232**	**32**	**899**	**300**	**1,563**

Source: GoP, 2023c.

Challenges in achieving the clean energy transition

Despite progress made, growth in the share of renewables has been slow. Between 2021 and 2024, the share of renewable energy in total electricity generation showed only a slight increase, from 3% in 2021-22 to 4.26% in 2023-24. Although renewable energy capacity is expanding, challenges persist. These include regulatory hurdles and financial constraints as well as issues with grid integration (Table 2.12).

The sector also faces operational inefficiencies that result in a gap between installed capacity and energy generation. This underscores structural challenges that need to be addressed to optimise energy production. While total installed capacity showed a marginal increase, rising from 41,000 MW in 2022-23 to 42,131 MW in 2023-24, total electricity generation declined from 94,121 GWh to 92,091 GWh over the same period. This is the result of operational inefficiencies, as summarised in Table 2.13.

Mitigation measures in the energy sector

Pakistan's approach to achieving NDC targets for the energy sector involves expanding the share of renewables in the energy mix, while removing inefficiencies in the system and reducing reliance on thermal power. Although progress is being made, challenges remain that need to be addressed. These include regulatory obstacles, financial constraints, structural issues and operational inefficiencies. Key measures required to address these issues are presented in Table 2.14.

Table 2.12: Challenges in renewable energy expansion

Challenge	Details
Policy and regulatory uncertainty	- Delays in implementation of renewable energy auctions and procurement frameworks - The slow pace of renewable energy project execution and delays in power purchase agreements have restricted the faster scaling-up of clean energy generation - Need for clearer long-term energy transition strategies with defined investment roadmaps
Financial and investment constraints	- Financing challenges and a lack of incentives for large-scale private sector investments in renewables continue to slow down progress - High up-front costs for solar and wind projects affecting private sector participation - Limited access to concessional climate finance for large-scale infrastructure development
Grid integration issues	- Renewable energy penetration remains constrained by grid capacity limitations and the absence of sufficient energy storage systems - The existing transmission network requires upgrades to accommodate decentralised renewable energy sources more effectively - The lack of grid-scale energy storage solutions further limits the ability to maximise renewable energy potential
Intermittency of renewable energy sources	- Solar and wind power generation is inherently variable, leading to fluctuations in electricity output, particularly during low sunlight and low wind periods - Variability in solar and wind energy production, requiring improved grid stability measures - Need for battery storage and smart grid solutions to enhance reliability
Dependence on fossil fuels	- Continued reliance on imported coal and LNG for base load generation - Gradual phase-out strategies required

Table 2.13: Operational inefficiencies in power generation

Issue	Details
Technical constraints and maintenance issues	- Aging power infrastructure and transmission losses hinder utilisation of installed capacity - Regular maintenance shutdowns of thermal and hydropower plants result in temporary declines in energy output
Fuel and resource availability challenges	- Shortages in fuel supply for thermal power plants can lead to underutilisation of available capacity - Seasonal fluctuations affect hydropower generation, especially during periods of lower water inflows
Economic and financial constraints	- Rising generation costs, exacerbated by currency fluctuations and fuel import dependency, have affected the operational efficiency of power plants - The financial strain on distribution companies (DISCOs) has resulted in load curtailments and inefficiencies in power dispatch, impacting total generation levels
Transmission and distribution losses	- Pakistan's power sector experiences high transmission and distribution losses, contributing to a significant gap between installed capacity and actual energy delivered - Investment in smart grids and transmission system upgrades remains crucial to enhancing capacity utilisation

Table 2.14: Measures to strengthen mitigation actions in the energy sector

Measure	Details
Accelerate renewable energy deployment	- Expedite approval and implementation of renewable energy projects - Fast-track implementation of ARE Policy through transparent bidding processes - Expand off-grid and mini-grid solutions to enhance rural energy access - Strengthen public-private collaboration to de-risk renewable energy investments
Provide financial incentives for decarbonisation	- Seek foreign direct investment and concessional financing for clean energy development - Phase out subsidies for fossil fuels while increasing incentives for renewables - Encourage clean energy financing mechanisms through green bonds and blended finance approaches
Improve grid efficiency	- Strengthen power sector governance to improve financial sustainability and operational effectiveness - Invest in transmission infrastructure to reduce transmission and distribution losses - Implement grid modernisation and energy efficiency measures - Deploy battery energy storage systems (BESS) to stabilise renewable energy output
Optimise power plant utilisation	- Strengthen fuel supply chains for thermal power plants to avoid fuel shortages - Improve hydropower reservoir management to mitigate seasonal fluctuations
Strengthen energy efficiency measures	- Implement building energy codes and industrial efficiency programmes - Promote energy audits and retrofitting initiatives

2.4.2 Transport

The NDC sets ambitious targets for the sector, with a focus on EVs and mass transit. Pakistan has put in place a policy framework, and is now in the process of implementation. Steps taken so far are summarised in Table 2.15.

Scaling up sustainable transport solutions

Efforts are underway across the country to promote EVs and develop mass transit systems that run on clean energy sources. The government is providing incentives to encourage the uptake of EVs and hybrid vehicles (Table

2.16). At the same time, infrastructure is being developed, such as charging stations, to facilitate the uptake of EVs. These initiatives are in various stages of completion.

- **Islamabad Capital Territory**. Islamabad is a key player in the EV transition. In 2024, the Capital Development Authority (CDA) allocated 160 electric buses to feeder routes of the Metro Bus Service, connecting these routes to the broader bus rapid transit (BRT) network. Various operators are installing EV charging stations across the city (PSO Electro, BMW Charge, Solar EV, Attock EV Ultra-Fast) to accelerate the pace of EV adoption. The 'Cycling as Alternative Transport' project is under development to promote sustainable and eco-friendly transportation. As part of this initiative, more than 146 km of dedicated cycling lanes will be developed across the city.
- **Khyber Pakhtunkhwa**. The Peshawar Sustainable BRT Corridor Project, currently underway, aims to serve a population of 0.5 million with a fleet of hybrid EVs.
- **Punjab**. Two major transport projects were approved in 2024, including for the provision of 20,000 electric motorbikes and 657 eco-friendly buses in urban areas. A project for 102 electric buses on 10 new routes is planned for Rawalpindi
- **Sindh**. The Karachi BRT System aims to establish a 30 km fully segregated BRT corridor. It will use the world's first

Table 2.15: Measures to implement mitigation actions in the transport sector

Measure	Details
Development of charging infrastructure	- Expanding EV charging stations across major cities and highways to support the growing EV market - Introducing public-private partnerships to attract investment in fast-charging networks
Green urban transport initiatives	- Deploying electric buses in metropolitan areas of Islamabad, Karachi and Lahore to replace diesel-based public transport - Encouraging non-motorised transport solutions, such as cycling, and building pedestrian-friendly infrastructure
Promoting EVs	- Encouraging adoption of electric cars through incentives such as lower customs duties and sales taxes
Fuel quality improvements	- Gradual phasing out of lower-grade fuels in favour of Euro-V compliant fuel standards - Promoting the use of biofuels and hybrid technologies to reduce emissions intensity

Table 2.16: Incentives for EVs and hybrid vehicles

Vehicle type	Incentives
Electric	- Customs duty on specific parts for EVs: 1% - Reduction of sales tax on locally manufactured EVs with a battery pack below 50 KWH: 1% (down from 17%) - Import of EV CBU: 10% CD for one year (reduced from 25%)
Hybrid	- Customs duty on specific parts for hybrid EVs: 4% - Customs duty on specific parts for plug-in hybrid EVs: 3% - Reduction of sales tax on hybrid vehicles: 8.5% - Reduction in regulatory duty on CBU import of hybrids: 15% for vehicles above 1800 cc, 0% for vehicles of 1800 cc and below

Source: EDB, 2021.

biomethane hybrid bus fleet, powered entirely by a dedicated biogas plant, and will feature last-mile connectivity options. In 2024, Karachi's Peoples Bus Service fleet was expanded, with the addition of 30 hybrid and 50 electric buses.

In addition to these measures, Pakistan is also promoting the use of better-quality fuels. As part of the National Clean Air Policy, the country is set to implement fuel quality standards in the transport sector, aiming to comply with Euro-5 or Euro-6 emissions standards. The goal is to achieve a complete shift to at least Euro-5 fuels by 2025, with a further transition to Euro-6 by 2030. This initiative aims to significantly reduce harmful emissions and improve air quality.

Challenges in implementing sustainable transport solutions

Certain national circumstances complicate the transition to EVs. The high up-front cost of EVs and the lack of sufficient charging infrastructure remain significant barriers for both individuals and public transport operators. Furthermore, Pakistan faces ongoing energy supply constraints, which could be exacerbated by the growing demand from EVs. To maximise impact, the country could benefit from stronger integration between electricity production and transport sector consumption, creating synergies that promote more sustainable energy use. Key challenges are summarised in Table 2.17.

2.4.3 Agriculture

The agriculture sector faces a dual challenge: it is both a victim and a driver of climate change. Agriculture is a critical part of the national economy and a sector that is highly vulnerable to climate change impacts. At the same time, it is one of the most significant contributors to emissions. As such, mitigation actions for the sector must also take into account the need to build a more resilient system for agricultural production.

Building resilience through climate-smart agriculture

Pakistan has launched several initiatives aimed at enhancing resilience and reducing emissions. These efforts focus on improving resource efficiency, reducing emission-intensive practices and increasing climate adaptation measures. Key initiatives include:

Table 2.17: Challenges in sustainable transport expansion

Challenge	Details
High up-front cost of EVs	- Limited affordability remains a key barrier to mass EV adoption, particularly for middle- and lower-income consumers - High import duties on EV batteries and components affect pricing competitiveness in the automotive market
Infrastructure gaps for e-mobility	- EV charging networks remain underdeveloped, with limited charging points across major transport corridors - The lack of battery-swapping stations and fast-charging facilities hinders EV adoption at scale
Electricity supply constraints	- Pakistan's power sector struggles with demand-supply imbalances, and increasing EV adoption may further strain electricity infrastructure - The need for grid modernisation and renewable energy-powered EV charging stations remains a critical priority
Consumer awareness and behaviours	- Low awareness regarding the long-term benefits of EV ownership, including lower operational costs and environmental advantages - Limited local expertise in EV maintenance and servicing, necessitating the development of a trained workforce

- **A ban on crop residue burning** has been imposed in several areas, particularly in Punjab, to curb GHG emissions and mitigate smog-related air pollution. Crop stubble burning contributes significantly to CO2 and CH4 emissions.
- **Development of water infrastructure projects** is underway to mitigate the impacts of drought and water scarcity. This includes the construction of new dams, the refurbishment of nullahs (seasonal streams) and the development of barrages to ensure sustainable irrigation.
- **Risk mitigation and incentive schemes**, such as crop insurance programmes and credit guarantees, are being implemented to protect farmers from climate-related disasters. These initiatives aim to safeguard food production and provide financial security to smallholder farmers.
- **Solar-powered tube wells** are being promoted as an alternative to traditional electric or diesel-powered equipment. This shift reduces dependence on grid electricity, lowers operational costs and provides climate mitigation co-benefits by cutting emissions associated with fossil fuel-based pumping.

Agriculture's limited role in Pakistan's NDC and the need for greater focus

Despite being a significant contributor to GHG emissions, the agriculture sector remains notably absent from direct mitigation targets in the NDC. As a result, the sector's immense mitigation potential remains underutilised, limiting its role in Pakistan's overall climate action strategy.

Including agriculture as a key mitigation focus area within the NDC would provide a comprehensive approach to emissions reduction, while strengthening climate resilience in the sector. Focus areas for emissions reduction include:

- Promoting low-emission agricultural technologies to enhance efficiency while reducing emissions
- Improving resource management, such as water conservation and soil fertility enhancement
- Scaling up climate-resilient agricultural practices to ensure food security while mitigating climate impacts.

Mitigation strategies for the agriculture sector

To maximise its mitigation potential, Pakistan must adopt climate-smart and sustainable farming practices that reduce GHG emissions while enhancing productivity. Key strategies include:

- **Precision agriculture technologies**, such as controlled-release fertilisers and site-specific nutrient management, to reduce N2O emissions
- **Drones and smart irrigation systems** can optimise resource use, curbing excess water and fertiliser application.
- **Agroforestry practices** should be expanded, integrating trees and shrubs within agricultural landscapes to increase carbon sequestration and reduce emissions
- **Conservation tillage techniques**, such as zero tillage, can improve soil health, reduce erosion and minimise emissions from land disturbance
- **Sustainable irrigation methods**, including drip and sprinkler irrigation systems, should be introduces to improve water-use efficiency and reduce over-extraction of groundwater
- **Improved water management in rice cultivation** through alternate wetting and

drying (AWD) irrigation techniques can lower CH4 emissions while maintaining or even improving rice yields.

Livestock and rice cultivation as key mitigation areas

The livestock sector is a major source of CH4 emissions due to enteric fermentation in ruminants.

- **Improved animal husbandry techniques**, including better feed quality, CH4-reducing additives and selective breeding, can reduce CH4 emissions while enhancing productivity
- **Biogas production** from livestock waste can further capture CH4 emissions while providing renewable energy solutions for rural areas.

Rice paddies significantly contribute to CH4 and N2O emissions due to continuous flooded field conditions. Implementing AWD irrigation techniques can substantially lower CH4 emissions while maintaining productivity.

Nature-based solutions for agriculture mitigation

Beyond technological interventions, integrating nature-based solutions in agriculture can offer cost-effective and long-term climate benefits. Some promising approaches include:

- **Soil carbon sequestration** through cover cropping and organic farming practices, which can enhance soil organic carbon levels, improving soil health while sequestering atmospheric carbon.
- **Regenerative agriculture practices** such as crop rotation, reduced chemical inputs and biodiversity conservation, can improve agricultural resilience while reducing emissions.

2.4.4 Forestry

Pakistan has made commitments to expand afforestation initiatives and increase the number of designated protected areas. The goal is to combat deforestation, enhance carbon sinks and promote ecosystem restoration.

Expanding forest cover to support mitigation

Many forestry and afforestation projects are being implemented across the country, from small community-based initiatives to ambitious nationwide programmes. Key large-scale programmes currently being implemented include the following:

- **Green Pakistan Upscaling Programme (Phase-I and Expansion)**. Launched in 2019, this is Pakistan's flagship afforestation project and a key contributor to Pakistan's reforestation targets. Phase-I, with a total cost of PKR 125.2 billion, has successfully met its plantation target of 2.12 billion plants nationwide, achieving an impressive success rate of 75% to 95%. The programme is being expanded for the 2024-2028 period with additional components, including:
    - Carbon finance mechanisms to attract climate investments and strengthen sustainable forest management
    - Scientific resource assessments to improve forestry planning and monitoring
    - Livelihood creation programmes, ensuring that local communities benefit from afforestation efforts
    - Biodiversity conservation strategies to safeguard endangered species and fragile ecosystems.

- **Chilgoza Pine Forest Restoration Project**. The chilgoza pine forests in northern Pakistan are of significant economic importance, given the high market value of chilgoza pine nuts. This GEF-funded project, valued at USD 4.4 million, is currently being implemented with the following objectives:
    - Ensure sustainable management and restoration of chilgoza pine forests, preventing degradation and deforestation
    - Enhance environmental resilience through climate-adaptive forestry practices
    - Support local livelihoods by promoting sustainable harvesting and processing of pine nuts, a key economic resource for local communities.

Exploring the potential of blue carbon

The **Indus Delta Blue Carbon Project** is Pakistan's first initiative in forest carbon trading, emphasising the critical role of coastal ecosystems in carbon sequestration and climate adaptation. The project has set ambitious targets for restoration:

- 2.10 million ha of degraded land and 1.20 million ha of degraded watersheds by 2045
- 0.7 million ha of community forests and woodlots
- 350,000 ha of mangroves over the next 60 years through public-private partnerships.

Activities to date include:

- Development of a National Action Plan for Forest Landscape Restoration, in consultation with national and provincial stakeholders
- Restoration of 75,000 ha of mangroves, with an estimated carbon sequestration potential of 127 million tons. This initiative is expected to directly benefit approximately 43,000 local residents, strengthening coastal resilience, biodiversity conservation and sustainable fisheries.

2.4.5 Other mitigation measures

Pakistan is looking to secure mitigation benefits in other sectors through innovative projects, international partnerships and the use of technological solutions.

Introducing climate-smart municipal service delivery

The **Safe Drinking Water Programme**, Punjab (2023-2032), implemented by the Punjab Saaf Pani Authority (PSPA), is distinguished by its focus on low-emissions technology.

The PSPA has installed 802 state-of-the-art water treatment facilities using low GHG-emitting technology. Each plant is designed to serve around 5,000 people, with a total reach of more than 4 million people across Punjab. Providing clean water for domestic consumers eliminates the need to boil water, reducing the use of fossil fuels or non-renewable biomass, thereby cutting emissions. The programme will achieve 4.3Mt carbon credits over 10 years from 802 water treatment plants under the VCS (Verified Carbon Standard of the VERRA).

The programme is being implemented in partnership with Project Team ATR, a South Korean company focusing on high-quality, large-scale nature-based projects and assisting governments and corporations in achieving net zero.

2.4.6 Social, economic and environmental co-benefits of mitigation actions

Implementation of NDC mitigation actions yield multiple co-benefits that extend beyond emission reductions. These include social, economic and

environmental gains that create jobs, strengthen the economy, build ecosystem resilience and improve the quality of life for all citizens. Key social, economic and environmental co-benefits from mitigation actions are presented in Table 2.18.

2.4.7 Mitigation co-benefits from adaptation actions

Almost all of Pakistan's adaptation actions have mitigation co-benefits. Key projects are presented in Table 2.19.

2.4.8 NDC alignment with Sustainable Development Goals

While Pakistan makes progress on NDC implementation, many initiatives aimed at achieving the United Nations Sustainable Development Goals (SDGs) generate co-benefits for climate change mitigation and adaptation. Similarly, measures that advance the country's climate agenda also contribute to achieving SDG targets. Key areas of alignment between the NDC and SDGs are as follows:

- Expanding clean energy access under SDG 7 (affordable and clean energy) aligns with Pakistan's NDC goal of increasing renewable energy capacity and reducing dependence on fossil fuels. Investments in solar, wind and hydropower will increase access and lower costs for consumers.
- Climate-resilient infrastructure and urban development under SDG 11 (sustainable cities and communities), aligns with NDC mitigation targets to upgrade public transport systems, promote the sale of EVs and strengthen energy efficiency building regulations. NDC adaptation measures for improved disaster preparedness also align with SDG 11.
- Strengthening climate-smart agriculture and sustainable land use under SDG 13 (climate action) and SDG 15 (life on land) are in line with NDC mitigation targets to reduce emissions and improve efficiencies in the agriculture sector, as well as adaptation goals to build resilience in the sector. Afforestation and agroforestry initiatives under the NDC also contribute to SDG 13 and SDG 15.
- Enhancing industrial sustainability under SDG 9 (industry, innovation, and infrastructure) is aligned with NDC targets to lower emissions from industry and transition to cleaner and more energy efficient production systems.
- Improving water resource management under SDG 6 (clean water and sanitation) aligns with NDC adaptation strategies to improve efficiency in water resource management.

2.5 Summary of greenhouse gas emissions and removals

This section presents an overview of Pakistan's GHG emissions and removals for the reporting year 2020-21 (referred to as the 2021 inventory), disaggregated by gas type and source category. The inventory was developed according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, using the tier 1 methodology. Emissions are shown in CO2 equivalent (CO2e), covering the three gases: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). The structure of the inventory is in line with IPCC sector classifications.

The 2021 inventory confirms NDC projections for the same period, with the bulk of emissions concentrated in the agriculture, energy and transport sectors. These findings are a clear reflection of national circumstances, where energy demand is growing, transport requirements are rising and agriculture continues to be a major driver of the economy.

Table 2.18: Co-benefits of NDC mitigation actions

Sector	Co-benefits	Dimension
Renewable energy	Reduced dependence on imported fuel conserves foreign exchange reserves	Economic
	Increased indigenous production improves energy security	Economic
	Hydropower provides base load support, improves grid reliability	Economic
	Renewables have lower generation costs	Economic
	Lower generation costs allow consumer tariffs to be lowered	Economic, social
	Increased access to electricity, particularly in remote areas	Social
	Improved air quality	Social, public health
	Supporting indigenous renewables industry creates green jobs	Economic, social
Transport	Reduced vehicular emissions improve air quality	Social, public health
	Cutting reliance on imported petroleum products lowers costs	Economic
	Improved access to public transport at lower cost	Economic, social
	Mass transport systems improve mobility, social equity, and reduce traffic congestion	Economic, social
	Supporting indigenous EV industry creates green jobs	Economic, social
Agriculture	Investment in green agricultural technologies improves resilience and long-term sustainability	Economic
	Sustainable approaches improve productivity	Economic
	Climate-resilience increases food security	Economic, social
	Climate-smart practices strengthen rural livelihoods	Economic, social
	Technological solutions create green jobs	Economic, social
	Improved land management restores habitats for wildlife	Environmental
	Improved agricultural practices stabilise soil and reduce erosion	Environmental
	Ban on crop residue burning improves air quality	Social, public health
Forestry	Forest cover prevents soil erosion and mitigates flood risks	Economic, social, environmental
	Increased tree cover improves air quality	Social, public health
	Urban plantation reduces heat stress, regulates temperature	Social, environmental
	Afforestation, conservation and sustainable harvesting initiatives support livelihoods	Economic, social
	Sustainable forest management increases resource availability for forest-dependent communities	Economic, social
	Ecosystem restoration through forestry promotes ecotourism, creating jobs	Economic, social
	Forestry initiatives lead to biodiversity conservation through habitat improvement for wildlife	Environmental
Protected areas	Expanding protected areas promotes ecosystem restoration and biodiversity conservation	Environmental, social
	Well managed protected areas encourage tourism, creating jobs for local residents	Economic, social
	Community-based protected areas management builds ownership and promotes environmental stewardship	Environmental, social
	Sustainable resource extraction improves food security and supports livelihoods	Economic, social

Table 2.19: Adaptation actions with mitigation co-benefits	
Adaptation project	**Mitigation co-benefits**
Living Indus	Carbon removal of 2.9 MtCO2eq over project life
Recharge Pakistan	Annual sequestration of 26,450 metric tons
Green Pakistan Upscaling Programme	Sequestration of 148.76 MtCO2 over 10 years
Delta Blue Carbon Project	Sequestration of 127 MtCO2 over project life
Hand-in-Hand Initiative	Objectives include enhancing carbon sequestration
Sustainable and Regenerative Management of Rice Production	Objectives include cutting emissions
Ecosystem Restoration Initiative	Forest restoration to improve carbon sinks
Protected Areas Initiative	Expansion of protected areas from 12% to 15% by 2023 to improve carbon sinks

2.5.1 Overview and of GHG emissions and removals

In 2021, AFOLU was Pakistan's highest-emitting sector, with 46.74% of the country's total GHG emissions. The energy sector followed close behind, as the second-largest source of emissions, accounting for 40.9% of total emissions. In comparison, the contribution of the industrial processes and waste sectors was significantly lower, collectively accounting for 12.35% of total emissions (Table 2.20).

2.5.2 Share of GHG types in total emissions

CO2 is the dominant GHG across all sectors except agriculture, where CH4 is the main GHG emitted. A breakdown of total emissions by GHG type is shown in Table 2.21. This shows that mitigation strategies need to focus on CO2 and CH4 as a matter of priority.

2.5.3 GHG emissions by sector

In line with the 2006 IPCC Guidelines, the 2021 inventory calculates emissions from four sectors: energy, IPPU, AFOLU, and waste. The 2021 inventory shows that the AFOLU and energy sectors together account for over 87% of total emissions, emphasising their centrality in any mitigation strategy. While emissions from the IPPU and waste sectors are comparatively lower, they nevertheless present an opportunity for targeted interventions.

Energy

Energy sector emissions in 2021 are 213.28 MtCO2e, or 40.9% of total emissions. The energy sector is the second-largest contributor to national emissions, with CO2 emissions dominating the sector due to fossil fuel combustion. Emissions are reported under two main sub-categories:

- Fuel combustion activities (208.91 MtCO2e): This includes energy industries (48.87 MtCO2e), manufacturing and construction (72.23 MtCO2e), transport (51.01 MtCO2e), and other sectors (36.80 MtCO2e).
- Fugitive emissions from fuels (4.37 MtCO2e): Resulting from leakages during production, storage and transport of coal, oil and gas.

Table 2.20: Summary of GHG emissions 2021				
Sector	**Sub-sector**	**Emissions (MtCO2e)**		
		By sub-sector	Sector total	Share (%)
Energy	Energy industries	48.87	213.28	40.90
	Manufacturing industries and construction	72.23		
	Transport	51.01		
	Other (commercial, residential, agricultural)	36.80		
	Fugitive fuel emissions	4.37		
IPPU	Mineral industry	27.39	31.98	6.13
	Chemical industry	3.02		
	Non-energy fuel and solvent use product	0.22		
	Other (paper and pulp, food and beverages)	1.35		
AFOLU	Livestock	130.14	243.76	46.75
	Land	34.82		
	Managed soils	66.80		
	Rice cultivation	12.0		
Waste	Solid waste disposal	17.52	32.44	6.22
	Waste incineration and open burning	0.31		
	Wastewater treatment and discharge	14.61		
Total emissions			**521.46**	**100**

Table 2.21: Total emissions by GHG type		
GHG type	**Emissions (MtCO2e)**	**Percentage of total**
Carbon dioxide (CO2)	273.24	52.4%
Methane (CH4)	173.90	33.3%
Nitrous oxide (N2O)	74.32	14.3%

Key drivers: Dependence on fossil fuels, aging energy infrastructure, limited penetration of renewable energy sources.

Mitigation potential: Energy efficiency improvements, electrification of transport, renewable energy deployment, CH4 leak prevention in oil and gas systems.

Industrial processes and product use

IPPU emissions in 2021 are 31.98 MtCO2e, or 6.1% of total emissions. In this sector, emissions are process related, mainly from the mineral and chemical industries.

- Mineral industry (27.39 MtCO2e): Primarily from cement and lime production.

- Chemical industry (3.02 MtCO2e): Driven by ammonia production.
- Other sources (1.57 MtCO2e): Including solvent use, and food and paper industries.

Key drivers: Rapid urbanisation, infrastructure demand, fertiliser production.

Mitigation potential: Process optimisation, substitution of clinker in cement, carbon capture technologies.

Agriculture, forestry and other land use

AFOLU emissions in 2021 are 243.76 MtCO2e, or 46.75% of total emissions. This is the sector with the highest emissions overall, contributing close to half of Pakistan's total GHG emissions. CH4 and N2O dominate the profile due to enteric fermentation, manure management, fertiliser application, and rice cultivation.

- Livestock (130.14 MtCO2e): Methane from enteric fermentation (112.83) and N2O/CH4 from manure (17.31).
- Land (34.82 MtCO2e): Emissions from forest conversion, cropland, wetlands and grasslands.
- Managed soils (66.80 MtCO2e): Emissions from urea use, and direct and indirect N2O from soil systems.
- Rice cultivation (12.00 MtCO2e): Methane emissions from flooded rice fields.

Key drivers: Expanding livestock populations, traditional farming practices, intensive nitrogen fertiliser use.

Mitigation potential: Livestock feed improvement, biogas digesters, AWD in rice farming, improved nutrient management plans.

Waste

Waste emissions in 2021 are 32.44 MtCO2e, or 6.22% of total emissions. In this sector, emissions come mainly from landfills, wastewater and waste incineration.

- Solid waste disposal (17.52 MtCO2e): Predominantly unmanaged landfills.
- Wastewater treatment (14.61 MtCO2e): Includes both domestic (12.39 MtCO2e) and industrial (2.22 MtCO2e) sources.
- Open burning and incineration (0.31 MtCO2e): Uncontrolled combustion practices.

Key drivers: Limited waste segregation, lack of engineered landfill sites, low wastewater treatment coverage.

Mitigation potential: Landfill CH4 recovery, improved solid waste management, scaling up anaerobic wastewater treatment.

Memo items (not included in national totals)

- International aviation and marine bunkers (0.15 MtCO2e): These emissions are reported separately in accordance with IPCC guidelines.
- CO2 emissions from biomass (0.175 MtCO2e): Considered biogenic and reported for transparency.
- Multilateral operations: No emissions reported from multilateral activities on national territory.

2.6 Projections for greenhouse gas emissions and removals

This section presents GHG emission projections for Pakistan under three scenarios: business as usual, stated policies and mitigation.

2.6.1 Assumptions

Pakistan developed its GHG emission projections during the preparation of the Intended Nationally Determined Contribution in 2016 (GoP, 2016a). The same projections were used to set targets against projected emission scenarios in the revised NDC submitted in 2021. The baseline and assumptions have not been updated since.

The baseline year used for projections was 2016. Projections were based on an average GDP growth rate of 7% until 2025, along with demographic changes expected to take place, leading to a rise in emissions across all sectors. Projection estimates also took into account additional economic growth driven by infrastructure development, including initiatives such as CPEC. A substantial gap between energy supply and demand was projected, requiring expansion in energy generation capacity. Peak emissions were anticipated to occur after 2030.

2.6.2 Emissions trajectory

Between 2016 and 2021, Pakistan's total emissions increased by 28.74%, reflecting sectoral growth driven by economic expansion, urbanisation, and infrastructure development. Notably, the agriculture sector has overtaken energy as the largest contributor to national emissions, highlighting shifts in sectoral dynamics. The agriculture sector experienced the most significant absolute increase, with emissions rising by 39.66%. The energy sector, historically the largest emissions source, saw a 14.69% increase, driven by rising energy demand, expansion in power generation, and continued dependence on fossil fuels. While there has been some diversification with increased adoption of renewables and LNG, overall emissions remain on an upward trajectory due to reliance on coal and oil-based power generation. The IPPU sector recorded a 46.00% rise in emissions while the waste sector experienced the steepest percentage increase at 164.04%. Total emissions reported in previous inventories are shown in Table 2.22.

Table 2.22: Total GHG emissions 1994-2021

Year	Total	GHG emissions by sector (%)				
	MtCO2e	Energy	Agriculture	LUCF	Industrial processes	Waste
1994	181.7	47.2	39.4	3.6	7.3	2.5
2008	329.5	51.1	38.2	2.8	5.6	2.2
2008	309.4	50.7	38.8	2.9	5.8	1.8
2012	374.1	45.8	43.5	2.6	5.2	2.8
2015	408.1	45.5	42.7	2.5	5.4	3.8
2018	489.87	44.7	40.4	5.2	5.3	4.4
2021	521.46	**213.28**	**243.76**		**31.98**	**32.44**

2.6.3 Overview of projections under various scenarios

Emissions projections are developed for three scenarios:

- **Business-as-usual** (BAU): This scenario represents the increase in emissions if a country continues on its current development path without any new mitigation measures besides those already in place. This provides a figure against which emission reduction efforts can be measured.
- **Stated Policies Scenario** (SPS): This describes a country's GHG emissions trajectory under the assumption that all officially adopted policies and measures, whether under active implementation or recently approved, are successfully executed without introducing additional mitigation measures. It is a middle-ground projection, reflecting future emissions influenced by national development priorities, sectoral strategies and environmental programmes, but without assuming transformative shifts or externally funded interventions. This makes it distinct from the BAU scenario, which assumes no new action, and the mitigation scenario, which includes ambitious future targets.
- **Mitigation scenario** (MIS): This represents a country's most ambitious GHG emissions reduction trajectory, assuming implementation of all existing policies as well as significant new measures. For Pakistan, this would entail transformative policy and investment interventions across the energy, transport, agriculture, forestry, industry and waste sectors, with domestic financing in addition to substantial international financial and technical support.

Scenario outcomes: 2030 and 2035

Business as usual

- 2030: Emissions rise to ~1,603 MtCO2e, more than three times the 2018 level, driven by fossil fuels, urban waste and expanding agriculture.
- 2035: Emissions exceed 1,820 MtCO2e, representing a high-carbon future with unsustainable economic development leading to greater environmental harms.
- Implication: BAU is incompatible with Pakistan's NDC and global climate goals. It will increase exposure to extreme climate events and economic instability.

Stated policies

- 2030: Emissions stabilise at ~1,360 MtCO2e, about 15% below BAU, as a result of current policy targets for renewable energy, EVs and afforestation.
- 2035: Emissions continue to rise, reaching ~1,490 MtCO2e, well above sustainable levels.
- Implication: SPS meets only the unconditional 15% reduction in the NDC. Without external support, only limited climate action is possible.

Mitigation

- 2030: Emissions fall to ~800 MtCO2e, exactly 50% of BAU, meeting Pakistan's full NDC target (15% unconditional + 35% conditional).
- 2035: Emissions plateau at ~850-900 MtCO2e, marking a potential national emissions peak (under certain conditions).
- Implication: MIS demonstrates Pakistan's

ability to align with international commitments, contingent on timely climate finance, technology transfer and institutional support.

Projections under each of these scenarios are shown in Table 2.23. Details are discussed in the sections that follow.

2.6.4 Emissions under the business as usual scenario

The BAU scenario in this section uses Pakistan's GHG inventory data for 2018 and 2021. These show that 2018 emissions stood at 489.87 MtCO2e and by 2021 had increased to 521.46 MtCO2e. The BAU projection extrapolates from this trend to derive estimates for the year 2030. As noted above, BAU assumes no additional measures are implemented to cut emissions. The projection covers the same sectors included in the GHG inventory (energy, IPPU, AFOLU, waste). For the purpose of the projections, however, agriculture is shown separately from forestry and other land use.

Under the BAU scenario, Pakistan's GHG emissions are projected to rise steeply over the next decade. A summary of BAU projections by sector is provided in Table 2.24.

Energy

By 2030, energy emissions under BAU will rise to 898 MtCO2e, making the energy sector the major contributor to total emissions. Projected emissions for 2030 are calculated based on an accelerated growth scenario for the energy sector, aligned with the government's estimated average GDP growth rate. This scenario anticipates high power sector demand, leading to a substantial expansion of total electricity generation capacity by 2030. The increase will be driven by both domestic and imported coal power plants, along with additional hydropower generation. Continued reliance on thermal power generation is expected under BAU. For the year 2030, the rise in energy sector GHG emission under BAU is projected to be.

Table 2.23: GHG emissions and projections

Year	GHG inventory	BAU	SPS	MIS
2018	489.87	-	-	-
2021	521.46	-	-	-
2030	-	~1,603	~1,360	~800
2035	-	~1,820+	~1,490	~850-900

Table 2.24: GHG emissions for 2016 and BAU projections for 2030

Sector	2016	2030
Energy	185.69	898
Agriculture	174.26	457
Industrial processes and product use	22.04	130
Land use change and forestry	10.20	29
Waste	15.51	89
Total	**408.1**	**1,603**

It is worth noting that some improvements are expected even under the BAU scenario as a result of technological improvements. For example, new power plants are likely to be more efficient. However, these changes are likely to be incremental and not enough to offset emissions resulting from a growth in demand.

IPPU

By 2030, IPPU emissions under BAU will reach 130 MtCO2e. Industrial activity will be a key driver of GDP growth and the economic impact of CPEC is expected to significantly increase trade volumes, with an estimated 24% rise between 2016 and 2020, followed by an additional 16% increase in the 2020-2030 period. As a result, industrial sector emissions are expected to rise.

Agriculture

By 2030, agriculture emissions under BAU will stand at 457 MtCO2e. Historical trends indicate an average annual growth rate of approximately 3%. But to enhance food security and meet the nutritional needs of a growing population, the government has set a minimum growth target of 4%. Improvements in per capita income have already contributed to shifting dietary patterns, a trend expected to intensify over time.

Land-use change and forestry

By 2030, land-use change and forestry emissions under BAU will reach 29 MtCO2e. Projections for emissions from land-use change and forestry are based on significant land use changes and extensive deforestation. Emissions from deforestation will be partially offset by ongoing afforestation initiatives, which are included in the BAU scenario, and are expected to contribute to carbon sequestration.

Waste

By 2030, waste emissions under BAU will rise to 89 MtCO2e. Pakistan has been experiencing rapid urbanisation, leading to a significant increase in overall waste generation and a corresponding rise in emissions from the waste sector. The projected GDP growth rate, combined with an urbanisation rate of 3% per annum, are key factors taken into consideration for the BAU projections, along with increased consumption patterns and inadequate waste management infrastructure.

2.6.5 Emissions under the stated policies scenario

SPS is crucial in assessing Pakistan's emissions outlook in a policy-rich but resource-poor environment. It incorporates the impact of policies such as the Alternative and Renewable Energy Policy 2019, the National Electric Vehicle Policy 2019, the National Energy Efficiency and Conservation Action Plan (NEECAP) 2023-2030, national and provincial clean air plans, and large scale projects such as the Green Pakistan Upscaling Programme as well as incremental improvements. Projections use the tier 1 approach, as set out in the 2006 IPCC Guidelines, ensuring consistency with Pakistan's GHG inventory.

Under this scenario, Pakistan's GHG emissions are also projected to rise but to a lesser degree compared to BAU.

Energy

Energy emissions under SPS are projected to be 780-800 MtCO2e by 2030, approximately 100 MtCO2e less than BAU projection of 898 MtCO2e. These reductions are primarily driven by the implementation of renewable energy targets, fossil fuel transition policies and efficiency interventions.

The energy sector is the cornerstone of mitigation under SPS. The ARE Policy 2019 sets a binding target of achieving a 30% share of renewables in the power generation mix by 2030. This includes grid-connected solar, wind and biomass-based projects, as well as continued development of large hydroelectric projects. By 2025, the share of renewables is expected to exceed 20%, with solar and wind alone contributing around 6-8 GW of new installed capacity. These displace coal, oil and gas plants in the future energy mix.

The moratorium on imported coal-fired power plants further cuts emissions from the electricity sector. Coal that would have entered the system under BAU is no longer part of future capacity additions. Natural gas maintains its role as a transition fuel but its share is diluted as renewables scale up.

On the demand side, the NEECAP introduces mandatory and voluntary efficiency programmes across sectors. Industrial energy audits, building codes, appliance labelling, and transmission and distribution loss reduction programmes contribute to an estimated 35 MtCO2e reduction by 2030.

In transport, the National Electric Vehicle Policy aims for 30% of new vehicle sales to be EVs by 2030. Although EV market penetration remains limited in 2025, consistent policy signals and localised EV assembly are expected to drive uptake. By 2030, SPS anticipates that over 2 million electric two- and three-wheelers and at least 100,000 electric cars and buses will be in operation. These replace fossil fuel-based vehicles and reduce gasoline and diesel consumption. EV charging infrastructure, battery recycling systems and fleet electrification in the public sector will be expanded through provincial and city-level programmes.

Despite these policy measures, fossil fuels, especially natural gas and oil, remain dominant in the overall energy mix under SPS. Without transformational support and measures such as carbon pricing, full decarbonisation remains out of reach in SPS.

IPPU

IPPU emissions under SPS are projected to be 65-70 MtCO2e by 2030, or around half of the BAU level of 130 MtCO2e, but still on an upward trajectory.

Industrial emissions under SPS continue to rise in line with overall economic growth and infrastructure development. Cement production, fertiliser manufacturing, chemicals and metal industries are the primary contributors.

There are currently no dedicated GHG reduction regulations for industrial process emissions. However, many large firms in the cement and fertiliser sectors are adopting cleaner production practices and waste heat recovery systems as part of broader sustainability and environmental compliance strategies.

In cement, the shift toward blended cement (with clinker substitution) and improved kiln efficiency helps marginally reduce emissions intensity. Fertiliser plants gradually upgrade to more efficient technologies and pursue co-generation. Small gains also occur from process optimisation in steel and chemical manufacturing.

Agriculture

Agriculture emissions under SPS are projected to be 270-280 MtCO2e by 2030, compared to 475 MtCO2e in the BAU scenario.

The agriculture sector remains a major emitter, particularly of CH4 and N2O from livestock, rice cultivation and synthetic fertiliser use. Several incremental changes under government-supported programmes moderate emissions:

- Alternate wetting and drying (AWD) is promoted in irrigated rice fields through provincial agricultural extension services, reducing CH4 emissions
- Livestock health and nutrition improvements increase productivity per animal, indirectly reducing CH4 per unit of dairy or meat output
- Soil fertility programmes encourage better use of synthetic fertilisers and integrate organic composting methods, reducing N2O emissions
- Crop residue burning is discouraged under clean air action plans, cutting emissions and improving soil health.

These initiatives are implemented through provincial agriculture departments, with support from national funding programmes and development partners. While they lack binding GHG targets, the cumulative impact yields moderate mitigation by 2030 and a slower growth trajectory toward 2035.

Forestry and other land use

Forestry removals under SPS are projected to be approximately 100 MtCO2e by 2030, compared to emissions of 29 MtCO2e from forestry and other land use under BAU.

The sector transitions from being a net source of emissions to a significant net sink under SPS, driven primarily by afforestation programmes. The Green Pakistan Upscaling Programme, led by the MoCC and executed in partnership with provincial forestry departments, is the largest of these interventions. Sequestration calculations are based on forestry data from the provinces and carbon stock estimates from national forest inventories. The SPS assumes an 80% success rate in survival and maintenance of new plantation.

By 2030, over 3.2 million ha of land are afforested or reforested, with an average annual sequestration rate of 3-4 tons CO2/ha (depending on species and location). Additional removals occur from the restoration of wetlands, protection of mangroves and revegetation of degraded rangelands.

While challenges exist in monitoring and sustaining afforestation gains, forestry is expected to continue functioning as a stable carbon sink under the SPS, making it one of Pakistan's most effective natural mitigation contributions.

Waste

Waste emissions under SPS are projected to reach 55 MtCO2e by 2030, compared to 89 MtCO2e under BAU, with the sector contributing CH4 and N2O emissions from increasing urbanisation and insufficient waste treatment capacity. In SPS, emissions reductions are achieved through:

- Gradual closure of open dumps and transition to engineered landfills in major cities
- Pilot-scale CH4 recovery from landfills in Islamabad, Karachi and Lahore
- Scaling up of urban composting and municipal solid waste segregation initiatives
- Expansion of wastewater treatment plants with anaerobic digesters in large urban centres

While coverage remains limited and enforcement challenges persist under SPS, the sector benefits

from national policy directives under the Clean Green Pakistan initiative, coordinated by the MoCC and implemented by local governments.

2.6.6 Emissions under the mitigation scenario

Under MIS, total emissions will be approximately 800 MtCO2e by 2030, compared to total emissions under BAU of 1,603 MtCO2e. With a 50% decline from BAU, this represents full achievement of NDC targets, both unconditional and conditional. Unconditional reduction measures, based on policies Pakistan will implement using its own resources, account for approximately 240 MtCO2e of this reduction, with an additional 560 MtCO2e of reduction achieved through international climate finance, technology transfer and capacity-building support.

Reductions under MIS are expected to be achieved primarily through focused mitigation efforts in the energy and transport sectors. In addition, MIS assumes large-scale carbon sequestration through afforestation and plantation initiatives.

Energy

With comprehensive measures **under MIS, energy emissions drop to 470-500 MtCO2e by 2030**, down from 898 MtCO2e in BAU, delivering close to 50% of the NDC commitment.

The energy sector is the single largest source of emissions under BAU and the largest opportunity for reductions under MIS. By 2030, Pakistan aims to generate 60% of electricity from renewable sources, including solar, wind and hydropower. Achieving this target requires scaling up renewable capacity from less than 10 GW in 2023 to 35-40 GW by 2030. This transition is achieved through:

- Large-scale solar and wind energy projects, including private sector utility-scale development
- Grid modernisation and battery storage deployment
- Reforms in energy pricing and subsidy structures to favour clean energy
- Complete cessation of new imported coal-fired power plants
- Withdrawal of fossil fuel subsidies, making renewables more competitive
- Natural gas repositioned as a bridge fuel and phased out in the power sector
- Energy efficiency improvements beyond NEECAP, including smart metering, demand-side management, green buildings and industrial electrification.

In transport, MIS assumes full implementation of the EV Policy, with 30% of all new vehicle sales being EVs by 2030. Fleet electrification of public transport systems accelerates the transition. Under MIS, pilot decarbonisation projects for heavy transport begin by 2030 and scale by 2035.

IPPU

Under MIS, IPPU emissions are projected at 60 MtCO2e by 2030, compared to 130 MtCO2e under BAU, representing an estimated 50% reduction compared to BAU.

The MIS envisions a strategic shift in Pakistan's industrial emissions through a mix of efficiency and innovation, implemented with substantial technology transfer and financial support. Key measures include:

- Mandatory clinker substitution in cement production using fly ash, slag and natural pozzolans to reduce process CO2 emissions
- Full rollout of waste heat recovery systems and electrified kilns in cement production
- Pilot deployment of carbon capture, utilisation and storage (CCUS) at two large

industrial facilities by 2030, with international technology partnerships
- Refrigerant transition to low GWP gases under Montreal Protocol obligations, with widespread replacement in air-conditioning and refrigeration appliances.

In addition, MRV systems are introduced in industrial facilities to support performance-based incentives and carbon market participation. These systems are initially donor-supported but become part of national GHG accounting post-2030.

Agriculture

Under MIS, emissions from agriculture are projected at 250 MtCO2e by 2030, compared to 457 MtCO2e under BAU.

The agriculture sector under MIS undergoes modernisation with an emphasis on low-emission farming, productivity gains and climate-smart technologies. Unconditional measures include:

- Expansion of AWD in rice production across Punjab and Sindh, covering up to 50% of paddy fields by 2030
- Improved management practices on approximately 40% of cropland and for 30% of livestock herds
- Improved animal nutrition and health, reducing CH4/kg of milk and meat production
- Farmer training in integrated soil nutrient management to reduce excessive nitrogen fertiliser use
- Elimination of crop residue burning through mulching and biochar.

Conditional measures build on these actions with:

- Deployment of CH4-reducing feed additives in livestock operations
- Establishment of rural-scale biogas digesters across dairy clusters for manure management and renewable energy co-benefits
- Digital MRV tools to track emissions and reductions from rice and livestock interventions.

Forestry and other land use

Under MIS, forestry is expected to sequester 100-120 MtCO2e annually by 2030, offsetting nearly 15% of Pakistan's total emissions.

In this scenario, forestry plays a transformational role as Pakistan's most effective carbon sink. The full implementation of the Green Pakistan Upscaling Programme is assumed. Additional interventions include:

- Expansion of community-managed forests with secure tenure rights
- Protection and reforestation of mangroves in Balochistan and Sindh
- Restoration of wetlands under Recharge Pakistan and other ecosystem-based adaptation projects
- Introduction of agroforestry and silvopasture in degraded lands and farming systems

Pakistan participates in international REDD+ frameworks, and MIS assumes the country receives results-based finance for verified removals and establishing safeguards to avoid reversal of carbon stock gains.

These removals are critical to meeting the conditional portion of the NDC, and their permanence is assured through forest monitoring systems, satellite verification and long-term livelihood incentives for forest-dependent communities.

Waste

Under MIS, waste sector emissions are projected to be 45-50 MtCO2e by 2030, compared to 89 MtCO2e under BAU.

In this scenario, Pakistan's waste sector achieves emission stabilisation and eventual decline through a national-scale transformation. This is achieved through a mix of unconditional policies and conditional, donor-funded infrastructure support. Key actions include:

- Construction of engineered landfills in all provincial capitals and 10 other cities
- Installation of landfill CH4 capture and flaring or energy generation systems
- Widespread rollout of composting facilities, especially for organic municipal waste
- Waste-to-energy plants operational in at least three urban centres (Islamabad, Karachi, Lahore)
- Upgraded wastewater treatment plants with biogas recovery in major cities
- CH4 and N2O emissions from landfills and sewage lagoons are significantly reduced
- Public awareness and behaviour change campaigns complement these measures, reducing open dumping and illegal burning of waste.

2.6.7 Alignment with NDC

Pakistan's NDC commits to reducing emissions by 50% from the BAU scenario by 2030, with a 15% unconditional reduction using national resources and an additional 35% conditional reduction dependent on international support.

Only the MIS achieves the full target, delivering on the 800 MtCO2e ceiling by 2030. **SPS delivers the 15% unconditional reduction**, while **BAU overshoots NDC targets entirely**.

Total emissions for 2021 (521.46 MtCO2e) show that Pakistan is not yet on a mitigation trajectory but also not irreversibly locked into BAU, suggesting that the window for action remains open.

2.6.8 Alignment of BTR GHG projections with Pakistan's forthcoming NDC 3.0

Pakistan is currently preparing its Third Nationally Determined Contribution (NDC 3.0), which will update the country's climate targets and implementation strategies under the Paris Agreement. Emission projections are a critical technical component of the NDC, providing a data-informed analytical framework for assessing ambition, planning sectoral measures and tracking progress.

2.7 Other information relevant to tracking progress on NDC implementation

The financial, technological and capacity development needs for NDC implementation are discussed in Chapter 4. This section focuses on other aspects relevant to NDC tracking.

2.7.1 Use of flexibility provisions

Flexibility provisions under Article 13 allow developing countries to tailor their reporting according to national capacities. Pakistan lacks robust systems to accurately track emissions and assess climate progress. There are also gaps in GHG inventory management. To address these issues, the country has adopted a progressive approach to enhancing transparency by gradually improving reporting methodologies. In the meantime, it applies the following flexibility provisions:

- **Conditional GHG reduction targets**: Pakistan commits to conditional reduction targets. It states that 35% of its overall reduction target

is contingent on international financial, technological and capacity-building support. This acknowledges the country's financial limitations and dependence on external funding.

- **Gradual transition towards full transparency**: Pakistan's NDC outlines plans to improve MRV capabilities, gradually reducing reliance on flexibility provisions over time.
- **GHG emissions reporting**: Pakistan relies on the tier 1 approach using default emission factors provided by the IPCC, in line with flexibility provisions for developing country Parties with data constraints.
- **Simplified reporting formats**: Pakistan has opted for a phased approach to adopting the common reporting tables. Where complete datasets are not available, Pakistan has provided qualitative assessments and projections to supplement missing data.
- **Time-series reporting**: Unlike countries that report GHG emissions annually, Pakistan compiles emissions data at selected time intervals. So far, national GHG emissions have been reported for the years 1994, 2008, 2012, 2015, 2018 and 2021 rather than on a continuous or annual basis. This reporting approach is used because of limited availability of historical data and resource constraints in data collection.

2.7.2 Research, risk assessment and GHG inventory preparation

Limited research has been conducted on the implications of climate change for the country's key economic sectors. Comprehensive vulnerability assessments for high-risk sectors, particularly water resources and agriculture, need to be conducted.

For GHG inventory preparation, a systematic data collection and documentation system is needed. Activity data is currently prepared by the relevant government departments and used by the GCISC but for many sectors the GHG inventory is based on estimates from data for regional countries. Comprehensive and more granular data is required to develop a more accurate GHG inventory.

2.7.3 Strengthening policy and institutional coordination

Climate change may be mentioned in federal policies on sectors that are relevant for NDC tracking and the ministries responsible are aware of the need to integrate NDC targets into their activities but progress to date has been limited. Relatively few policies have identified specific actions to address climate related risks and none have set targets for such actions (Table 2.25).

2.7.4 Continuous improvement for NDC reporting

Current constraints in NDC reporting and recommendations for improvement are presented in Table 2.26.

Comparison with international best practices

Pakistan can improve reporting by learning from global best practices in transparency, data management and governance. These are summarised in Table 2.27.

Adaptive learning

Improving the accuracy and timeliness of national reporting requires a structured approach drawing on past experience. The first step is to review previous reports to identify common challenges and areas for improvement. Integrating real-time adjustment mechanisms ensures that issues identified during reporting cycles can be addressed promptly, building a

Table 2.25: Integration of climate change in national sectoral strategies, policies and plans

Policies	Climate change mentioned as potential risk	Possible actions for reducing risk identified	Targets identified for specific adaption measures
National Agriculture and Food Security Policy	Identified	Identified	Absent
National Disaster Risk Reduction Policy	Identified	Identified	Absent
National Drinking Water Policy	Identified	Absent	Absent
National Environmental Policy	Identified	Absent	Absent
National Forest Policy	Identified	Absent	Absent
National Power Policy	Nil	Nil	Nil
National Sustainable Development Strategy	Identified	Identified	Absent

Source: Parry, 2016.

Table 2.26: Strengthening NDC reporting

Constraints	Measures to enhance transparency and effectiveness	
	Short-term (1-2 years)	Medium-term (3-5 years)
Data collection and quality assurance - Inconsistencies in GHG inventory methodologies - Data gaps - Irregular updates of GHG inventories affect long-term tracking - Limited integration of sectoral data from provinces and industries - Sectoral reporting inconsistencies lead to gaps in data analysis - Lack of standardised reporting mechanisms across agencies - Economic indicators not integrated into emissions tracking	- Strengthen sectoral data collection - Establish data-sharing agreements with key stakeholders	- Establish a centralised climate data repository, integrating inputs from ministries, provincial governments and private sector actors - Achieve full compliance with ETF reporting obligations and global best practices
MRV system - MRV system underdeveloped, not fully operational - Lack of institutional coordination and capacity - RISQ platform integration in progress, requires enhancements	- Improve MRV system functionality by expanding RISQ - Pilot sectoral data integration	- Fully operationalise national MRV system with sector-specific indicators - Enhance transparency through independent third-party verification of emissions data
Institutional and governance challenges - Lack of national NDC Coordination and Implementation Plan - Weak coordination between federal and provincial governments - Shortage of skilled professionals in GHG inventory preparation and climate data analysis	- Capacity-building for provincial and federal agencies on ETF compliance	- Institutionalise NDC Coordination and Implementation Plan for improved governance - Establish permanent Climate Transparency Committee, involving MoCC, Ministry of Finance, Ministry of Planning, and provincial EPAs to streamline BTR and NDC submissions
Alignment with ETF requirements	- Regular stocktake and review mechanism: Biennial stocktaking reviews on NDC progress and compliance with Article 13 of the Paris Agreement - Integration with global stocktake: Ensure BTR aligns with the global stocktake cycle to provide updated, accurate and comparable data at international forums - Climate finance tracking: Enhance transparency in climate finance mobilisation and expenditure, detailing domestic and international sources	

Table 2.27: International best practices for climate reporting

Requirement	Pakistan (current status)	International best practices
Institutional framework	MoCC leads reporting, with limited coordination between federal ministries and provincial departments	Germany, South Korea and the UK have dedicated climate reporting units with structured inter-ministerial coordination
Data management and MRV	Data gaps exist in GHG inventory, NDC tracking and climate finance transparency	Canada and the EU have automated MRV systems integrating data from multiple sectors with real-time access
Third-party verification	Limited third-party review mechanisms for reported data	France and the US involve independent agencies and academia for verification
Climate finance transparency	No tracking mechanisms for domestic and international climate finance	Norway and Sweden publish detailed annual reports on climate finance disbursement and impact
Legislative framework	No legal requirement for provinces or industries to submit climate-related data	New Zealand and South Africa have legally binding climate reporting laws
Alignment with Global Stocktake	Limited integration with GST process.	The EU and Japan align reporting cycles with the GST and UNFCCC synthesis reports

more agile and responsive reporting framework. Key approaches for continuous improvement are presented in Table 2.28.

Stakeholder feedback

Comprehensive consultations were held with federal, provincial and regional stakeholders to align implementation plans with national and international climate objectives. The goal was to include key stakeholders in decision making, increase transparency and agree on monitoring mechanisms for NDC tracking. The process also allowed for data sharing between government agencies and technical experts, helping to establish baselines for emissions, energy consumption and sectoral vulnerabilities. Sectoral priorities were refined based on feasibility, cost effectiveness and the potential to contribute to NDC targets. Key recommendations from stakeholder consultations are summarised in Table 2.29.

Continuous improvement framework

The UNFCCC synthesis report calls for Parties to identify best practices for NDC implementation and continuous improvement. For Pakistan, a framework for continuous improvement can be is structured into key components, as presented in Table 2.30.

Future updates to the NDC

Key considerations for future NDC updates to ensure continuous alignment with evolving standards are presented in Table 2.31.

2.7.5 Improving NDC implementation

Based on the analysis in this chapter, key recommendations for improving NDC implementation are summarised in Table 2.32.

Table 2.28: Approaches to improve reporting effectiveness

Approach	Measures
Structured feedback mechanism	- Stakeholder engagement: Conduct biannual consultations with relevant government agencies, academic institutions, private sector representatives and civil society organisations - Data review panels: Form expert review panels to assess data collection methods and recommend refinements
GHG inventory methodologies	- IPCC Guidelines: Transition from tier 1 to tier 2 and tier 3 methodologies where feasible to improve emissions estimation accuracy - Satellite and AI-based monitoring: Integrate advanced remote sensing and AI tools for land-use and forestry emissions tracking
MRV framework	- Institutional capacity building: Conduct training programmes on MRV procedures for government officials and technical staff - Automated data collection and processing: Implement digital tools to streamline data collection from provincial departments
Data gaps and challenges	- Data standardisation: Develop templates for data submission across sectors - Subnational data collection: Strengthen provincial-level reporting structures to capture more granular data - Sectoral benchmarking and best practices: Enter into data-sharing agreements with international organisations and other countries
Evaluation and revision of reporting practices	- Performance reviews: Conduct annual evaluations to assess the effectiveness of improvements made to reporting methodologies - Lessons learned: Establish a repository of best practices, challenges encountered and mitigation strategies - Flexibility: Adapt methodologies based on emerging scientific research and UNFCCC reporting requirements
Financial and technical support for reporting	- International climate finance: Strengthen engagement with financial mechanisms such as the GCF and GEF for MRV improvements - Technical partnerships: Collaborate with international organisations for capacity-building initiatives and technology transfer - Private sector: Seek partnerships with businesses for enhanced climate data analytics and reporting solutions

Table 2.29: Stakeholder recommendations for NDC tracking

Recommendation	Details
Geographic and sectoral coordination	- Form NDC implementation committees at the provincial and federal level through a centralised forum for knowledge sharing, collaboration, policy formation and implementation - Establish regional task forces to oversee implementation and reporting - Encourage data sharing mechanisms between provinces and the federal government - Identify key performance indicators for provincial and national tracking
Financial tracking and resource mobilisation	- Identify funding gaps and potential sources of climate finance - Incorporate NDC priorities in national budget allocations - Develop transparent mechanisms for tracking climate finance flows
Improving information management	- Establish centralised and integrated data management systems to improve collection and management of climate data
Capacity building	- Conduct training programmes for personnel engaged in climate action implementation
Gender mainstreaming	- Integrate gender-responsive approaches in climate action strategies to address inequalities
Advanced MRV systems	- Strengthen institutional capacity for implementing automated MRV systems, leveraging real-time data assimilation and predictive modeling techniques
Interoperability of reporting frameworks	- Align national MRV protocols with the ETF, ensuring compatibility with IPCC tier 2 and tier 3 methodologies for emissions inventories
Industry-specific emissions accounting	- Develop sector-specific GHG accounting frameworks for energy, agriculture and industrial processes, incorporating Scope 3 emissions into corporate climate disclosures
Standardised emissions estimation methods	- Establish sector-specific emissions factors based on regionally calibrated IPCC methodologies, ensuring consistency across all reporting entities
Research collaborations	- Encourage partnerships between government agencies, universities and climate research centres to enhance methodological robustness
Sustainable financing for technological integration	- Secure long-term financial support for deploying AI-powered MRV systems
Independent verification mechanisms	- Implement third-party audits and certification processes for reported climate actions to enhance transparency and credibility

Table 2.30: Continuous improvement framework

Component	Lead agencies	Actions	
		Short-term (2025-2027)	Long-term (2028-2030)
Governance and institutional strengthening	Ministry of Climate Change and Environmental Coordination (MoCC)	- Establish dedicated NDC Reporting and Compliance Unit (NRCU) - Strengthen coordination with provincial environmental agencies and sectoral ministries - Develop and implement capacity-building roadmap for relevant stakeholders - Conduct preliminary assessment of pre-2020 efforts to identify gaps and needs and develop NDC roadmap - Institutionalise climate policy development within joint planning frameworks by integrating climate considerations into national and sectoral policies	- Institutionalise NRCU as a permanent body - Develop legal frameworks for mandatory reporting by sectors - Incorporate experience and lessons learned from NDC preparation and implementation efforts - Mainstream NDC goals in existing strategies, plans and policies to obtain political support and benefit from existing governance arrangements
Data collection and management	Pakistan Bureau of Statistics (PBS), provincial EPAs, sectoral ministries	- Develop National GHG Inventory System (NGHGIS) for systematic data collection - Ensure integration of sector-specific data (energy, agriculture, forestry, waste, industrial processes) - Conduct biannual data validation exercises with independent experts - Develop planning and reporting systems for transparency and public scrutiny - Conduct preliminary assessment of pre-2020 efforts to identify gaps and needs in data collection	- Implement automated and real-time data collection systems - Expand NGHGIS to include regional and community-level emissions tracking - Establish scientific and quantitative system for analysing and assessing implementation progress - Strengthen collaboration with international organisations to adopt best practices in climate data reporting
Methodological enhancements	MoCC, GCISC	- Adopt updated IPCC Guidelines (2019 refinement) and align sectoral methodologies - Conduct periodic reviews of emission factors and data sources - Incorporate experience and lessons learned from NDC preparation and implementation efforts into future methodological refinements	- Develop national emission factors for key sectors - Establish research partnerships for continuous methodological innovation - Integrate findings from stakeholder consultations to refine methodologies and enhance reporting accuracy
Capacity building and stakeholder engagement	MoCC, international development organisations	- Organise NDC capacity-building workshops for government and private sector stakeholders - Develop online NDC Reporting Portal to facilitate engagement - Conduct annual stakeholder consultations to incorporate feedback - Conduct extensive stakeholder consultation and peer review to enhance understanding of the NDC - Strengthen stakeholder capacity to participate substantively in NDC preparation and implementation by developing sector-specific training modules	- Establish national network of climate data contributors - Develop specialised training programmes for local government bodies - Partner with regional and international organisations to build institutional capacity for climate governance
Transparency and international compliance	MoCC, UNFCCC, development partners	- Establish third-party review mechanism for independent verification - Publish biennial NDC progress reports aligned with the ETF - Submit updated NDC every five years with interim updates - Partner with regional and international organisations to develop a robust NDC	- Develop integrated climate monitoring and reporting system - Establish mechanisms for real-time tracking of policy impacts - Implement international best practices to enhance credibility and robustness of NDC targets and commitments

Table 2.31: Key considerations for future updates

Theme	Measures
Economy-wide absolute 2030 target	- Pakistan's mitigation framework includes economy-wide targets covering energy, transport, agriculture and industry - The NDC integrates provincial action plans to improve nationwide mitigation effectiveness - Future updates will include clear economy-wide absolute targets with transparent methodologies and progress tracking
Carbon budget aligned with 1.5°C	- Pakistan has yet to develop a formal carbon budget but aims to align future climate action with the 1.5°C pathway through targeted sectoral interventions - The 2021 NDC aligns with low-carbon development strategies supported by national and international financing mechanisms - Future NDC will integrate decarbonisation roadmaps for key emitting sectors, including energy, transport and industry
Clear adaptation objectives	- Pakistan's NDC and BTR emphasise adaptation in water resource management, agriculture and disaster risk reduction - The NAP focuses on strengthening climate resilience in vulnerable communities - A loss and damage component will be introduced, with risk assessments and quantification of climate-induced loss and damage
Just transition and inclusiveness	- Pakistan's NDC recognises the importance of a just transition, emphasising green job creation and gender-responsive climate action - Stakeholder consultations include civil society, academia and the private sector to ensure participatory decision making - The inclusion of indigenous peoples, labour unions and marginalised groups in climate decision-making processes needs to be strengthened
Strengthened MRV and transparency framework	- Pakistan is establishing an MRV system under the BTR framework - A National Climate Data Repository is being developed to improve data collection and reporting consistency - Future updates will align MRV systems with Global Stocktake outcomes and UNFCCC reporting standards - Clarity and transparency measures will be enhanced by ensuring that MRV system aligns with international best practices, including sectoral GHG accounting, data-sharing mechanisms and independent third-party verification - Progress reports will be published regularly to track implementation of NDC targets and ensure alignment with the evolving climate governance framework
Linkages with SDGs	- The NDC aligns with multiple SDGs, including SDG 13 (Climate Action), SDG 7 (Affordable and Clean Energy), and SDG 15 (Life on Land). - Co-benefits of climate action include improved air quality, energy security and biodiversity conservation - Pakistan will integrate climate and biodiversity actions, ensuring alignment with the Kunming-Montreal Global Biodiversity Framework
Future roadmap and continuous improvement	- Pakistan plans to update its NDC every five years in line with the Global Stocktake process - Future revisions will emphasise enhanced financing mechanisms, adaptation planning and integration of carbon markets - Pakistan will ensure that its NDC aligns with the latest Global Stocktake findings, using scientific assessments and climate models to refine its mitigation and adaptation strategies - Transparency frameworks will be strengthened to ensure accountability in the implementation of NDC commitments, with regular updates to reflect progress and gaps

Table 2.32: Recommendations for improving NDC implementation

Recommendation	Details
Develop a robust MRV system	- Establish an MRV system to improve GHG inventory management - Track emission trends and projections to support mitigation strategies - Define sectoral adaptation priorities and identify key policy actions
Enhance climate finance capacities	- Strengthen access to climate finance for priority mitigation sectors - Build capacity to access international finance via carbon markets - Ensure adaptation remains a high-priority area for funding - Update and analyse public sector climate expenditures to align with national policies and development plans
Develop an NDC implementation plan	- Develop an eight-year NDC implementation plan aligned with the Sustainable Development Goals - Conduct periodic stocktaking and reviews of NDC progress in line with the UNFCCC process - Prioritise policies and measures to meet new NDC commitments
Assess and finance NDC implementation	- Conduct cost assessments for mitigation and adaptation targets - Develop sector-specific financing strategies for NDC implementation - Establish a roadmap to achieve net-zero targets, leveraging international climate finance
Operationalise a dedicated climate fund	- Develop a mechanism to operationalise the Loss and Damage Fund - Address existing funding gaps in climate resilience initiatives
Encourage corporate sector participation	- Mobilise the corporate sector to support climate finance and mitigation efforts - Encourage private-sector involvement in sustainable climate action
Strengthen institutional capacities	- Build institutional capacity at the federal and provincial levels - Ensure civil society organisations play an active role in supporting climate governance
Establish a national steering mechanism	- Create a National Steering Mechanism to track NDC implementation - Integrate provincial stakeholders and civil society organisations into climate action plans - Assess institutional capacities and review regulatory frameworks for effective NDC implementation
Engage multiple stakeholders for NDC alignment	- Launch a multi-stakeholder process to integrate NDC targets into government projects - Strengthen awareness campaigns to enhance NDC implementation - Assign a central role to the MoCC in coordinating efforts
Foster international collaboration for the implementation of NDC targets	- Strengthen collaboration between the MoCC and funding mechanisms such as the GCF, GEF and AF - Foster scientific research, capacity-building and technology transfer to support NDC implementation. - Mobilise international finance, such as grants and concessional loans, to secure funding for climate action projects

Chapter

3

Climate change impacts and adaptation under Article 7 of the Paris Agreement

3. Climate change impacts and adaptation under Article 7 of the Paris Agreement

3.1 National circumstances, institutional arrangements and legal frameworks

The climate adaptation narrative has gained criticality in Pakistan following the repeated occurrence of climate-related disasters across the country, leaving devastation in their wake. Extreme weather events have severely impacted the country's agriculture, water resources, ecosystems and communities, as well as the national economy. Global and regional projections point to the country's increased vulnerability to climate impacts in the years ahead. Recognising the need to build resilience, adaptation has become the central pillar of Pakistan's climate and development policy.

3.1.1 National circumstances

Pakistan's geography exposes the country to a range of climate risks. Agriculture, the largest sector of the economy, is highly vulnerable to the effects of climate change. Added to this is the pressure of population growth, making Pakistan's climate challenges particularly complex.

Geography

In the north and north-west stand some of the world's highest mountains, interspersed with glaciers that serve as reservoirs for the country's freshwater resources. These areas face significant climate-related challenges, particularly glacial melt, which affects water availability and increases the risk of glacial lake outburst floods (GLOFs).

The central and eastern parts of the country are the backbone of Pakistan's agricultural economy. This region, nourished by the Indus River and its tributaries (Beas, Chenab, Jhelum, Ravi and Sutlej), supports the cultivation of important crops such as wheat, cotton and rice. The Indus River Plain is highly vulnerable to shifting rainfall patterns, reduced river flows and the impacts of glacial melt.

In the west, the Balochistan Plateau is an arid expanse faced with rising temperatures, climate-induced shifts in monsoon patterns and decreased rainfall. In the southeast, the Thar Desert extends into Sindh province and beyond into India, while the Cholistan Desert lies in southern Punjab. In these arid regions, prolonged drought has led to severe water scarcity, threatening agriculture. The fragile ecosystems in these areas are also becoming increasingly water-stressed, leading to biodiversity loss and speeding up the pace of desertification.

Pakistan's coastline stretches approximately 1,050 km along the Arabian Sea, from the western border with Iran at Jiwani to the eastern border with India at Sir Creek, traversing the provinces of Balochistan and Sindh. Coastal areas are vulnerable to rising sea levels and frequent cyclone activity, which destroy livelihoods and displace entire communities (Weeks et al., 2023; Noman et al., 2022).

Climate

Pakistan falls predominantly within the subtropical zone, partially extending into

temperate regions (Farooqi et al., 2005). The country experiences four seasons, the onset and duration of which vary according to the location. Winter is generally dry, with temperatures in the plains between 4°C and 20°C, while mountain regions can drop to as low as -50°C. The area weighted precipitation during the winter is around 30% of total annual rainfall. Spring is pleasant with mild temperatures up to 25°C, with area weighted rainfall at around 12% of total annual rainfall

Summer in the plains and coastal areas is characterised by temperatures from 30°C to extremes as high as 50°C. In mountainous regions summer temperatures remain comparatively mild. The weather is usually dry, except during the monsoon from mid-June to September. Monsoon rainfall accounts for nearly 55% of annual precipitation. In the autumn or post-monsoon season, temperatures range between 10°C to -4°C in hilly areas. Rainfall during autumn is around 4% of total area weighted annual precipitation.

Pakistan's climate is highly variable, with significant fluctuations in rainfall patterns leading to recurring droughts and floods. This variability is influenced by phenomena such as El Niño, which impacts both temperature and flood frequency, but also increasingly by the effects of climate change.

Demographics

Pakistan is the sixth most populous country in the world, with an estimated 241.47 million people as of 2023 (PBS, 2023a). Population density stands at approximately 303 individuals per sq km, with the majority of the population (61.18%) living in rural areas (PBS, 2023b).

The total fertility rate is 3.7 children per woman (PBS, 2020b), placing Pakistan among the countries with the highest fertility rates in the Asia-Pacific region (PRB, 2025). With an average annual growth rate of 2.55%, the country is projected to become the fifth most populous country globally by 2050.

As of 2023, more than one third of the population (37.2%) is estimated to live below the poverty line, defined as earning less than USD 3.65 per day (WB, 2023).

Economy

Agriculture is the largest sector of Pakistan's economy, employing close to half of the country's labour force and accounting for 23% of GDP (PBS, 2022b). It is also one of the sectors that is most vulnerable to the impacts of climate change, with intense pressure on agricultural land, increasing water scarcity and changing weather patterns putting food security at risk and threatening the livelihoods of millions of farmers.

3.1.2 National institutional arrangements

This section describes the federal institutions and entities responsible for various aspects of climate governance, including planning and implementation of initiatives related to climate adaptation, data collection, climate modelling and disaster risk reduction.

Ministry of Climate Change and Environmental Coordination

Responsibility for climate policy and planning lies with the federal Ministry of Climate Change and Environmental Coordination (MoCC). The MoCC develops national policies, plans and strategies

related to climate action and environmental protection. It serves as the national focal point for multilateral environmental agreements to which Pakistan is a signatory or Party. The MoCC works with other federal ministries and provincial departments to coordinate climate action and facilitate integration of climate change considerations across all sectors of the economy.

The MoCC has notified two national committees to steer climate governance and coordination:

- Prime Minister's Committee on Climate Change: Provides high-level strategic guidance and serves as a platform for coordination
- National Climate Change Policy Implementation Committee: Responsible for the monitoring and updating of the National Climate Change Policy every five years.

The MoCC recently established an Adaptation Working Group (AWG), led by Ministry of Water Resources and chaired by the Federal Flood Commission. The AWG is supported by various sectoral working sub-groups consisting of federal and provincial policy makers, scientists, technical experts and other stakeholders.

Pakistan Climate Change Authority

The Pakistan Climate Change Authority (PCCA) is mandated to formulate national adaptation policies and programmes to address the effects of climate change. It is responsible for the development of the NAP and supports the preparation of provincial and local adaptation action plans. It advises the government on legislative, policy and implementation measures and actions related to disaster preparedness, capacity building, institutional strengthening and awareness raising. The Pakistan Climate Change Authority is a key institution in terms of the sustainability of the NAP process.

Pakistan Climate Change Council

The Pakistan Climate Change Council (PCCC) approves and monitors the activities of the PCCA, including initiatives to meet Pakistan's obligations under international climate agreements and to achieve the United Nations Sustainable Development Goals (SDGs). It monitors implementation of the NAP and subnational action plans. Chaired by the Prime Minister, the PCCC includes provincial chief executives and representatives from relevant ministries, as well as members from academia, civil society and the private sector.

Pakistan Climate Change Fund

The Pakistan Climate Change Fund (PCCF) has yet to be operationalised. Its purpose is to serve as the financial mechanism to carry forward the NAP process. Once established, it will provide financial assistance to projects related to climate adaptation and mitigation, sustainable development and climate change research. It will rely on multiple funding sources including donations, endowments, grants and gifts, in addition to funds raised by the PCCA.

National Disaster Management Authority

The National Disaster Management Authority (NDMA) is responsible for disaster management across the country. It prepares risk assessments, develops action plans and disaster risk reduction strategies, and oversees preparedness and resilience building activities carried out by provincial disaster management authorities (PDMAs). The NDMA is the national focal point for the Sendai Framework for Disaster Risk Reduction.

In recent years the NDMA has improved its capacity across the board, strengthening disaster response and rescue services, coordinated nationwide through the PDMAs. It has launched a powerful numerical weather prediction model to generate medium-range weather forecasts for the South Asia region, with focus on Pakistan.

National Disaster Risk Management Fund

The National Disaster Risk Management Fund (NDRMF) provides grants for projects that strengthen Pakistan's resilience to climatic and other natural hazards, and for activities to strengthen disaster response. The NDRMF has entered into partnerships with a number of international donors, and has improved transparency in proposal evaluation, grant approval and spending.

Pakistan Meteorological Department

The Pakistan Meteorological Department (PMD) provides weather forecasts and information on climate and geophysical phenomenon to government institutions and other organisations. PMD data is used to issue alerts for extreme weather events, provide weather forecasts for agriculture and other sectors, monitor climate change trends and impacts, and make climate projections for disaster risk reduction, mitigation and adaptation strategies.

The PMD issues impact-based forecasts and weather warnings 3-7 days ahead of time. It has greatly improved its monitoring and forecasting capabilities in recent years, switching to computerised weather prediction, enhancing its radar network, improving data analysis and training staff.

Food Security and Climate Change Cell

The Ministry of Planning, Development and Special Initiatives (MoPDSI) established the Food Security and Climate Change Cell to monitor the impact of climate change on food security, with an emphasis on agricultural yields. The Cell advises research institutions on crop growth and development in the context of climate change.

Global Climate-Change Impact Studies Centre

The GCISC is the MoCC's research arm. It is responsible for conducting research, policy analysis and capacity building. It supports planners and policymakers on issues related to climate change impacts on key sectors. The GCISC serves as the secretariat for the AWG.

Pakistan Bureau of Statistics

The Pakistan Bureau of Statistics (PBS) is the country's premier data collection and statistical analysis agency. It conducts household and standard of living surveys, and compiles a variety of reports and datasets covering social and economic indicators. It publishes the Compendium on Environment Statistics, based on data collected through secondary sources.

3.1.3 Provincial institutions and agencies

In addition to institutions at the federal level, a number of provincial agencies and departments play a role in climate governance and implementation of adaptation measures at the local level, as follows:

- Balochistan Environment Department: Responsible for addressing environmental pollution, including though the improper discharge of industrial effluents. It enforces the National Environmental Quality Standards (NEQS) and other environmental regulations.
- KP Climate Change Forestry, Environment and Wildlife Department: Responsible for

integrating climate resilience into development plans, enhancing carbon sequestration and optimising climate finance. Through initiatives like the Green Growth Strategy and Urban Forestry Policy, KP aims to reduce emissions, protect forests and bolster community resilience.

- KP Climate Change Cell: Part of the KP Planning and Development Department, the Cell coordinates policy input and capacity building, connects provincial stakeholders with national and international climate initiatives, and supports climate-responsive planning.
- Punjab Environment Protection Department: Responsible for the protection, conservation, rehabilitation and improvement of the environment, the prevention and control of pollution, and the promotion of sustainable development in the province.
- Sindh Environment, Climate Change and Coastal Development Department: Its responsibilities include addressing climate change impacts, conserving the environment and managing coastal areas. It formulates policies and coordinates initiatives to promote sustainability, resilience and ecological protection across the province.

3.1.4 National legal and policy framework

Key policies and laws related to climate governance and adaptation are discussed in this section, along with the main challenges for implementation.

National Climate Change Policy 2021

The National Climate Change Policy (NCCP), initially developed in 2012 and comprehensively updated in 2021, is Pakistan's first policy document to emphasise adaptation as a priority. The policy identifies key sectors such as agriculture, water, forestry and health for targeted adaptation actions. In addition to provisions for mitigation, the policy focuses on strengthening the adaptive capacity of communities and building resilience in climate-vulnerable sectors like agriculture, water and energy. It calls for strengthening institutional capacity, fostering regional collaboration and promoting community-led adaptation.

Framework for Implementation of Climate Change Policy 2013

This document was developed after the approval of Pakistan's first National Climate Change Policy, released in 2012. It highlights the vulnerabilities of various sectors to climate change (water, agriculture, forestry, coastal areas, biodiversity, health, ecosystems) and provides a broad framework for climate change adaptation and mitigation efforts, outlining actions related to disaster preparedness, capacity building, institutional strengthening and awareness raising.

Pakistan Climate Change Act 2017

The Pakistan Climate Change Act 2017 provides for the establishment of mechanisms to address climate change impacts and fulfil Pakistan's obligations under international climate agreements. These include the Pakistan Climate Change Council and Pakistan Climate Change Authority, which are responsible for overseeing the implementation of climate policies and adaptation and mitigation measures. It also provides for the establishment of the Pakistan Climate Change Fund, which has not yet been operationalised.

Updated Nationally Determined Contributions 2021

The NDC notes that adaptation is the cornerstone of Pakistan's climate response. It aims to address the country's climate-induced

vulnerabilities while reducing poverty and ensuring a stable economy. It outlines sector-specific adaptation measures to build resilience. These include:

- Promoting climate smart inputs and management practices in agriculture, and improving irrigation and water management
- Building resilience through nature-based solutions and the protection of ecosystems and biodiversity
- Mitigating impacts of extreme events through preparedness and capacity building
- Strengthening the climate resilience of communities.

National Adaptation Plan 2023

The NAP provides a strategic framework to build climate resilience through comprehensive measures across multiple sectors. It aims to integrate climate change adaptation into development processes, projects and strategies. It identifies six sectors for priority interventions. The NAP sets out an implementation strategy covering issues such as policy cohesion, coordinated governance, operational planning, resource mobilisation, monitoring and evaluation, and public communications. (Details of these provisions are discussed below.)

Climate Change Gender Action Plan 2022

Pakistan's first Climate Change Gender Action Plan (ccGAP) aims to ensure that gender considerations are integrated into climate action. It calls for women to be involved in decision-making processes and to benefit equally from climate initiatives. It recognises that while climate change impacts all of society, women and girls are disproportionately affected. The plan focuses on six priority sectors: disaster risk reduction, agriculture and food security, forests and biodiversity, integrated coastal management, water and sanitation, and energy and transport.

National Water Policy 2018

The National Water Policy addresses the critical challenges posed by water scarcity and the need for sustainable water management. It provides a framework for the development, conservation and efficient use of water resources to ensure water security, food security and energy security.

Federal Flood Protection Plan IV

This ambitious plan proposes a combination of structural and non-structural interventions to build flood resilience. Structural measures include the construction of flood protection and management infrastructure, and refurbishing aging infrastructure. Non-structural measures include upgrading flood forecasting and warning systems, conducting studies on watershed management and flood prevention, and capacity building for institutions dealing with flood management.

National Food Security Policy 2018

The National Food Security Policy seeks to address the critical challenges of food insecurity, malnutrition and poverty in Pakistan. The policy provides a framework to ensure food availability and stabilise supply systems. It discusses the agriculture-water nexus in light of the climate impacts on both sectors. The policy includes a long-term agricultural growth strategy, with a focus on productivity improvement, climate resilience and physical expansion.

National Forest Policy 2015

The National Forest Policy provides a framework for the expansion, protection and sustainable use

of Pakistan's forests, protected areas, natural habitats and watersheds. It aims to restore ecological functions and improve livelihoods. The policy addresses the challenges posed by deforestation and forest degradation, and the need for a unified national approach to forest management.

3.1.5 Provincial legislation and policies

The provinces have developed their respective climate change policies, outlining adaptation priorities based on local needs. The provinces are also developing action plans aligned with their policies, incorporating measurable targets for priority interventions. The NAP recommends that provinces prepare provincial adaptation plans and this process is underway. Local adaptation plans are also being developed at the district level. This devolution of the planning process ensures that adaptation measures address identified vulnerabilities and challenges at the community level. Key provincial policies are as follows:

- Balochistan Climate Change Policy 2024: Aims to create a climate-resilient province with a comprehensive framework for adaptation, mitigation and resilience building. Key measures include improving water resource management, promoting climate-smart agriculture and strengthening disaster preparedness. The policy prioritises sustainable resource use, biodiversity conservation and capacity building for vulnerable communities. It emphasises gender inclusivity.
- KP Climate Change Policy 2022: Prioritises adaptation by building resilience across critical sectors, with an emphasis on agriculture, forestry, water resources and health. Adaptation strategies include promoting climate-smart agriculture, improving water conservation and storage, protecting biodiversity, and strengthening disaster preparedness.
- Punjab Climate Change Policy and Action Plan 2024: Emphasises adaptation to protect ecosystems and communities. Key measures include ensuring water security through conservation and improved infrastructure, strengthening disaster resilience with early warning systems, and integrating adaptation into the healthcare system. The plan promotes social protection for vulnerable populations and calls for gender-responsive approaches.
- Sindh Climate Change Policy 2022: Outlines adaptation measures to build resilience across vulnerable sectors. The policy includes socio-economic measures to address poverty, health initiatives to combat climate-related diseases and agriculture improvements to support climate-resilient crops. It emphasises water resource management, biodiversity conservation and disaster preparedness to address the risks of floods, droughts and heatwaves, and to protect livelihoods and infrastructure.

3.2 Climate impacts, risks and vulnerabilities

This section discusses observed climate trends and their impact on key sectors.

3.2.1 Current and projected climate trends and hazards

Pakistan's climate has undergone significant changes over the last several decades. This section provides an overview of observed climate trends.

Temperature rise. The country has experienced a steady rise in average annual temperatures, increasing by 0.16°C per decade from 2001 to 2023. In fact, every decade in the 21st century

has seen record breaking temperatures across the country and projections suggest this trend will continue.

Heatwaves. During the last decade, the country has experienced extreme heatwaves, with temperatures regularly exceeding 40°C in many parts of the country. Rising temperatures, coupled with the increase in humidity, are making such areas increasingly uninhabitable.

Unpredictable rainfall. Precipitation patterns are becoming erratic, with an increasing trend observed from 1951 to 1970 (+0.80 mm/decade) and a declining trend ever since. Rainfall declined by 5 mm/decade in 1971-1990 and 4.68 mm/decade in 1991-2020.

Glacial melt and water scarcity. Rising temperatures are accelerating glacial melt, leading to significant challenges in water management, disaster risk planning and long-term sustainability.

Sea-level rise. Rising sea levels have submerged large swathes of the Indus Delta, inundating agricultural land and displacing communities. Coastal erosion has intensified, threatening key infrastructure such as ports, roads and housing.

Extreme weather events. Recent decades have seen devastating floods causing widespread displacement and loss of life, along with damage to homes, land and infrastructure. Flooding is a persistent threat, leading to river overflows and landslides. Droughts are becoming more frequent, as are heatwaves. Coastal areas are battered by tropical cyclones and storm surges.

3.2.2 Sectoral vulnerabilities

The impacts of climate change on key socio-economic sectors are discussed in the sections that follow.

Agriculture

Climate change poses a severe threat to agricultural productivity. Pakistan relies heavily on the Indus River system, with 90% of water use in the country applied for irrigation. Reduced river flows from melting glaciers makes water supply increasingly unpredictable.

Rising temperatures affect crop yields, with wheat, rice and maize particularly vulnerable to heat stress. The hotter climate also promotes the spread of pests and diseases. Shifting weather patterns bring untimely rains, often in the wheat harvesting and threshing season, inflicting heavy pre- and post-harvest losses.

Extreme weather events have a long-term impact on agricultural land and farming communities. The 2022 floods inundated millions of acres of farmland, destroying crops, disrupting agricultural activities and leaving millions of farmers without a source of income.

Livestock, a major component of Pakistan's agricultural economy, is also at risk. Heat stress reduces animal productivity, while floods and droughts kill animals and destroy grazing lands and fodder supplies.

Water

Pakistan is already one of the most water stressed nations in the world and climate change is exacerbating this situation. Reduced glacier melt and erratic rainfall patterns will further reduce water availability, affecting agriculture, domestic consumption and hydropower production. Rising temperatures also increase evaporation rates, further depleting water resources in reservoirs, rivers and lakes.

Energy

The country's reliance on hydropower, which accounts for around 30% of its electricity generation (NEPRA, 2021), makes it highly vulnerable to changes in water availability. Reduced river flows due to glacial melt and erratic rainfall patterns will reduce the generation capacity of hydropower plants, leading to energy shortages. At the same time, the increased demand for cooling during heatwaves will place additional strain on the power grid, increasing the frequency of loadshedding and power shortages.

Infrastructure

Floods, heatwaves and extreme weather events damage roads, bridges, buildings and communications infrastructure. Urban areas, particularly Karachi, are increasingly facing challenges as population growth and climate change exacerbate the strain on existing facilities. Poor urban planning makes it difficult to mitigate climate-related risks. Rural infrastructure is also at risk from extreme weather events, with floods and GLOF events destroying homes, wiping away roads and bridges, and leaving communities stranded.

Health

Rising temperatures contribute to the spread of heat-related illness and disease. Heatwaves are a growing public health crisis, particularly in urban centres like Faisalabad, Karachi, Lahore and Multan. Prolonged exposure to extreme heat leads to heatstroke, dehydration and cardiovascular stress, disproportionately affecting vulnerable populations such as children and the elderly, along with outdoor workers. Healthcare facilities struggle to cope during such events.

Flooding and stagnant water after heavy rains increase the prevalence of waterborne diseases such as cholera and typhoid. The 2022 floods triggered widespread outbreaks, particularly among displaced populations with limited access to clean water and sanitation (PDMA Sindh, 2022). Similarly, mosquito-borne illnesses like dengue and malaria are becoming more common as warmer temperatures and flooding create ideal breeding conditions for mosquitoes.

3.2.3 Socioeconomic vulnerabilities

Pakistan's socioeconomic landscape is characterised by high levels of poverty and extreme income inequality. Close to half of the labour force is employed in agriculture. Climate change exacerbates pre-existing vulnerabilities, and creates new challenges and risks.

Poverty and inequality

Poverty is a key driver of vulnerability to climate change in Pakistan. The poor, particularly those depending on agriculture or working in informal sectors, are more severely affected by climate hazards. Climate-induced droughts, floods and heatwaves affect crop yields and threaten the livelihoods of millions of farmers. In urban areas, low-income communities living in informal settlements are vulnerable to climate impacts such as flooding and extreme heat, as they often reside in poorly constructed housing. The poor are also less able to adapt to climate impacts due to limited access to healthcare and emergency services.

Gender inequality

Gender disparities in Pakistan further exacerbate climate vulnerabilities. Women in rural areas are primarily responsible for food production and water collection, tasks that are heavily affected

by drought, water scarcity and changing agricultural patterns. Women's limited access to education, information and financial resources impedes their ability to adapt to climate change. Women also face social and cultural constraints that limit their participation in climate adaptation planning and decision making.

3.2.4 Ecosystem vulnerabilities

Pakistan's diverse ecosystems are threatened by climate change, which is speeding up the pace of ecosystem degradation and biodiversity loss, intensifying environmental stresses, and pushing many species to the brink of extinction.

Mountain ecosystems

The northern regions of Pakistan support unique ecosystems that are home to a number of rare and endangered species. The iconic markhor and snow leopard are among the many animals that were once abundant in these areas. Today their habitats are shrinking and the ecosystems that support them are becoming increasingly fragile. As temperatures rise, glacial retreat is a critical threat to mountain ecosystems, disrupting the flows that maintain ecological balance. The result is shrinking and degraded habitats, and loss of biodiversity. The degradation of alpine habitats has pushed many species of flora and fauna to the brink of extinction.

Wetlands and river ecosystems

The Indus Delta is one of the country's most productive ecosystems, providing vital services such as water filtration and flood regulation. These wetlands are part of the migratory route known as the Central Asian Flyway and millions of birds, including many endangered species, pass through the area during their migration (CMS, 2023). Reduced river flows due to climate change have significantly decreased the volume of freshwater reaching the delta, which is essential for maintaining this delicate ecosystem. Saltwater from the Arabian Sea is increasingly encroaching on the delta, making the soil saline and uninhabitable for many species.

Coastal ecosystems

Pakistan's coastal regions are home to important ecosystems, such as mangrove forests, coral reefs and coastal wetlands. Mangroves are an important carbon sink. They also act as a natural barrier against coastal erosion, protect against storm surges and serve as a breeding ground for marine species. Sea-level rise, driven by global warming, is causing mangrove forests to be submerged. The increased frequency and intensity of storms and cyclones exacerbates the damage to mangroves.

Desert ecosystems

Increasing temperatures and erratic rainfall are altering the flora and fauna that thrive in these harsh environments. Many species are finding it difficult to withstand changes in vegetation, water availability and temperature (Jhala and Bhardwaj, 2017). Desertification is a growing concern in many arid regions.

Forests and terrestrial biodiversity

Climate-induced stresses are affecting forest ecosystems. Rising temperatures and changing rainfall patterns are destroying habitats, with many species unable to adapt and becoming increasingly vulnerable. Rising temperatures and reduced rainfall also increase the frequency of forest fires, further damaging these fragile ecosystems.

Forest ecosystems are vital for carbon sequestration. As forests continue to be degraded or lost, Pakistan loses an important tool for combating climate change and building resilience.

Implications for human communities

The degradation of ecosystems and loss of biodiversity have direct implications for human communities. Many rural populations depend on forests, wetlands and marine ecosystems for their livelihoods, whether through forest produce, fishing or tourism. The loss of these ecosystems affects livelihoods and forces many to seek alternative sources of income, often leading to migration to urban centres.

As biodiversity declines, the ecosystem services provided by these natural systems, such as water filtration, air purification and flood regulation, are weakened. Climate-induced changes in ecosystems also have cultural and social consequences, as many communities have deep cultural ties to their environment and the species that inhabit it. The loss of biodiversity can lead to the loss of traditional practices, knowledge and ways of life.

3.2.5 Institutional and policy challenges

Although Pakistan has developed a number of strategies and frameworks for climate action, institutional weakness, lack of coordination and inadequate policy implementation hinder effective climate governance.

Weak institutional capacity

While the MoCC is responsible for leading climate action, many government departments, such as those dealing with water resources, agriculture and disaster management, work in silos. The absence of interdepartmental coordination limits the effectiveness of climate policies. Local governments have limited capacity to implement climate adaptation strategies due to resource constraints and a lack of trained personnel. Climate change adaptation and mitigation strategies are often undermined by political instability and shifts in leadership, making long-term planning and policy continuity difficult.

Policy gaps and lack of implementation

Although Pakistan has developed several climate-related policies, the resources and political will needed for implementation are lacking. Climate concerns are rarely prioritised in national development plans and funding for climate adaptation projects is inadequate. The country's development policies have tended to emphasise short-term growth over long-term sustainability, leading to environmental degradation and increased vulnerability to climate change impacts.

Limited public awareness and engagement

Public awareness about the risks of climate change and the importance of adaptation is another challenge. While international NGOs and local organisations are working to raise awareness, much remains to be done to engage citizens in climate action. Public participation in climate-related policy formulation and decision-making processes is limited, particularly from women and vulnerable groups. This lack of awareness and involvement reduces the effectiveness of climate adaptation programmes and policies.

3.3 Adaptation priorities

The NAP sets out the country's adaptation priorities and provides a strategic framework to build climate resilience through comprehensive measures across multiple sectors. This section discusses adaptation priorities and measures outlined in the NAP, covering six key thematic areas.

3.3.1 Agriculture-water nexus

Climate change impacts will lower crop and livestock productivity, while increasing water requirements for irrigation. NAP provisions cover the agriculture food system, agricultural land, water management for irrigation and farmer-level challenges.

Climate-smart agricultural practices

Farming methods involving physical expansion and input intensification are rapidly approaching their natural limits and have already exceeded their environmental sustainability limits. Climate-smart agriculture allows for the responsible and sustainable use of natural resources, employing techniques such as precision irrigation, tunnel farming, alternative crops and integrated pest management. Climate-smart practices should be promoted through agriculture extension services, access to finance and transfer of technology.

Efficient irrigation systems

Traditional flood irrigation methods are highly inefficient, resulting in excessive water use and the depletion of surface and groundwater resources. Poor monitoring and mismanagement make these irrigation systems unsustainable. After the subsidised provision of solar tube-wells, the pressure on groundwater extraction has increased. Efficient irrigation technologies such as sprinklers and drip irrigation should be incentivised, supported by measures to reduce losses such as the lining of water channels.

Long-term agriculture growth strategy

A policy framework is required to promote, develop and institutionalise climate-smart agriculture, providing incentives to farmers, including financial support and technology transfer, to make the shift to modern agronomic practices. This could include crop-specific agromet advisories, crop selection based on weather predictions, the use of climate-resilient crop varieties and improving the efficiency of water use.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.1.

Table 3.1: NAP objectives and initiatives for the agriculture-water nexus

Objectives and initiatives		Time frame	Implementation responsibility
Objective 1: Incentivise farmers to adopt climate-smart practices			
1.1	Improve agriculture extension and research services by:	Short/medium	MoNFSR Provincial and regional departments of agriculture, livestock and fisheries Livestock and dairy development boards Agriculture universities
	▪ Promoting climate-resilient crop varieties, regenerative practices for land preparation, improved sowing and harvesting practices, efficient fertiliser application and on-farm water management	Short/medium	
	▪ Providing extension services for crop diversification based on agro-ecological zones	Short/medium	
	▪ Providing extension services for irrigation scheduling, timely and accurate climate information, groundwater recharge and efficient consumption	Short/medium	

Objectives and initiatives		Time frame	Implementation responsibility
	▪ Strengthening livestock disease control, promote breeding of more productive and disease-resistant animals	Short/medium	
1.2	Support the creation of forums, such as producer groups, to facilitate collaboration between small farmers and other actors in crop-specific value chains, including the private sector	Short/medium	Provincial and regional departments of agriculture, livestock and fisheries Local governments Financial institutions (ZBTL, microfinance, private banks) SMEs
1.3	Provide easy access to credit for on-farm technology and purchase of inputs with institutional guidance to adopt climate-smart agriculture practices	Short/medium	MoNFSR Provincial and regional departments of agriculture, livestock and fisheries Financial institutions (ZBTL, microfinance, private banks) SMEs
1.4	Restructure existing financial tools to target small farmers to incentivise them toward crop diversification, enhance water productivity and improve land management	Short/medium	MoF, MoPDSI, MoNFSR ZBTL
1.5	Strengthen EWSs for climate risks, develop a risk management system including crop insurance	Short/medium	MoF, MoNFSR, MoPDSI NDRMF National insurance companies, financial institutions
Objective 2: Modernise surface and groundwater irrigation services			
2.1	Rehabilitate the Indus Basin Irrigation System to modernise surface water distribution by: ▪ Increasing hydraulic control in secondary distribution, ensuring sufficient delivery to watercourses ▪ Improving real-time groundwater monitoring in canal command areas ▪ Developing integrated hydro-agro informatics to make irrigation supply responsive to crop water requirement ▪ Establishing participatory institutional arrangements to maximise equity and reliability	Medium/long	PMD MoWR, IRSA Provincial and regional departments of agriculture and irrigation Local governments
2.2	Develop long-term plan for asset management, operations and maintenance with focus on: ▪ Maintaining conveyance efficiency ▪ Reducing losses, especially leakages in saline groundwater zones and waterlogged areas ▪ Ensuring due share of water to tail-end users ▪ Regular calibration and periodic maintenance of equipment	Short term	MoWR Provincial and regional departments of P&D, agriculture and irrigation Local governments
2.3	Develop regulatory frameworks to manage groundwater use and aquifer recharge	Short term	
2.4	Modernise the abiana framework with digital assessment and collection systems, improve revenues	Short/medium	

Objectives and initiatives		Time frame	Implementation responsibility
Objective 3: Develop long-term agriculture growth strategy with a focus on productivity improvement, climate resilience and physical expansion			
3.1	Establish a coordination mechanism to reduce overlap and maximise synergies between public and private sector initiatives	Short term	MoCC Provincial and regional departments of P&D, agriculture and irrigation
3.2	Develop a dashboard for crop water requirement using remote sensing and observed datasets	Short/medium	
3.3	Develop a soil and water conservation plan, including rainwater harvesting	Long term	
3.4	Assess culturable wetlands and identify feasible interventions to bring land to sustainable productive use	Long term	MoPDSI, MoCC EAD, PMD Provincial and regional departments of P&D, agriculture and irrigation
3.5	Reduce weather-induced post-harvest losses by using technology in response to reliable EWSs	Long term	
Objective 4: Develop a plan to manage projected river flows and rainfall variability under most likely climate change scenarios			
4.1	Develop comprehensive drought and flood management plans, including to: ▪ Promote impact-based weather forecasts and refurbish EWSs for floods and drought ▪ Support community-based flood management and rationalising water use during droughts ▪ Plan for disaster risk reduction through river profiling and HVRA	Short/medium	MoPDSI, MoCC EAD, PMD Provincial and regional departments of P&D and irrigation PDMAs
4.2	Develop strategic water storage plan in different ecological zones, including for: ▪ Small rainfall runoff capture dams to recharge groundwater ▪ Productive use of hill torrents ▪ Small structures in canal distribution to regulate irrigation supply ▪ Watershed restoration to increase infiltration	Short/medium	WAPDA, MoWR Provincial and regional departments of P&D and irrigation

3.3.2 Natural capital (land, water and air)

Priorities for adaptation include sustainable management of land and water resources.

Sustainable land management

Sustainable land management includes the restoration of rangelands, forests and mangroves. By increasing forest cover, Pakistan can cope with floods, prevent soil erosion and reduce sedimentation in dams. Other examples are the establishment of marine protected areas, the restoration of mangroves and the creation of no-take zones along the coast.

Integrated watershed management

Watersheds supporting forests and rangelands require integrated management to allow regeneration, which will help to control soil erosion and reduce the impact of floods and drought. Integrated management reduces sedimentation in reservoirs, increasing their holding capacity and operational life. A basin-wide approach should be used to recharge aquifers and improve water quality.

Coastal and marine protection

Effective coastal management and resilience measures are needed to restore mangroves and

control coastal pollution. Harnessing the potential of the blue economy while conserving marine and coastal ecosystems can promote fisheries and ecotourism. Along with nature based solutions, structural interventions can prevent sea water intrusion into agricultural lands, thereby improving the livelihoods of farming and fishing communities.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.2.

3.3.3 Urban resilience

Key priority measures for building climate-resilient cities include improving urban planning and service delivery.

Climate-informed urban planning

Climate and disaster risk considerations should be included in urban planning to optimise resource utilisation, improve service delivery and create resilient systems that are able to withstand the impacts of weather-induced hazards. Incorporating green spaces, parks and permeable surfaces can act as natural buffers against extreme weather events, reducing flood risk and reducing the heat island effect.

Municipal service delivery

Rationalising municipal services can increase the resilience of urban systems against climate shocks. Cities can expand while maintaining efficient service delivery, which entails measures like smart zoning, and developing connected neighbourhoods that minimise travel distances and reduce energy consumption. Well designed and maintained stormwater management and drainage systems are essential to prevent flooding.

Nature-based solutions

Adopting nature-based solutions is among the most effective climate change adaptation strategies, being cost-effective and environment friendly. Measures such as forest plantation, rainwater harvesting, slope stabilisation, water retention and treatment, and measures to protect against soil erosion have shown success in reducing heat and flood risks, while providing

Table 3.2: NAP objectives and initiatives for natural capital

Objectives and initiatives		Time frame	Implementation responsibility
Objective 1: Mainstream sustainable land management into ecosystem services			
1.1	Prepare and implement landscape restoration programme across Pakistan highlighting characteristic features of each ecological zone, including innovative financing approaches and mainstreaming into provincial programmes	Short/medium	MoPDSI, MoCC Provincial, ICT and regional departments of forestry, wildlife, irrigation WASA
1.2	Transition to regenerative agriculture to reduce agro-chemical use and curb water body pollution	Continuous	Provincial, ICT and regional EPAs, departments of agriculture, industries Local governments
1.3	Expand agro-forestry in smallholder farming and promote rangeland management	Short/medium	Provincial, ICT and regional departments of forestry, wildlife and agriculture
1.4	Promote integrated pest management and reduce/replace pesticides and chemical fertilisers	Long term	Provincial, ICT and regional EPAs, departments of agriculture
1.5	Eliminate residue burning and promote green processing to improve soil fertility	Long term	

Objectives and initiatives		Time frame	Implementation responsibility
1.6	Increase investment in restoration of ecosystem services, develop protected areas and income-generating mechanisms	Long term	Provincial, ICT and regional departments of forestry, wildlife, agriculture, P&D Banks, PPP
1.7	Introduce right pricing, user charges and fees for natural resources (water, fisheries, timber) and the polluter-pays principle		Provincial, ICT and regional departments of forestry, wildlife, agriculture, P&D Local governments
Objective 2: Promote integrated watershed management			
2.1	Restore the top 20% of heavily degraded watersheds through re-seeding, forest planting, land reclamation structures, and livestock management and productivity improvement	Short/medium	Provincial, ICT and regional departments of forestry, wildlife, agriculture, livestock, fisheries, P&D Banks
2.2	Introduce of ecosystem services payments to communities for providing clean, sediment-free water downstream, trophy hunting and watershed management	Long term	Provincial, ICT and regional departments of forestry, wildlife, agriculture, irrigation, public health Local governments, SMEs
2.3	Operationalise the Living Indus initiative	Short/medium	Provincial, ICT and regional departments of forestry, wildlife, agriculture, P&D
Objective 3: Improve water quality through better waste water management			
3.1	Instal wastewater treatment plants and develop a financing model for maintenance and operation	Short/medium	Provincial, ICT and regional departments of public health, P&D Local governments
3.2	Replicate existing best practices in anaerobic digestion technology for recycling and waste-to-energy use	Short/medium	
Objective 4: Invest in coastal and marine resources protection			
4.1	Develop and implement coastal management and resilience plans to restore mangroves, coastal barriers and coastal aquifer recharge	Long term	MoMA, Balochistan and Sindh coastal development authorities, port authorities
4.2	Pollution free coastal plan including plastic, solid waste and chemical pollution	Long term	
4.3	Harness the potential of the blue economy, including the health of marine and costal ecosystems	Long term	
Objective 5: Invest in air pollution-climate change nexus			
5.1	Develop and implement clean air investment plan to achieve WHO air quality standards	Continuous	Provincial, ICT and regional departments of public health, transport, industries, P&D Local governments
5.2	Improve air quality governance	Continuous	
5.3	Establish and enforce air quality standards in different sectors	Continuous	
5.4	Implement identified programmes and periodically review and update investment plans	Continuous	

carbon credits through the conservation and restoration of ecosystems.

Municipal financial capacity

Efficient and reliable urban services require substantial investment. Public-private partnerships can create a competitive environment, improve performance and ease the financial burden on provincial governments. Local governments should improve cost-recovery mechanisms for municipal services.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.3.

3.3.4 Human capital

Key priority areas for strengthening human capital focus on health, education, resilience and capacity building.

Climate adaptation in health and education policies

National and subnational rapid response plans should be developed for educational institutions and healthcare providers. Sectoral climate vulnerability assessments should be regularly updated with data on early warning systems, shelters, schools and hospitals. Maintaining records on areas prone to floods, heatwaves, drought, landslides and air pollution is important.

Table 3.3: NAP objectives and initiatives for urban resilience

	Objectives and initiatives	Time frame	Implementation responsibility
Objective 1: Mainstream climate adaptation in urban planning			
1.1	Develop a database on climate risks, poverty, infrastructure and communities to be targeted for adaptation measures	Short/medium	MoCC, PBS Provincial and regional departments of P&D Local governments
1.2	Ensure that hazard vulnerability risk assessments are indicated in city master plans	Long term	MoCC, PBS NDMA, PDMAs Provincial and regional departments of P&D Local governments
Objective 2: Improve land regulation and land use planning to bolster climate resilient services			
2.1	Improve land use planning, control and governance to avoid illegal settlements	Long term	MoCC, PBS Provincial and regional departments of P&D Local governments
2.2	Use planning and RS/GIS tools to build more efficient cities	Short/medium	MoCC, PBS Provincial and regional departments of P&D Local governments, urban units
2.3	Regulate peri-urban properties making them part of urban planning and management systems for climate resilience	Medium	
2.4	Make unified digital maps for climate-informed risk management	Short/medium	MoCC, PBS Provincial and regional departments of P&D Local governments
2.5	Develop national and subnational urban resilience action plans	Short/medium	
2.6	Upgrade informal settlements based on adaptation plans	Short/medium	
2.7	Regulate current low-density growth patterns and incentivise vertical growth	Long term	

Objectives and initiatives		Time frame	Implementation responsibility
Objective 3: Bolster climate-smart municipal services			
3.1	Remove debris and garbage from drains with community involvement	Ongoing	MoCC, PBS Provincial and regional departments of P&D Local governments, urban units
3.2	Upgrade to climate smart drainage networks	Ongoing	MoCC, PBS Provincial and regional departments of P&D Local governments
3.3	Improve governance through competent institutions and community involvement	Long term	MoCC, PBS Provincial and regional departments of P&D Local governments, urban units
3.4	Standardise adequate and equitable municipal services	Long term	MoCC, PBS Provincial and regional departments of P&D Local governments
Objective 4: Leverage nature-based solutions to adapt to climate change			
4.1	Implement NBS initiatives to enable adaptation to heat, water scarcity and flood risks	Long term	MoCC Provincial and regional departments of climate change, P&D Local governments, urban units
4.2	Scale up urban forest plantation to create environmental balance	Long term	MoCC Provincial and regional departments of P&D Local governments
4.3	Maintain open spaces and wetlands to store stormwater	Short/medium	MoCC Provincial and regional departments of P&D
4.4	Make permeable pavements to help rainwater drainage	Long term	MoCC Provincial and regional departments of P&D Local governments
Objective 5: Develop financing instruments to ensure sustainable revenue streams for green and resilient urbanisation			
5.1	Regulate public-private partnerships to generate revenues for municipal services	Long term	MoCC Provincial and regional departments of climate change, P&D Local governments, urban units
5.2	Encourage multi-sectoral investments for adaptation actions	Long term	Provincial and regional departments of P&D Local governments, urban units
5.3	Improve service standards and cost recovery for municipal services	Long term	

Community resilience through emergency preparedness and response

Investment in climate resilient infrastructure is crucial for the health and education sectors to improve emergency responses in the face of extreme weather events. Evacuation procedures and training should be provided in schools and health facilities. Floods and heatwaves follow seasonal patterns so preparations should begin in advance, with the participation of all stakeholders.

Workforce capacities to address climate risks

It is important to integrate climate education across all levels, from primary schools to universities. A generation of educated youth will be better equipped to face the climate challenges of the future. Education departments, universities and research institutions should develop comprehensive training programmes for their graduate and post-graduate students.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.4.

3.3.5 Disaster risk management

Key priority areas to strengthen disaster risk management include improving forecasting capabilities and strengthening disaster response.

Hydromet, climate and early warning systems and services

Hydro-meteorological, climate and early warning services are indispensable for disaster risk management. These services enable preparedness in the event of hazards such as floods, tropical cyclones and heatwaves, allowing for proactive measures and timely evacuation. Hydromet data helps in adaptive planning and the development of integrated responses.

Table 3.4: NAP objectives and initiatives for human capital

Objectives and initiatives		Time frame	Implementation responsibility
Objective 1: Mainstream climate adaptation in health and education policies			
Health			
1.1	Develop a roadmap for adaptation to address climate change impacts on public health	Medium	MoCC, MoNHSR&C Provincial, ICT and regional departments of health
1.2	Establish a national database for climate-induced disease	Long term	MoCC, MoNHSR&C Provincial, ICT and regional and district departments of health
1.3	Develop a weather-related disease outbreak monitoring and forecasting system	Long term	
1.4	Integrate of climate adaptation measures in health policies	Long term	MoCC, MoNHSR&C Provincial, ICT and regional departments of health
Education			
1.5	Develop a roadmap for adaptation to address climate change impacts on education	Long term	MoFEPT Provincial, ICT and regional departments of education

Objectives and initiatives		Time frame	Implementation responsibility
1.6	Establish a national database for climate-related loss of education, dropouts	Long term	MoFEPT Provincial, ICT, regional and district departments of education
1.7	Mainstream climate change adaptation in skills development roadmap	Long term	
1.8	Integrate climate adaptation measures in education policies	Long term	
Objective 2: Enhance climate resilience by disaster emergency preparedness and response			
Health			
2.1	Develop a communication strategy for the climate-health nexus and launch awareness and prevention campaigns	Long term	MoNHSR&C, MoCC NDMA, PDMAs Provincial, ICT and regional departments of health
2.2	Provide timely alerts, advisories and EWSs for climate-induced health issues	Medium	
2.3	Enhance capacity of healthcare providers before seasonal disease outbreaks	Medium	
2.4	Provide family planning services at all levels	Long term	
2.5	Upscale WASH climate resilient facilities for vulnerable communities	Medium	
Education			
2.6	Develop SOPs for emergency evacuation plans	Short/medium	MoFEPT NDMA, PDMAs Provincial, ICT and regional rescue 1122
2.7	Conduct emergency response training and simulation drills for teachers, students and workers	Short/medium	MoFEPT NDMA, PDMAs Provincial, ICT and regional rescue 1122, education departments
2.8	Use education institutions as shelters in case of climate disasters in vulnerable areas	Long term	MoFEPT, MoCC Provincial, ICT and regional departments of education
Objective 3: Build workforce capacities to address climate risks			
3.1	Include climate change in the curricula of secondary schools, colleges and universities	Long term	MoFEPT, MoCC, HEC Provincial, ICT and regional departments of education
3.2	Develop vocational programmes to train the workforce for climate change adaptation	Long term	MoFEPT, MoCC, HEC Provincial, ICT and regional departments of vocational training
3.3	Promote entrepreneurs, SMEs to develop environment friendly products and services	Long term	MoCC, MoC

Disaster risk governance

Pakistan's first disaster risk map was prepared in 2012 with the technical assistance of the Japan International Cooperation Agency (JICA). The National Disaster Risk Reduction Policy was developed in 2013, based on the disaster mapping. It included disaster risk management institutions and mechanisms to cope with climate-induced disasters.

Resilience of communities and critical infrastructure

Effective disaster risk management involves a meticulous process of identifying vulnerabilities and conducting in-depth risk analyses that consider different climate scenarios. Once this process is completed, sectoral adaptation strategies can be implemented to mitigate these risks and strengthen the resilience of systems and services.

Disaster response and recovery

Strengthening disaster preparedness for effective response and to build back better requires incorporating risk-informed approaches into recovery and reconstruction efforts. To address delays in post-disaster relief, recovery and planning, the focus should be on institutionalising recovery before the disaster. This includes activities such as conducting risk assessments, developing delivery plans, securing financing and establishing coordination mechanisms. By preparing in advance, communities and authorities can better anticipate and respond to disasters, reducing the time and resources needed to recover and rebuild.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.5.

3.3.6 Gender, youth and social inclusion

Key priority areas for gender, youth and social inclusion are building capacity and ensuring that planning and policy processes take into account the needs of all stakeholders.

Capacity development of vulnerable groups

It is crucial to tackle both the immediate risks and impacts of climate change, and the underlying causes of inequality. To address immediate risks, the focus should be on empowering communities to adapt to uncertainties. This includes preparing vulnerable groups for disaster risk management through targeted education and training programmes, supporting climate resilient livelihoods by diversifying income sources, and promoting sustainable practices like climate-smart agriculture and nature-based solutions.

Table 3.5: NAP objectives and initiatives for disaster risk management

Objectives and initiatives		Time frame	Implementation responsibility
Objective 1: Understand climate and disaster risk by investing in state-of-the-art hydromet, climate and early warning systems			
1.1	Develop an open-access, credible hydromet database	Long term	PMD, MoCC, FFC, NDMA, PDMAs
1.2	Carry out district level multi-hazard vulnerability and risk assessments	Medium	
13	Conduct GIS mapping of irrigation infrastructure, flood embankments for flood monitoring	Short	PMD, SUPARCO, MoCC, FFC, NDMA, PDMAs
1.4	Carry out hydromet modelling and floodplain zoning under different scenarios	Long term	

Objectives and initiatives		Time frame	Implementation responsibility
1.5	Strengthening hydromet monitoring, forecasting and improving EWSs	Long term	
1.6	Use RS/GIS based cryosphere monitoring and research for water resource assessment	Long term	PMD, SUPARCO, MoCC, WAPDA, FFC, NDMA, PDMAs
1.7	Strengthen GCISC capacity as a knowledge forum and research base	Long term	PMD, SUPARCO, MoCC, GCISC, NDMA, PDMAs
Objective 2: Strengthen disaster risk governance			
2.1	Upgrade the National Disaster Management Plan and National Flood Protection Plan IV	Short	NDMA, PDMAs, FFC, PMD
2.2	Prepare provincial disaster management and adaptation plans	Medium	
2.3	Implement policies and regulatory frameworks	Long term	
2.4	Enhance coordination between entities responsible for DRM	Long term	
Objective 3: Invest in disaster risk reduction to bolster the resilience of communities and critical infrastructure			
3.1	Develop robust disaster and climate risk screening tools	Medium	MoCC, MoPDSI, NDMA, PDMAs, FFC, PMD
3.2	Mainstream disaster and climate risk screening into public investment	Medium	MoCC, MoPDSI, EAD, NDMA, PDMAs, FFC, PMD
3.3	Implement cost-effective, innovative and agile DRM solutions	Medium	NDMA, NDRMF, PDMAs Local governments
3.4	Establish climate and DRM funds at the provincial level	Short/medium	MoCC, MoF, EAD, PDMAs Provincial and regional departments of finance
3.5	Develop and implement climate and disaster risk finance and insurance	Medium	MoCC, MoPASS, BISP Provincial and regional departments of social welfare
3.6	Establish a climate and disaster shock responsive social protection system	Short/medium	
3.7	Develop climate resilient infrastructure including power, transport and utilities	Short/medium	
Objective 4: Enhance disaster preparedness for effective response and to build back better by incorporating risk-informed approaches into recovery and reconstruction efforts			
4.1	Develop a disaster recovery framework to strengthen the existing system	Medium	MoCC, NDMA, PDMAs Provincial and regional departments of P&D
4.2	Launch a last-mile EWS using AI-based technology	Short/medium	MoCC, NDMA, PDMAs Provincial and regional departments of information, P&D
4.3	Strengthen community-based EWSs and DRR systems	Long term	MoCC, NDMA, PDMAs
4.4	Develop SOPs to define the roles and responsibilities of all stakeholders	Long term	MoCC, NDMA, PDMAs Provincial and regional departments of P&D Local governments
4.5	Strengthen capacities of DRM agencies	Long term	MoCC, NDMA, PDMAs
4.6	Scale-up community-based DRM to strengthen the adaptive capacity of communities	Long term	MoCC, NDMA, PDMAs Provincial and regional departments of social welfare
4.7	Upgrade shelters and provide training on their use	Long term	Local governments, CSOs

Inclusive policy making and development planning

By promoting inclusive and equitable policy and planning, Pakistan is determined to unlock the full potential of all communities, harnessing their expertise to develop more effective and sustainable climate solutions. Engagement and participation foster resilience with a more just and inclusive approach to tackling climate change impacts.

Based on these priority areas, key objectives and initiatives identified in the NAP are summarised in Table 3.6.

3.4 Adaptation approaches

This section outlines the strategic approaches that underpin Pakistan's adaptation efforts.

These cross-cutting approaches inform policy and planning to build resilience across sectors and within communities.

3.4.1 Community-based adaptation

Community-based adaptation is emerging as an essential strategic approach, particularly in rural areas. In regions prone to drought, floods and other climate-related disasters, communities are adopting innovative solutions to cope with climate change. These grassroots initiatives involve traditional knowledge, local resources and community involvement.

For example, in the drought-prone region of Tharparkar, Sindh, communities have started to plant **drought-resistant crop varieties** and use **rainwater harvesting** techniques to address

Table 3.6: NAP objectives and initiatives for gender, youth and social inclusion

Objectives and initiatives		Time frame	Implementation responsibility
Objective 1: Support vulnerable groups to strengthen their capacity for climate adaptation			
1.1	Conduct capacity needs assessments of stakeholders for gender and socially inclusive DRM and develop training	Short/medium	NDMA, PDMAs Local governments
1.2	Ensure equal participation of women in decision making, training and awareness	Long term	PDMAs, DDMAs
1.3	Set up a helpline for women to report violence and child marriage in post-disaster situations	Long term	MoIB, HRCP Provincial, ICT and regional departments of social welfare
1.4	Prepare learning materials for gender and social inclusion in climate change adaptation	Long term	MoFEPT Provincial and regional departments of education
1.5	Develop community based EWSs with local ownership for operation and maintenance	Long term	NDMA, PDMAs, DDMAs, PMD
Objective 2: Empower vulnerable groups by supporting climate-resilient livelihoods			
2.1	Introduce energy-efficient, low-cost cooking technology	Long term	Provincial and regional departments of energy Tech incubators
2.2	Conduct training for climate-smart and regenerative agriculture	Long term	MoNFSR Provincial and regional departments of agriculture
2.3	Promote agro-based entrepreneurship with financial incentives	Long term	
2.4	Train female agriculture extension officers to advise female farmers and tenants	Short/medium	

Objectives and initiatives		Time frame	Implementation responsibility
2.5	Introduce climate-smart water technology for sustainable water use	Long term	MoNFSR Provincial and regional departments of irrigation
2.6	Provide comprehensive training on WASH and climate change adaptation	Long term	MoCC Provincial and regional departments of health
2.7	Provide training on land and watershed management and biodiversity conservation	Long term	MoCC Provincial and regional department of water resources
2.8	Provide training on fisheries and coastal management	Short/medium	Provincial and regional departments of fisheries
2.9	Promote entrepreneurship in forestry and non-timber forest products with financial incentives	Long term	Provincial and regional departments of forests
Objective 3: Promote inclusive participation of vulnerable groups in climate-related policy and development planning			
3.1	Conduct community-based research to identify impacts and vulnerabilities	Short term	MoCC
3.2	Launch awareness campaigns and outreach programmes for gender inclusive decision making on climate issues	Short term	MoCC, MoIT
3.3	Encourage participation of gender, youth and vulnerable groups in advisory committees, working groups	Short term	MoCC
3.4	Integrate gender and social inclusion considerations in all climate policies and programmes	Medium	MoCC

water scarcity. These efforts are complemented by the introduction of sustainable farming practices that conserve soil moisture and improve crop yields.

In flood-prone areas, community-based adaptation includes the **construction of elevated houses** that are less vulnerable to flooding. Community-driven **early warning systems** have been established in many flood-prone regions, giving residents time to evacuate. Pakistan is also a part of the global Early Warning System for All initiative

3.4.2 Technological solutions

Technological innovation plays a vital role in building resilience. Pakistan has begun to adopt technologies aimed at improving climate resilience, particularly in agriculture, energy and disaster management.

In the agricultural sector, technologies like **drip irrigation, climate-resilient crop varieties** and **precision farming** are helping farmers adapt to changing weather patterns, reduce water wastage and maintain productivity. Similarly, drought-resistant crop varieties are essential to ensure food security in areas where rainfall is unpredictable.

Renewable energy technologies, such as **solar power** and **wind energy**, are increasingly being promoted to reduce dependence on fossil fuels and hydropower. The government has provided several incentives to encourage private

investment in solar and wind power, and there are ongoing efforts to expand the national grid to incorporate renewable energy sources.

Geographic information systems (GIS) and **satellite data** are being used to enhance climate forecasting and disaster preparedness. These technologies allow for real-time monitoring of climate patterns, helping policymakers and disaster management authorities take informed decisions. GIS is particularly useful for mapping vulnerable areas, tracking changes in land use and managing natural resources.

3.4.3 Disaster risk management

A key priority for disaster risk management is improving **early warning systems**. In recent years, the government has invested in advanced technologies and data collection equipment to improve the accuracy of weather forecasts and early warnings.

Pakistan is investing in **flood protection infrastructure**, such as embankments, dams and reservoirs, to reduce the impacts of floods. The Federal Flood Commission has prepared a comprehensive flood protection plan.

For communities at risk, efforts focus on **evacuation plans** and **emergency shelters**. After the devastating 2015 heatwave in Karachi, a heatwave early warning system was established to provide timely alerts to government agencies and the public, and to coordinate with the electricity distribution company to manage loads. Similar heatwave early warning systems can be replicated across the country.

3.4.4 International cooperation

Pakistan has been engaging with international governments, donor agencies and aid organisations to finance climate adaptation projects. The country has received funding as well as technical assistance. Key sources of funding and the types of support received are discussed in Chapter 4.

3.4.5 Sector-specific adaptation approaches

Strategic approaches to build resilience in climate-vulnerable sectors are summarised in Table 3.7.

3.4.6 Priority adaptation actions

Priority adaptation actions are summarised in Table 3.8.

3.5 Progress on implementation of adaptation actions

With the support of international financing mechanisms and donor agencies, Pakistan is in the process of implementing a number of adaptation projects for ecosystem restoration, forest regeneration, coastal protection, disaster risk reduction and climate-vulnerable sectors.

As of December 2024, a costing exercise is underway for 117 adaptation measures for six priority sectors identified in the NAP. This exercise is important to track the finance gap and will enable targeted mobilisation of resources. Upon completion of the exercise, these measures will be converted into actionable and bankable projects for nationwide implementation.

3.5.1 Adaptation projects currently in implementation

Key adaptation projects currently being implemented are discussed in the sections that follow. For a detailed list of ongoing and pipeline projects, see Annex A.

Table 3.7: Sector-specific adaptation approaches	
Sector	**Approaches**
Agriculture	▪ Promote climate-resilient crops and farming techniques, such as laser levelling, water-efficient irrigation techniques and minimum-tillage farming ▪ Demonstrate climate smart agriculture techniques ▪ Expand the scope of crop and livestock insurance schemes to cover climate-related risks ▪ Provide crop-specific and reliable impact-based climate services from sowing to harvesting and marketing
Water resources	▪ Invest in water storage and conservation infrastructure to address seasonal variability and water scarcity ▪ Build small, medium and large dams to increase water storage capacity ▪ Modernise irrigation systems to reduce water wastage and improve irrigation efficiency, using the latest technology ▪ Improve watershed management to reduce erosion, control sedimentation and improve water quality
Urban planning	▪ Implement green urban planning initiatives, including urban forests and permeable pavements, to mitigate heatwaves and reduce urban flooding ▪ Strengthen waste management systems to prevent overflow in drainage systems during heavy rains ▪ Improve water supply infrastructure to minimise leakage, tax water consumption at the household level
Energy	▪ Increase the use of renewable energy sources, particularly solar and wind ▪ Transition to EVs as quickly as possible ▪ Improve energy efficiency and adopting green technology standards for industries and households ▪ Implement energy-efficient green town planning
Health	▪ Strengthen public health systems to address climate-induced diseases ▪ Develop heat action plans for urban centres and improve environmental conditions in cities ▪ Control pollution from industrial and transport emissions

Table 3.8: Priority adaptation actions	
Short term (1-3 years)	
Policy and institutional strengthening	▪ Establish a national climate resilience fund for adaptation projects in vulnerable zones ▪ Continue updating vulnerability assessments to identify new areas affected by climate change ▪ Strengthen operation of the PMD, FFC and NDMA with increased funding, modern equipment, monitoring tools and trained human resources
Pilot projects	▪ Launch pilot projects on ecosystem-based adaptation, such as community-based afforestation in flood-prone areas, household level rainwater harvesting and water conservation ▪ Test climate-smart irrigation technologies in drought-affected and water-scarce regions ▪ Promote research on weather and climate forecasting methods to improve prediction and early warning systems ▪ Integrate local wisdom with scientific techniques to increase the confidence of local communities in climate services
Data collection and research	▪ Develop a climatic zone-specific national database on climate risks and vulnerabilities ▪ Support academic research on localised information to provide climate adaptation solutions ▪ Establish a reliable monitoring and evaluation mechanism to continuously improve climate information standards

Medium term (3-7 years)	
Scaling successful interventions	▪ Expand and replicate successful pilot projects ▪ Improve, upscale and integrate EWSs into national disaster management strategies ▪ Educate young children about climate change and raise awareness of local communities on DRR ▪ Encourage gender to participate actively in climate change adaptation and promote women organisations to lead adaptation measures and DRR ▪ Promote mangrove plantation to protect against storm surges and minimise destruction from cyclones
Infrastructure development	▪ Build multipurpose dams for water storage, flood control and hydropower generation ▪ Develop climate resilient housing projects in urban slums with proper drainage system and sanitation ▪ Remove structures on waterways with the help of communities informed and aware of the risks ▪ Construct sea walls to prevent saltwater intrusion along the Sindh coast
Long term (7+ years)	
Sustainable Development Goals (SDGs)	▪ Align climate adaptation efforts with SDGs, particularly Goal 13 (Climate Action) ▪ Intensify adaptation measure to restore natural ecosystems, in line with UNEP initiatives ▪ Foster partnerships with global organisations
Climate-resilient communities	▪ Establish self-sufficient, climate-resilient communities through integrated approaches combining education, health and livelihood support ▪ Undertake pilots in each ecosystem to develop community-level climate resilience, scale up successful interventions

Living Indus

The Living Indus (LI) programme is a comprehensive effort to restore the ecological health of the Indus River basin, which is severely impacted by climate change. Setting out 25 initial measures, LI prioritises nature-based solutions, focusing on biodiversity, groundwater, pollution, livelihoods, green infrastructure and governance (Table 3.9). These interventions are in line with international best practices for community-driven nature-based approaches.

The programme was conceived in 2021-22 with support from the United Nations and formally launched at COP 29. It is one of Pakistan's key initiatives to implement NAP priorities.

The programme proposes a framework of action requiring an estimated investment of USD 11-17 billion over a period of 5-15 years from public, private, civil society and development partners. Resource mobilisation of approximately USD 1 million has been achieved in FY 2022-23 (see Figure 3.1) (UN Pakistan, 2022).

In 2023, the United Nations named LI as one of the seven UN World Restoration Flagship programmes. Under the programme, the Clean Indus Drive was launched in 2023. The LI Knowledge Portal is operational (livingindus.org.pk) and a communications strategy has been developed (UN Pakistan, 2022).

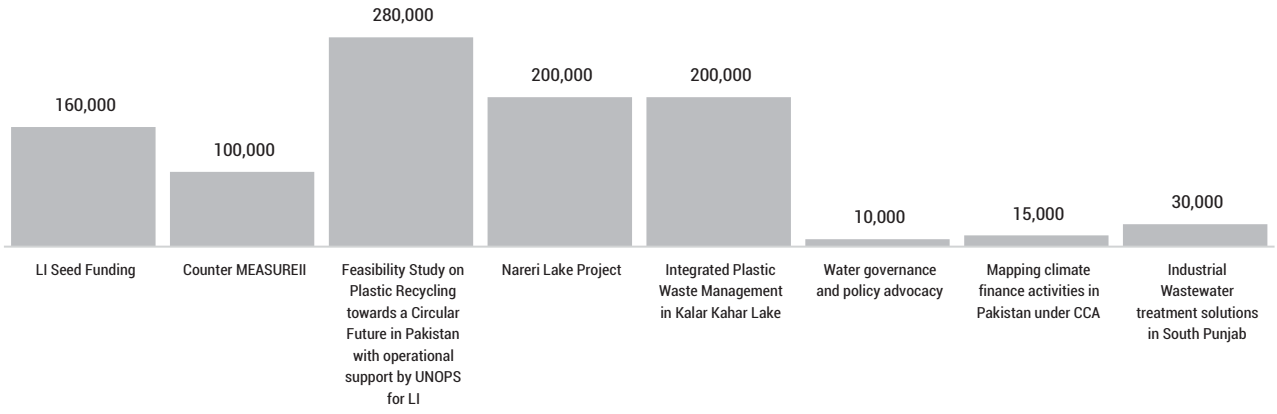
Recharge Pakistan

'Recharge Pakistan: Building Pakistan's Resilience to Climate Change through Ecosystem-Based Adaptation for Integrated Flood Risk Management' aims to strengthen resilience to climate-induced challenges by leveraging nature-based solutions. The project focuses on increasing water storage and

Table 3.9: Interventions under the Living Indus programme

1. Green Infrastructure for Flood Control and Groundwater Recharge	2. 100,000 Community Ponds	3. Sustainable Groundwater Governance through Provincial Water Acts	4. A Living Indus Knowledge Platform: Crowd sourcing knowledge	5. Indus Clean-up: Industrial and Urban Effluent Treatment
6. Salinity Control in the Lower Indus	7. Climate Resilience on the Indus Delta	8. Sustainable Aquaculture and Fisheries Management	9. Nature-Based Resilient Agriculture	10. Indus Trust Fund
11. Climate and Nature Performance Bonds	12. Social Entrepreneurship for a Climate Resilient Indus	13. Community Access to Clean Energy	14. Zero Plastic Waste Cities Along the Indus	15. Urban Forests along the Indus
16. Indus Protection Act	17. Indus Protected Areas	18. Build Back Biodiversity in the Indus Basin	19. Community Based Ecotourism	20. Indus Heritage Sites
21. Nature-Based Watershed Management	22. Expanded GLOF II	23. Promoting Permaculture	24. Managing Agricultural Wastewater	25. Telling the Living Indus Story

Figure 3.1: Resource mobilisation for the living indus programme



recharge through the sustainable management of wetlands, floodplains and hill torrents. Key interventions include ecosystem-based adaptation measures, green infrastructure development and natural resource management, which also supports livelihoods.

The initiative aims to reduce flood-affected areas by 50,800 ha, capturing 20 million m³ of water and replenishing 1,600 million litres of soil infiltration water. Benefiting a population of 0.8 million directly and 10 million indirectly, this nationwide programme is an example of integrated and sustainable flood risk management. The World Wide Fund for Nature (WWF) leads this USD 77.8 million project, which includes a GCF grant of USD 66 million (WWF, 2021). Activities to date are summarised in Table 3.10.

Table 3.10: Interventions under the Recharge Pakistan programme		
Intervention	Quantity	Volume (m^3)
DI Khan, Ramak (KP)		
Reforestation	14, 215 ha	
Green infrastructure (total)	94	11,653,152
Flood protection embankments	9	2,025,000
Dispersal embankments	1	225,000
Gabion bunds	39	5,265,000
Small retention areas	34	2,571,250
Large retention areas	2	1,527,752
Recharge basins	9	39,150
Manchar and Chakar Lehri (Balochistan and Sindh)		
Green infrastructure (total)	33	4,135,337
Dispersal embankments	6	1,350,000
Gabion bunds	6	810,000
Small retention areas	8	511,400
Large retention areas	7	1,450,887
Recharge basins	6	13,050

Green Pakistan Upscaling Programme

The 'Green Pakistan Upscaling Programme' is the 4th largest afforestation programme in the world. Implemented by the MoCC with the support of provincial forest and wildlife departments, it aims to increase forest cover across the country, conserve biodiversity and strengthen the protected areas regime. Running from 2019 to 2023 (Phase 1), the programme allocates PKR 71.29 billion (USD 400 million) for reviving the forestry sector and an additional PKR 10.54 billion (USD 60 million) for wildlife resources. The programme aims to sequester 148.76 MtCO2 of emissions over the next decade.

Delta Blue Carbon Project

The 'Delta Blue Carbon Project' in Sindh is one of the world's largest mangrove restoration initiatives, aiming to protect 102,000 ha of existing mangrove forests and rehabilitate another 226,000 ha of degraded mangrove areas. To date, 75,000 ha of degraded mangroves have been rehabilitated, benefiting 43,000 people. The project, a partnership between Indus Delta Capital Private Limited and the Sindh Forest and Wildlife Department, will help to sequester over 127 MtCO2 over the project's lifetime.

Other ecosystem restoration projects

Pakistan has achieved an annual growth rate of 3.74% in mangrove cover through **voluntary mangrove plantation** drives, making it the only country in the region with expanding mangrove forests. A collaborative project with the South China Sea Institute of Oceanology and Lasbela University has successfully restored 16 acres of mangrove forest in the Sonmiani Marsh Dam

area in Balochistan (Gilani et al., 2020; CEN, 2023).

The '**Sustainable Actions for Ecosystems Restoration in Pakistan**' project, with funding of USD 20 million from the Adaptation Fund (AF), focuses on ecosystem restoration across Pakistan. Currently in the hard pipeline, the project aims to enhance ecosystem resilience using adaptive nature-based solutions, improve community resilience through climate-resilient water and sanitation facilities, strengthen institutional capacities to address climate risks, and foster awareness and local ownership of climate adaptation and risk reduction (AF, 2024b).

Efforts to scale up forest and landscape restoration through the Food and Agriculture Organisation (FAO) '**Hand-in-Hand Initiative**' aim to restore degraded lands, enhance carbon sequestration and protect water resources, contributing to ecosystem resilience (FAO, 2025).

Scaling up of Glacial Lake Outburst Flood Risk Reduction

The United Nations Development Programme (UNDP) leads the 'Scaling up of Glacial Lake Outburst Flood Risk Reduction' project. Operating in GB and KP, the project focuses on strengthening national and subnational institutional capacities while enhancing community resilience through early warning systems and capacity-building initiatives. Activities include the construction of 250 engineering structures, using weather monitoring systems to mitigate risks and improving policy implementation.

Phase I (2011-15) was successfully completed and Phase II (2017-24) is currently underway. Phase II targets 16 valleys across 10 districts in GB and 8 valleys in 5 districts of KP. The programme will benefit approximately 696,000 people in 24 villages. The project has a budget of USD 37.5 million, with a GCF grant of USD 37 million and co-financing of USD 0.5 million (in-kind contribution of PKR 50 million from the GB government) (GCF, 2022).

Adaptation projects in agriculture

'**Transforming the Indus Basin with Climate Resilient Agriculture and Water Management**' is a GCF-funded project being implemented by FAO in Punjab and Sindh. Addressing Pakistan's vulnerability to arid conditions and the country's reliance on a single river system, the project empowers farmers through technology and skills development for climate-smart agriculture and water management (GCF, 2019). At a cost of USD 47.6 million, the project is expected to benefit 1.3 million people directly, and an additional 16 million people indirectly, of whom 8 million will be women (GCF, 2019).

Similarly, the FAO's '**Strengthening Resilience of Agro-Pastoralists in Sindh**' project aims to boost the climate resilience of farming communities by introducing drought-resistant fodder systems and improved livestock management practices (FAO, 2023).

The '**Sustainable and Regenerative Management of Rice Production**' project aims to transform rice farming practices by reducing water consumption and cutting emissions to build more sustainable production systems. In Sindh's Tharparkar and Umerkot districts, capacity-building programmes have equipped extension workers with the skills to implement climate-resilient range management practices, benefiting local communities and promoting sustainable rangeland use (FAO, 2016).

Innovative approaches are also being tested. The '**Bananas in Pakistan's Bio-Economy**' project, an FAO-GCF collaboration, is converting agricultural waste into textiles, aiming to establish sustainable value chains while reducing waste (FAO, 2024a).

Other adaptation projects

The '**Integrated Climate Risk Management for Strengthened Resilience to Climate Change in Buner and Shangla Districts of Khyber Pakhtunkhwa Province, Pakistan**' project aims to build climate resilience in vulnerable districts, focusing on flood early warning systems and preventive measures. Key activities include installing automatic weather stations, improving the dissemination of early warnings and providing technical assistance to government staff. Emergency response protocols will be developed and institutionalised within government departments and local adaptation plans with community-prioritised actions will be developed. The project will capture and share knowledge and lessons learned to enable replication and scaling up of successful practices. The project runs from 2024 to 2028, with a budget of USD 9.8 million (USD 8.8 million from the GCF) (GCF, 2024a).

In the water sector, the '**Capacity Building on Water Quality Monitoring and SDG 6 (6.1) Reporting**' project aims to develop and establish a national and provincial drinking water quality monitoring and surveillance system. Working with public health engineering departments and environmental protection agencies in KP and Punjab, the project benefits water quality monitoring agencies directly and the general population of these provinces indirectly. Achievements include developing baselines for water quality monitoring, installing water quality testing equipment in laboratories (8 in KP, 36 in Punjab), delivering 9 mobile water quality testing laboratories, and creating an information management system for water quality tracking and reporting (in KP). Standard operating procedures (SOPs) for laboratories have been developed. The project, which runs from 2020 to 2025, is supported by a USD 7.42 million in-kind grant from the Korean International Cooperation Agency (KOICA) (MoCC, 2025).

Another adaptation initiative in the pipelines is the '**Nature-Based Solutions for Flood Mitigation and Restoration**' project, with funding of USD 40 million from GCF. This project aims to strengthen governance and institutional frameworks to promote large-scale investment in ecosystem-based adaptation for flood impact reduction in Sindh. Activities will include ecosystem restoration to mitigate flood impacts, and supporting smallholder farmers and SMEs to adopt climate-resilient agricultural practices.

Several other adaptation projects are in the pipeline, awaiting funding approval (see Annex A).

3.5.2 Challenges in implementation of adaptation actions

Despite progress on the policy front and a portfolio of adaptation projects under implementation, significant challenges persist in translating policy commitments into impactful outcomes.

Limited financial resources

The lack of adequate and reliable financing remains a major challenge. Pakistan's Updated NDC identifies the current gap to be USD 7-14 billion annually (GoP, 2022). Meanwhile, the World Bank estimates that Pakistan needs to invest USD 152 billion for adaptation and resilience by 2030 (WB, 2022). Pakistan's 2021 estimated spending on adaptation and

restoration was USD 1 billion, while the actual annual finance need is around 15 times as much (WB, 2022).

International partners are supporting some adaptation initiatives but the overall financing gap is substantial. The absence of a mechanism to mobilise international climate finance adds to the challenge. Pakistan's domestic private sector is not positioned to finance adaptation needs because the private sector operates on the basis of quick and tangible returns whereas adaptation projects offer no such quick fixes. The private sector requires guarantees and de-risking, and the absence of these mechanisms is a serious impediment in attracting domestic private investment.

Policy implementation gaps

There is a disconnect between high-level policies and on-ground implementation. Provincial adaptation plans, though recommended in the NAP, are still under development in many regions. There is a need for greater third-party verification and validation of the work being done to ensure transparency and identify bottlenecks.

Weak institutional coordination

Adaptation actions involve multiple federal, provincial and local entities, leading to overlaps and fragmentation in planning and implementation. The institutional framework for adaptation, though defined in the NAP, can benefit from greater clarity on roles and responsibilities, especially at the provincial and local levels.

Challenges in data and monitoring systems

Effective adaptation requires accurate, region-specific data and robust monitoring systems. There are gaps in Pakistan's climate and socio-economic data regime, which hinder the prioritisation of adaptation actions. Data collection and analysis are resource-intensive processes that require substantial funding and technical capacity. In the context of Pakistan, these critical components are inadequate or lacking. While the NAP emphasises the need for an MRV system, implementation is limited, making it difficult to measure the effectiveness of adaptation initiatives.

Capacity constraints

Provincial governments and local institutions often lack the technical expertise and training to develop and implement effective adaptation measures. This is particularly evident in rural and remote areas, where the impact of climate change is most severe. With the introduction of the ETF and new reporting tools such as the Biennial Transparency Report (BTR), new skills and capacities will need to be developed to meet international benchmarks on reporting.

Sectoral and regional disparities

Adaptation actions are not uniformly prioritised across sectors and regions. While the NAP identifies six priority areas, implementation has been skewed towards agriculture and water, leaving other critical sectors underfunded and neglected. Marginalised regions like Balochistan and the former tribal areas have seen limited adaptation interventions compared to the rest of the country.

Lack of local ownership

There is limited local participation in the design and implementation of adaptation measures. This means that interventions lack relevance to ground realities, leading to the absence of community ownership after project completion. All adaptation projects should include

requirements for community involvement and participation during the planning stage and throughout implementation. This will ensure that interventions address real needs and increase local ownership. Communications and behaviour change components should be considered, where relevant, to improve local understanding and encourage community involvement.

Exclusion of women and vulnerable groups

Although the NAP emphasises gender-responsive adaptation, in practice the integration of gender considerations and the inclusion of vulnerable groups in adaptation planning and implementation is limited. This is partly the result of a complicated interplay of cultural, economic and social factors. As noted in the ccGAP, this lack of integration makes women and children much more vulnerable, especially in the wake of climate-induced disasters.

Challenges in scaling up proven solutions

Successful pilot projects, such as those funded by the GCF or other mechanisms, often fail to scale up due to limited resources, lack of institutional support and poor coordination.

3.6 Monitoring and evaluation of adaptation actions and processes

Pakistan is in the process of developing monitoring and reporting platforms in line with international requirements and best practices. Many national policies and plans call for the establishment of monitoring mechanisms and provide broad outlines for reporting on progress, based on their own objectives and targets. The government has yet to finalise a consolidated framework for implementation at the federal and provincial levels.

This section discusses the legal, institutional and advisory mechanisms in place for monitoring, along with monitoring tools and systems being developed.

3.6.1 Legal and policy framework for monitoring

Pakistan has established a comprehensive legal and policy framework to allow for the systematic tracking of adaptation activities. Several legislative and policy instruments provide for the development of a monitoring system.

National Climate Change Act 2017

The National Climate Change Act establishes the Pakistan Climate Change Authority, which is responsible for monitoring policies, plans and programmes related to climate change adaptation and mitigation. The Act requires monitoring of adaptation interventions in infrastructure, agriculture, climate-resilient water resource management and disaster risk reduction.

Coordination is required between the Authority, federal ministries, provincial governments and other stakeholders to ensure effective monitoring. Regular reporting is encouraged to keep the Climate Change Council informed on progress. The Act requires the development of adaptation impact evaluations and research on climate-resilient technologies and practices.

National Climate Change Policy 2021

The National Climate Change Policy emphasises the need for an MRV framework to track progress on adaptation actions and processes. It calls for the integration of monitoring mechanisms into existing national and subnational institutional frameworks. Federal and provincial governments

are required to work collaboratively to monitor adaptation efforts at the local level and to provide data for a consolidated national review.

The policy identifies the need to develop indicators for key sectors, such as agriculture, water resources, health and ecosystems. These indicators are to be developed in consultation with stakeholders and aligned with global best practices. The policy highlights the role of research institutions, academia and government agencies in generating data, including baselines and progress tracking.

The policy assigns responsibility to the MoCC for overall reporting on adaptation efforts. Provincial governments are advised to monitor adaptation actions at the subnational level. The policy encourages third-party validation to ensure transparency.

Pakistan's Updated Nationally Determined Contributions 2021

The NDC acknowledges the importance of a policy and institutional framework to monitor adaptation actions. The financing gap for adaptation is noted, with the NDC calling for international support to meet adaptation needs, including for the development of an MRV system to track progress and identify bottlenecks.

National Adaptation Plan 2023

The NAP includes an implementation and monitoring strategy. It sets the following goals for monitoring:

- Track and assess progress in achieving adaptation objectives across sectors
- Enhance accountability and transparency in resource utilisation
- Evaluate outcomes and impacts of adaptation initiatives, ensuring they address climate vulnerabilities effectively
- Facilitate knowledge sharing to scale up successful adaptation practices
- Support international reporting on adaptation efforts under the Paris Agreement, aligned with the NDC.

The NAP proposes the establishment of a comprehensive monitoring, evaluation and reporting framework, as summarised in Table 3.11.

3.6.2 Institutional framework for monitoring

The institutional framework to support monitoring includes a number of ministries and statutory bodies with various responsibilities.

Ministry of Climate Change and Environmental Coordination

The MoCC is the primary national entity responsible for monitoring adaptation measures. It consolidates information on nationwide adaptation efforts through annual and biennial mechanisms. It is also responsible for the country's international reporting obligations.

Global Change Impact Studies Centre

As the research arm of the MoCC, the GCISC provides scientific and technical evidence to support monitoring. The ETF, MRV system and CCIT dashboard are housed at the GCISC.

National and Provincial Disaster Management Authorities

The NDMA and PDMAs play a critical role in monitoring disaster risk reduction and resilience measures. They collect data, and conduct hazard mapping and vulnerability assessments that feed into monitoring frameworks. In the provinces, PDMAs monitor the effectiveness of emergency

Table 3.11: Key components of monitoring and evaluation under the NAP

Component	Details
Indicators for adaptation monitoring	▪ Quantitative and qualitative indicators to measure progress across sectors such as water, agriculture, health and disaster risk reduction ▪ Focus on - Reduced vulnerability - Improved adaptive capacity - Increased resilience of communities and ecosystems
Institutional mechanisms	▪ MoCC is the lead agency to oversee adaptation monitoring ▪ Collaboration with sectoral ministries, provincial governments and other stakeholders ▪ Integration of adaptation monitoring into the broader MRV framework for climate action
Data collection and analysis	▪ Systems for data collection, storage and analysis to track adaptation progress at the national, subnational and sectoral levels ▪ Collaboration between GCISC and provincial climate departments to generate and share data
Stakeholder involvement	▪ Engagement of local governments, communities, private sector and civil society in monitoring and evaluation processes ▪ Third-party evaluations to ensure objectivity and transparency
Tools and systems	▪ Geospatial technologies (e.g., GIS and remote sensing) for tracking ecosystem changes and vulnerability trends ▪ Climate Change Investment Tracking Dashboard to monitor adaptation financing ▪ Early warning systems to measure progress in disaster risk reduction

response systems. After a disaster, the NDMA and PDMAs conduct post-disaster assessments to evaluate the effectiveness of adaptation measures.

Other ministries and statutory bodies that have a role in monitoring include the following:

- Climate Change Authority: Among its responsibilities is monitoring to ensure compliance with adaptation-related goals in national policies and international commitments
- Pakistan Climate Change Council: Mandated to oversee progress on climate action
- Expert Group: Once established, it will be responsible for monitoring and evaluation under the NAP, reporting back to the PCCC
- Ministry of Planning, Development and Special Initiatives: Working on greening CPEC and monitoring adaptation measures along major CPEC routes
- Ministry of Finance: Responsible for tracking climate finance
- Special Investment Facilitation Council: Advises on and facilitates climate-resilient investments and supports the monitoring of adaptation-related projects
- Climate change policy implementation committees: Operating at the federal and provincial levels, these committees are mandated to review progress on implementation of priority actions
- Federal Flood Commission: Responsible for coordinating flood management, contributes to monitoring flood resilience measures
- Pakistan Meteorological Department: Has regional offices, weather stations and hydrometeorological data collection systems in place across the country, providing data to support monitoring of adaptation activities.

3.6.3 Monitoring tools and platforms

As a Party to the UNFCCC, Pakistan complies with reporting obligations set out in the convention. It has also developed a number of tools and platforms to monitor progress on climate action.

Enhanced Transparency Framework

Under the ETF, countries are required to report on emissions, climate action, and support needed and received. The ETF replaces the Biennial Update Report (BUR) as a reporting tool and requires more regular and detailed reporting. The ETF process includes technical reviews from third party experts. ETF-based reporting feeds into the Global Stocktake held every five years.

Biennial Transparency Report

The Biennial Transparency Report (BTR) is one of the mechanisms under the ETF. The BTR process has been integrated into all adaptation reporting mechanisms at the national level to ensure that transparency is maintained. The BTR will be the main monitoring and reporting tool for adaptation and mitigation activities.

Measurement, Reporting and Verification System

Pakistan's MRV System integrates data collection, analysis and reporting to ensure:

- Transparency in the implementation of adaptation measures
- Accountability for the allocation and use of resources
- Timely identification of gaps and areas for improvement.

The MRV System covers progress toward adaptation goals outlined in the NAP, NCCP and provincial adaptation initiatives. It includes provisions for stakeholder consultations to ensure inclusiveness and reflect diverse perspectives in adaptation monitoring. Pakistan plans to integrate the MRV System in all major reporting requirements.

Pakistan Climate Portal

The MoCC has developed a number of online tools that are available on the Pakistan Climate Portal (ccit.pk), including a tool for climate adaptation and mitigation finance tracking (MoCC, 2024a). The platform is an effort to ensure transparency in climate finance flows and track adaptation and mitigation activities against commitments made in the NDC (Figure 3.2).

RiSQ Transparency Platform

The RiSQ platform provides access to inventories, documents and climate-related information (Figure 3.3). The platform also publishes the status of monitoring and verification of submitted documents.

3.6.4 Key challenges in monitoring

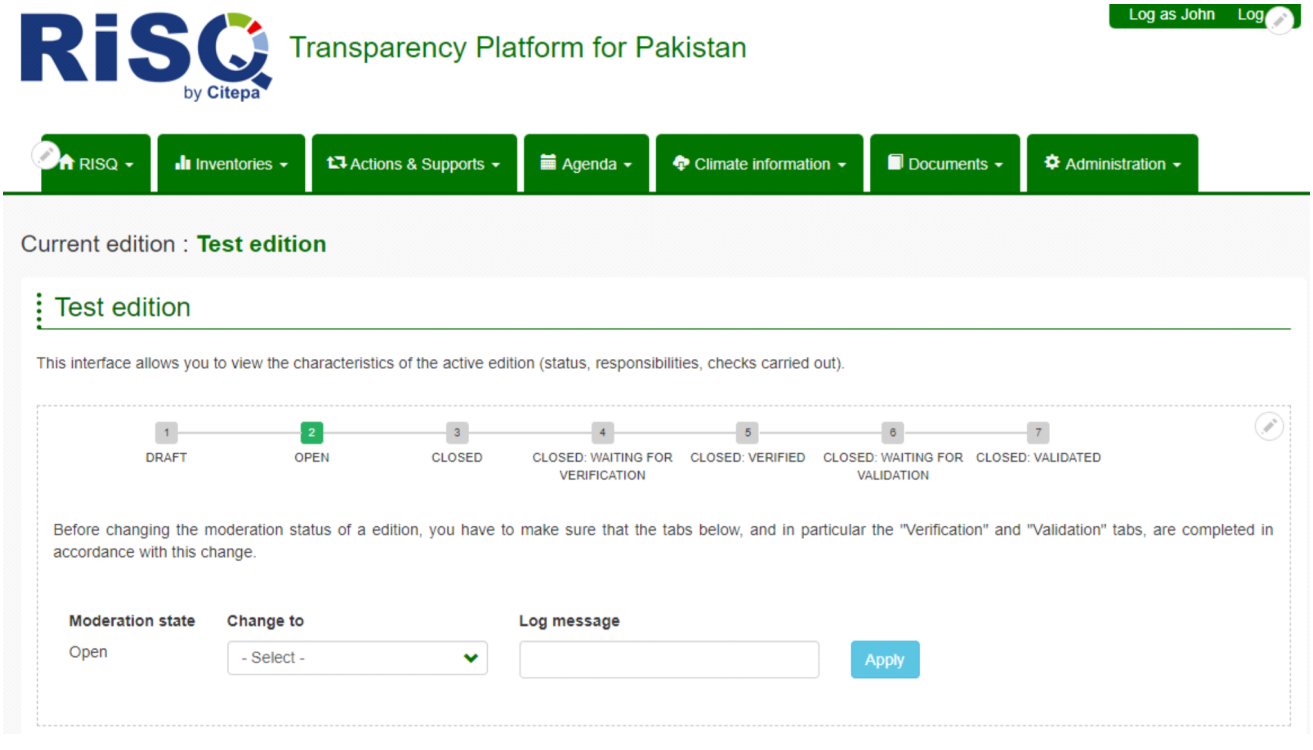
The main challenges for adaptation monitoring are related to data and financing. Data collection, analysis and management are expensive and resource-intensive processes. Funding and technical expertise are key constraints.

Data collection and analysis

Pakistan faces significant gaps in technical expertise, capacity and equipment for data collection and analysis. Investments in technology, such as remote sensing and GIS tools, along with dedicated resources, are essential to build a reliable database. Capacity-building initiatives, knowledge and technology transfer are critical to allow Pakistan to meet international reporting standards.

Figure 3.2: Pakistan Climate Portal

Figure 3.3: RiSQ Transparency platform



Institutional coordination

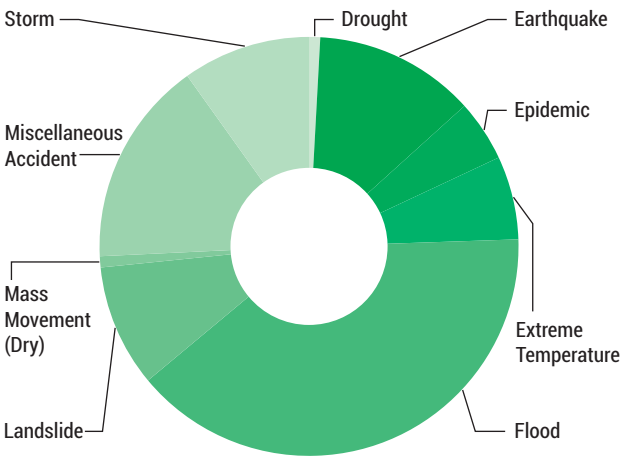
The lack of standardised metrics and methodologies for reporting makes it difficult to consolidate data. The problem is compounded by capacity issues at the provincial and local levels, along with technical barriers to implementing MRV systems based on quantitative indicators. A centralised monitoring and reporting framework is required, integrated across climate-related sectors at the national and sub-national levels.

3.7 Loss and damage associated with climate change impacts

Pakistan is the world's most vulnerable country to the impacts of climate change (Germanwatch, 2025). Until recently, the country was 8th in the Climate Risk Index of vulnerable nations (Germanwatch, 2023). The Index was revised in 2025 and Pakistan is now ranked 1st mainly because of the exceptionally high economic losses it has suffered and the number of people affected (Figure 3.4).

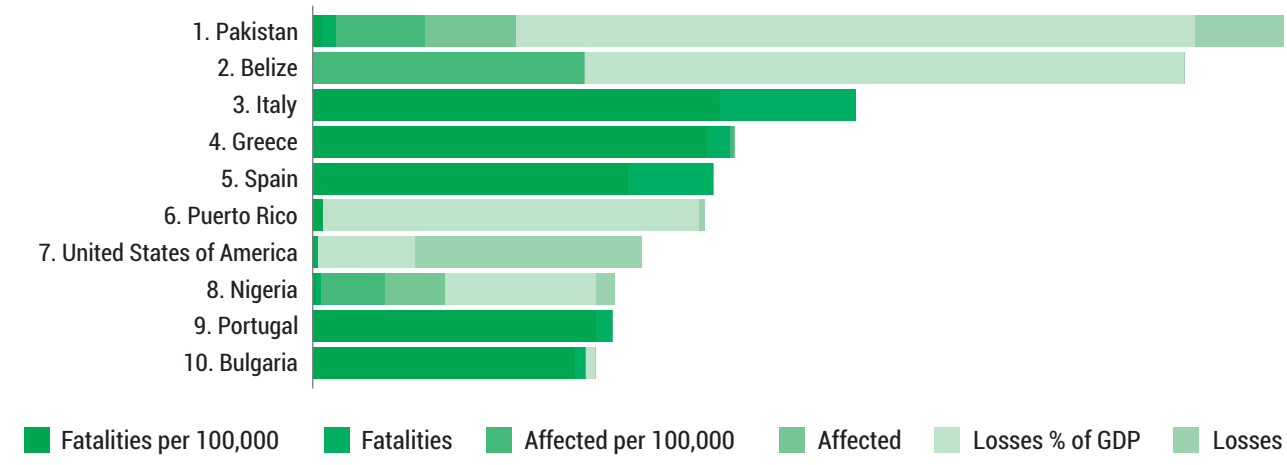
Over the last four decades, the most frequent natural disasters in Pakistan have been related to extreme weather events (Figure 3.5). The country's diverse geography, ranging from arid deserts to high mountains, makes it particularly vulnerable to a range of climate hazards, including floods, droughts, GLOFs and heatwaves. High levels of poverty, low adaptive capacity and inadequate infrastructure exacerbate these vulnerabilities.

Figure 3.5: Average annual natural disaster occurrence (1980-2020)



Source: Climate Change Knowledge Portal

Figure 3.4: Climate Risk Index 2025 rankings



Source: Germanwatch, 2025

3.7.1 Climate disasters and their impacts

Over the last two decades, Pakistan has faced a number of climate-induced disasters of increasing frequency and severity. These disasters have killed thousands, displaced million and resulted in extensive damage to land, homes and infrastructure. This section provides an overview of climate disasters in Pakistan and their impacts.

Floods

Between June and September 2022, Pakistan was hit by unusually heavy monsoon rains. The resulting floods, the worst in the country's history, affected more than 33 million people (nearly 15% of the population) and displaced around 8 million (IFRC, 2023). A national state of emergency was declared in August of that year, when around 10% of the country was inundated.

More than 1,700 people were killed and 12,800 were injured. Around 1 million homes were destroyed and 2.1 million sustained significant damage (GoP, 2023b). The floods inundated 4.5 million acres of agricultural land and killed 1.1 million livestock (IFRC, 2023). More than 5,000 km of roads and 250 bridges were destroyed (Khan, 2022). Education was disrupted for millions of children and public health services struggled to cope with the rise in waterborne disease (WB, 2022).

Total economic losses from the 2022 floods exceed USD 30 billion, with an estimated USD 14.9 billion in damage and around USD 15.2 billion in loss to GDP (UNDP, 2022). Sectors that were worst affected were housing (USD 5.6 billion); agriculture, food, livestock and fisheries (USD 3.7 billion); and transport and communications (USD 3.3 billion).

The cost of reconstruction and rehabilitation is estimated at USD 16.3 billion (GoP, 2023b). Sectors with the greatest reconstruction and recovery costs are transport and communications (USD 5.0 billion); agriculture, food, livestock and fisheries (USD 4.0 billion); and housing (USD 2.8 billion). The provinces of Balochistan and Sindh were the worst hit, accounting for approximately 15% and 50%, respectively, of reconstruction costs (GoP, 2023b).

Pakistan is no stranger to devastating floods. In 2010 the country witnessed severe floods that affected around 20 million people, with close to 2,000 killed, 1.6 million houses damaged or destroyed, and millions of hectares of agricultural land inundated. The 2010 floods caused an estimated USD 10 billion in financial losses (NDMA, 2011). Other major floods occurred in 2011 and 2012, affecting 55-60 million people and causing more than 3,500 deaths (Qamer et al., 2023).

Heatwaves

Pakistan has witnessed several record-breaking heatwaves during the last decade. The 2015 Karachi heatwave caused more than 1,200 fatalities, making it one of the deadliest in the country's history. Many of the victims were labourers or the elderly, and the majority were from low-income social groups without access to medical care or air conditioning. In May 2019, another heatwave struck, causing at least 65 deaths, with Jacobabad (Sindh) recording a high of 49°C.

During the most recent heatwave, in April-May 2022, temperatures soared to 50°C in Jacobabad and 49.5°C in Nawabshah (Sindh). A real-time extreme event attribution study shows that climate change made the heatwave 30 times more likely (WWA, 2022).

Droughts

Droughts have become increasingly frequent, with major events recorded in 1998-2002, 2014-15 and more recently, in 2018-20. Balochistan and Sindh are the worst affected, with intense heat and below-normal rainfall leading to water scarcity and crop failures. In 2020, the Pakistan Meteorological Department declared drought conditions in several districts of Balochistan, citing a rainfall deficit of up to 60% below normal. In 2022, the UN listed Pakistan as one of 23 drought-hit countries (UNCCD, 2022).

Recurrent droughts in Balochistan and Sindh have severely impacted agriculture and livestock, destroying livelihoods and leading to food insecurity. They have exacerbated poverty, forced internal migration and led to malnutrition, especially among children. The long-term impacts include desertification, soil degradation, loss of biodiversity and increased reliance on humanitarian assistance.

Glacial lake outburst floods

The northern regions of Pakistan, particularly Chitral district (KP) and GB, are home to over 7,000 glaciers and highly vulnerable to GLOFs. The GLOF event of 2010 in the Bagrot valley (GB) and the one in 2015 in Chitral are notable examples. The highest frequency of GLOF events (37 in a single season) was recorded in 2022, causing massive destruction to houses, farmland and infrastructure, leaving communities cut off for days.

There are over 3,000 glacial lakes in Pakistan, of which around 33 are considered potentially dangerous (ICIMOD, 2020). More than 7 million people are at risk.

Cyclones

Six record-breaking cyclones during the last two decades have devastated coastal communities (GoS, 2012). Most recently, Biparjoy was a powerful tropical cyclone that formed over the east-central Arabian Sea in June 2023. An estimated 1.2 million people were affected by winds of 90-120 km/h (55-75 mph) and 81,000 people were evacuated. Heavy gusts and torrential rain damaged or destroyed more than 2,500 houses.

3.7.2 Experience from extreme weather events

The massive destruction following **mega floods** has exposed significant shortcomings in Pakistan's disaster preparedness and response, particularly weather prediction, early warning systems and evacuation protocols. However, the disaster also highlighted the effectiveness of community-led resilience measures, such as voluntary evacuation, local shelters and volunteer networks for disaster relief. Experience from the floods underscores the need to integrate climate resilience and community involvement in disaster risk reduction activities.

Disruptions caused by **heatwaves** highlight the need for more effective emergency responses. Cities need to develop action plans, issue alerts, set up emergency kiosks and launch public information campaigns. Rapid urbanisation and poor planning intensify the urban heat island effect. In the longer term, urban adaptation measures are essential, such as heat-resilient infrastructure, green urban planning and the creation of green spaces.

Experience from prolonged **droughts** highlights the need for climate-smart agricultural practices, efficient irrigation systems and drought-resistant

crop varieties. Climate models indicate that drought conditions will occur more frequently in the coming decades and their intensity will continue to increase. To avoid crop failures and the loss of livelihoods, ongoing pilot initiatives for climate-smart practices need to be scaled up on an emergency basis.

Rising temperatures are accelerating glacial melt, leading to the formation of unstable glacial lakes and the increased risk of **GLOF events**. Measures to mitigate the risks include early warning systems, the construction of protective infrastructure and community-based disaster preparedness.

Lessons learned

While important steps are being taken to address these risks, there are broader lessons that should be taken into consideration. Key lessons are as follows:

- Proactive planning is essential to minimise loss and damage, and to avoid the widespread destruction and displacement caused by extreme weather events. This requires strengthening weather forecasting and early warning systems, and developing locally appropriate emergency response protocols.
- The integration of climate resilience into national development agendas is critical if development goals are to be achieved. This means ensuring that climate change is a central consideration in all policy frameworks, particularly in sectors like agriculture, forestry, water, energy and urban planning.
- Improved coordination between federal, provincial and local governments is essential to avoid fragmentation and/or duplication of efforts.
- Local knowledge and traditional practices can help to mitigate climate risks. Community engagement in adaptation efforts builds resilience and empowers communities.
- Technological solutions are essential to build resilience at the scale that is required. The frequency of extreme weather events and the severity of their impacts mean that Pakistan must seek out and deploy the most advanced technology and tools to strengthen emergency response and build resilience.
- Adaptation and resilience measures must be gender-responsive and should take into consideration the needs of vulnerable groups such as the elderly and people with disabilities.

Challenges

Key gaps and challenges in current approaches include the following:

- Inadequate data and damage assessment tools
- Limited institutional capacity and coordination
- Absence of climate risk insurance
- Reliance on ad-hoc international aid
- Weak community-level engagement.

3.7.3 Measures to address loss and damage

Pakistan has developed a number of strategies and plans for disaster management and resilience building. These include the National Adaptation Plan (2023), Resilient Recovery, Rehabilitation and Reconstruction Framework (2022), National Flood Protection Plan IV (2017) and National Disaster Risk Management Framework (2007). What they all have in common is the failure to include a dedicated mechanism to address loss and damage.

While Pakistan has yet to develop a dedicated strategy for this purpose, this section summarises key measures that are required to address loss and damage, as shown in Table 3.12.

3.8 International cooperation

Pakistan's climate risk profile makes it more difficult for the country to meet economic growth targets and achieve human development goals. The country relies on international cooperation and support in a number of areas including financing, knowledge exchange and technology transfer. These include international cooperation and partnerships for knowledge exchange and technology transfer.

3.8.1 Financial support

International financial institutions play a critical role in Pakistan's climate adaptation efforts. Pakistan has been able to access support from international climate funds such as the AF, GCF and GEF, and continues to explore new opportunities. For instance, in 2025 the International Monetary Fund approved the country's request for an arrangement under the Resilience and Sustainability Facility (RSF), giving Pakistan access of about USD 1.4 billion to support efforts to reduce vulnerability to natural disasters and build climate resilience (Sherani, 2025). RSF financing is subject to disbursement on completion of specific resilience projects and policy actions.

Table 3.12: Key measures to address loss and damage

Thematic area	Measures
Institutional capacity	- Consider the establishment of a National Loss and Damage Authority to manage and coordinate efforts to address climate-induced losses - Strengthen coordination between the NDMA, PDMAs and local governments though regular meetings, joint planning and data sharing
Policy integration	- Integrate strategic frameworks on climate change and disaster risk management to develop a coordinated and cohesive approach to loss and damage - Integrate loss and damage into climate policy and development planning to ensure that loss and damage are adequately addressed, and to align measures with development goals - Align national loss and damage policies with international frameworks such as the Paris Agreement and the Sendai Framework for Disaster Risk Reduction to ensure coherence and mobilise global support
Financing	- Increase allocations for disaster risk and recovery in national and provincial budgets - Access global funding mechanisms, such as the COP 27 Loss and Damage Fund, through proactive engagement, and by establishing robust governance structures and ensuring transparency in fund utilisation - Explore innovative finance mechanisms such as climate bonds, public-private partnerships and international co-financing to diversify funding sources
Preparedness	- Invest in technology to improve the accuracy of disaster forecasts and provide better data for decision-makers at all levels - Modernise forecasting infrastructure by expanding weather radar coverage, improving satellite-based weather monitoring systems and utilising advanced modeling techniques to predict extreme weather events - Expand and improve early warning measures, including mobile- and SMS-based alerts, and risk awareness campaigns - Strengthen emergency response by training local disaster planners, developing community-specific disaster management plans, and ensuring that disaster response personnel are well trained and properly - Ensure that the needs of women, children, the elderly and people with disabilities are front and centre is disaster response planning

Thematic area	Measures
Risk insurance	- Establish and operationalise a National Climate Risk Insurance Facility to offer products that can provide a buffer against financial losses incurred as a result of climate-induced disasters - Provide subsidised insurance policies for small farmers, small businesses and communities to support faster reconstruction and recovery - Introduce index-based crop and livestock insurance with payouts tied to specific climate thresholds, such as rainfall or temperature, allowing farmers to receive compensation in the event of climate-induced crop failures or livestock losses - Develop regional risk-pooling mechanisms to share the financial burden of disaster recovery with other countries and to leverage collective bargaining power for better terms - Partnering with private insurers and international donors to expand coverage, with subsidised insurance products tailored to the needs of low-income communities
Community-based adaptation	- Support and encourage locally driven projects to ensure that communities have the resources and support they need to cope with loss and damage - Promote climate-resilient farming and water management for long-term food security and poverty reduction - Involve women and vulnerable groups in disaster planning to ensure that their needs are properly addressed - Train women in climate resilience techniques, facilitate their participation in local disaster response teams, and ensure equitable access to disaster recovery resources, services and support
International collaboration	- Strengthen engagement with UNFCCC and G77+China - Advocate for fair and timely disbursement of loss and damage funds when participating in international forums - Develop partnerships with regional and global research centres

These financial mechanisms will enable Pakistan to implement large-scale adaptation projects that cannot be financed solely through domestic resources. Details of the financial support received are discussed in Chapter 4.

3.8.2 Technical assistance and technology transfer

International cooperation has facilitated technology transfer to strengthen climate resilience actions. This includes providing advanced radar technology and automatic weather stations to upgrade and expand weather surveillance, strengthening early warning systems and significantly reducing disaster response times (JICA, 2021). International agencies have supported the introduction of drought-resistant crops and efficient irrigation systems (FAO, 2020). Details of technology transfer support received are discussed in Chapter 4.

3.8.3 Bilateral and multilateral partnerships

Pakistan engages with a number of international partners to strengthen its adaptive capacity. Notable collaborations include partnerships with the Asian Development Bank (ADB), Food and Agriculture Organisation (FAO), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), UN Office for Disaster Risk Reduction (UNDRR) and World Bank (WB), as well as bilateral agreements with countries like Germany and Japan. These partnerships focus on capacity building, climate-resilient infrastructure and community-based adaptation. For example, Germany's International Climate Initiative has funded projects to enhance water management and agricultural resilience in Pakistan's arid regions.

3.8.4 Regional collaboration

Pakistan is part of several regional initiatives that support adaptation efforts at home. These forums provide a platform for the exchange of knowledge, technology and expertise. Key regional collaborations are as follows:

- Commission on Science and Technology for Sustainable Development in the South
- International Centre for Integrated Mountain Development
- Ministerial Standing Committee on Scientific and Technological Cooperation of the Organization of Islamic Cooperation
- Regional Integrated Multi-hazard Early Warning System
- South Asian Association for Regional Cooperation
- South Asian Climate Change Adaptation Network
- South Asian Heat Health Information Network
- South Asian Meteorological Association.

3.8.5 Collaboration with international research institutions

Through partnerships with international research institutions, Pakistan gains access to the latest research, data and modeling tools that help inform climate adaptation policies. Key research partnerships include:

- China-Pakistan Joint Research Centre
- Institute of Mountain Hazards and Environment
- International Food Policy Research Institute
- International Water Management Institute
- Max Plank Institute for Climate Change Research.

Chapter

4

Financial, technology development and transfer, and capacity-building support needed and received under Articles 9-11 of the Paris Agreement

4. Financial, technology development and transfer, and capacity-building support needed and received under Articles 9-11 of the Paris Agreement

4.1 National circumstances, institutional arrangements and country-driven strategies

4.1.1 National circumstances

Despite achieving modest GDP growth of 2.4% in the fiscal year 2023-24, Pakistan's economic recovery has been sluggish (GoP, 2024c), in large part due to the disastrous floods in 2022. The agriculture sector, which experienced a growth rate of 6.25%, remains highly susceptible to climate risks (GoP, 2024c). A recent report by the ADB shows that an overwhelming majority of Pakistanis consider climate change to be a serious problem that affects them but they also understand that the government has limited capacity to take action to reduce climate change impacts (ADB, 2024). A vast majority of respondents consider heatwaves to be the most significant climate induced challenge. The same report has projected that by 2070 Pakistan may lose up to an average of 21.1% of GDP due to climate change, of which losses in labour productivity (up to 10.4%) and agriculture, forestry and fisheries (up to 12.0%) will be major contributors.

In 2022 Pakistan experienced its wettest summer since 1961, resulting in severe floods that affected over 33 million people across 94 districts (GoP, 2022f). The floods caused more than 1,700 fatalities and resulted in significant damage amounting to PKR 3.3 trillion (USD 15.2 billion) (GoP, 2022f). The sectors most affected were housing, agriculture, food, livestock and fisheries (GoP, 2022f). Rebuilding and recovery costs are significant, with the transport and communications sector requiring the largest outlay, amounting to PKR 1.1 trillion (USD 5.0 billion) (GoP, 2022e). Balochistan and Sindh were the provinces hardest hit, requiring 15% and 50%, respectively, of the total funding for recovery and rebuilding (GoP, 2022e).

Similarly, in 2024 Pakistan witnessed an unprecedented heatwave, killing more than 550 people (Davies, 2024).

These events serve as a stark reminder of the severe impact climate change is already beginning to have on Pakistan's development and poverty reduction goals. Climate change will also have a significant impact on water availability, with severe water stress expected in arid regions. The economic costs of climate change are projected to be substantial, potentially weakening economic growth by 0.2-2.0% once global temperatures increase by 2°C (IPCC, 2015).

Pakistan has recently been assessed as the country most vulnerable to the impacts of climate change (Germanwatch, 2025) but it lacks domestic resources to tackle this threat and must rely on external funding (Majeed and Anjum, 2020). At the same time, the country is

faced with a burgeoning energy import bill amounting to USD 17.5 billion in 2023 (Rana, 2024), while crude oil imports are expected to grow by 5-7% in 2025 (Zamir, 2024).

To address these challenges, Pakistan is expanding indigenous energy sources, particularly renewable energy, and implementing incentives to promote green energy projects. Green financing has emerged as an important component in the finance sector, providing substantial resources for low-carbon, renewable and climate-neutral projects and initiatives.

Taken together, these factors highlight the urgent need to increase the flow of financial, technology development and transfer, and capacity-building (FTC) support to Pakistan.

4.1.2 Paris Agreement framework for FTC support

Pakistan ratified the UNFCCC on 1 June 1994 (UNGA, 1994), followed by the Kyoto Protocol (UNFCCC, 1997) on 10 January 2005 and the Paris Agreement (UNFCCC, 2015) on 10 November 2016. The Paris Agreement provides a framework for FTC support to developing countries that need it (UNFCCC, 2024):

- **Article 9: Finance**. The Paris Agreement reaffirms that developed countries should take the lead in providing **financial assistance** to developing countries that are more vulnerable, while for the first time also encouraging voluntary contributions by other Parties. Climate finance is needed **for mitigation**, because large-scale investments are required to significantly reduce emissions. Climate finance is equally important **for adaptation**, as significant resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate.
- **Article 10: Technology**. The Paris Agreement envisions the comprehensive **development and transfer of technology** to both improve resilience to climate change and reduce GHG emissions. It establishes a **technology framework** to provide guidance for accelerating technology development and transfer.
- **Article 11: Capacity building**. Not all developing countries have the capacity to deal with climate change challenges. The Paris Agreement places **emphasis on climate related capacity building** for developing countries and requests all developed countries to enhance support for capacity-building actions in developing countries.

The Paris Agreement also emphasises the need for transparent reporting of climate actions, and support provided and received:

- **Article 13: Enhanced Transparency Framework**. The Paris Agreement establishes the ETF. Starting in 2024, countries are to report on actions taken and progress made in mitigation and adaptation efforts, and on support provided or received. It also provides procedures for the review of submitted reports. The information gathered through the ETF will feed into a global stocktake to assess collective progress towards long-term climate goals.

For the full text of Articles 9, 10, 11 and 13 of the Paris Agreement, see Annex B.

In line with its commitments under the UNFCCC and the Paris Agreement, Pakistan has so far made timely submissions of all required documentation (Table 4.1). Next on the submission agenda is the BTR, of which this chapter is a part.

This chapter follows the 'Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement' or MPGs (UNFCCC, 2018), and subsequent guidance provided by the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the UNEP.

4.1.3 Institutional arrangements

Pakistan's contribution to global GHG emissions is just 0.93% but the country is among those most affected by climate change (Germanwatch, 2025). Pakistan has an institutional framework, supported by policies and legislation, to address the challenges of climate change. This section discusses key institutions that are engaged in climate finance related activities and/or have climate finance related responsibilities.

Ministry of Climate Change and Environmental Coordination

The Ministry of Climate Change and Environmental Coordination (MoCC) is the apex body responsible for national-level policy and coordination on climate action. This includes fulfilling obligations under international environmental agreements, liaising with donors and funding agencies, promoting research and technical cooperation, and serving as the focal point for the UNFCCC.

The MoCC is responsible for reporting progress on multilateral environmental agreements, including the Paris Agreement (see Table 4.1). Preparation and submission of National Communications, Nationally Determined Contributions, the Biennial Update Report, and now the BTR, are part of its mandate.

The MoCC plays a pivotal role in prioritising climate finance needs and designing proposals, acting as clearing house. Climate finance related responsibilities are assigned to the Additional Secretary-I, who is assisted by the Climate Finance Wing.

The **Climate Finance Wing** is a dedicated office within the MoCC established to facilitate coordination with global climate finance mechanisms and opportunities, including international climate finance institutions such as the GCF and GEF. It focuses on project development, accreditation of national entities and the Country Readiness Programme. It builds the capacity of federal and provincial stakeholders, particularly with respect to the implementation of national climate policies and frameworks, and GEF/GCF programmes (MoCC, 2024b).

Under the Pakistan Climate Change Act 2017, the **Pakistan Climate Change Authority** (PCCA) has recently been established. Its role includes formulating policies, establishing institutional

Table 4.1: Pakistan's submissions to the UNFCCC

Submission	Date
Pakistan's Initial National Communication on Climate Change	2003
Pakistan's Intended Nationally Determined Contribution	2018
Pakistan's Second National Communication on Climate Change	2018
Pakistan Updated Nationally Determined Contributions	2021
Pakistan's First Biennial Update Report	2022

and policy frameworks, conducting assessments, preparing reports, advising the government, coordinating and monitoring policy implementation, conducting research, and mobilising resources. The Member Climate Finance is responsible for facilitating needs identification, prioritisation and resource mobilisation for climate action. There are plans to operationalise the **Pakistan Climate Change Fund** (PCCF), as envisaged in the Act of 2017, to coordinate and manage climate finance more effectively. The Fund will provide financial assistance based on established criteria and procedures.

The **Global Climate-Change Impact Studies Centre** (GCISC), which works under the MoCC, is responsible for research on the effects of climate change on key sectors, along with capacity building and public awareness. The research programme is organised into three groups: (i) climatology and environment, (ii) water resources and glaciology, and (iii) agriculture, forestry and land use. It provides technical and communications training, and disseminates research findings to the scientific community, policymakers and the public. The GCISC is mandated to prepare the national GHG inventory.

Ministry of Foreign Affairs

As a developing nation highly vulnerable to the impacts of climate change, Pakistan has an important role to play in shaping the global climate agenda, such as leading the Group of 77 and China at the UNFCCC. The Ministry of Foreign Affairs (MoFA) participates in all climate related negotiations, advancing the country's position on climate finance and international commitments. MoFA represents Pakistan on the GCF Board, where it advocates for the country's interests and priorities to ensure that GCF decisions and initiatives are aligned with Pakistan's national climate objectives and strategies. MoFA serves as Pakistan's second national focal point to the UNFCCC.

Ministry of Finance

The Ministry of Finance (MoF) plays a crucial role in climate finance by mobilising and allocating resources for climate mitigation and adaptation. This includes attracting international climate finance, integrating climate considerations into national budgeting processes and strengthening domestic financial systems to support climate-resilient development. The MoF collaborates with other government agencies and international organisations to ensure that climate finance aligns with national priorities and international commitments.

The MoF was responsible for development of the Pakistan Climate Change Financing Framework 2017 (GoP, 2017) and the Pakistan Climate Public Expenditure and Institutional Review (GoP, 2015). It has been spearheading Pakistan's efforts to access international climate finance.

Ministry of Economic Affairs

The Ministry of Economic Affairs (MoEA) plays an important role in climate finance by coordinating and facilitating economic policies that support climate-resilient development. This includes working with international financial institutions and donors to secure funding for climate projects, and ensuring that climate finance is integrated into national economic planning. The MoEA helps to identify and address barriers to climate finance, such as debt payments, access and accreditation requirements, risk appetite, transaction costs and market failures. It advocates for policies that encourage private sector investment in climate-friendly initiatives.

All requests to a foreign government or an international organisation for economic or technical assistance related to climate finance are made through the Economic Affairs Division, which liaises with the relevant foreign government or organisation through prescribed channels.

Ministry of Planning, Development and Special Initiatives

The MoPDSI is primarily responsible for development planning. It has a pivotal role in addressing climate change by integrating climate considerations into national development plans, bringing the planning and development perspective to climate policy and strategy formulation, ensuring focus on economic growth, gender-sensitive adaptation and mitigation efforts, and identifying sectoral priorities to scale climate finance in terms of private sector engagement, international climate finance and carbon markets.

MoPDSI has established the **Sustainable Finance Bureau** to transform climate finance by reorienting the Public Sector Development Programme (PSDP) towards sustainable finance, with a significant portion of new schemes being green. It has developed a **Climate-Responsive Public Investment Framework** to integrate climate considerations into the planning and implementation of all development projects. This framework is aligned with the NAP and the NDC. It has also developed a **Green Growth Framework** to promote emerging green value chains and support environmentally sustainable and financially viable economic activities. It ensures that development projects are climate-proofed to enhance resilience to climate impacts. The MoPDSI has started the process to acquire GCF accreditation so that it can serve as a direct access entity (DAE) for the federal PSDP.

Ministry of Science and Technology

The Ministry of Science and Technology (MoST) collaborates with national and international organisations to secure funding for climate-related projects. It is responsible for promoting scientific research and technological innovation, and facilitates the transfer of technology from developed countries to Pakistan. This includes projects focused on renewable energy, energy efficiency and climate change adaptation. MoST works to build the capabilities of scientists, researchers and institutions, providing financial resources and training. In doing so it aims to build a larger pool of skilled human resources and strengthen technology institutions in the country.

National Energy Efficiency and Conservation Authority

Established under the National Energy Efficiency and Conservation Act 2016, the National Energy Efficiency and Conservation Authority (NEECA) is responsible for implementing energy efficiency and conservation initiatives. Notable achievements include the Energy Efficiency Standard and Labelling programme, Minimum Performance Energy Standards for electric fans, and a GEF-funded project promoting energy-efficient lighting. NEECA collaborates with provincial governments and international organisations to establish energy conservation tribunals and support provincial energy conservation efforts, setting standards for technology adoption to conserve energy.

Provincial climate change and environment departments

Provincial climate change and environment departments are responsible for implementing climate change policies and strategies within their respective jurisdictions. Their task is to

develop and implement measures for adaptation and mitigation in vulnerable sectors. Provincial departments work to improve financing for climate action by planning and prioritising climate related development projects. Administratively, provincial departments are responsible for spending of the climate change and environment portfolio under the provincial PSDP and reporting on this expenditure.

Provincial planning departments

Similar to the MoPDSI at the federal level, provincial planning departments are responsible for planning, approving and monitoring public sector development expenditure. They manage climate finance at the provincial level, integrating climate considerations into provincial development plans, coordinating with federal and local governments to ensure cohesive climate action, identifying and accessing financing to fund climate-related projects, overseeing the implementation of climate projects, and monitoring outcomes.

Two provincial planning departments, KP and Punjab, have started the process to acquire GCF accreditation to serve as DAEs for the provincial PSDP.

Specialised research and development organisations

There are a number of specialised research and development organisations in the public sector that play a crucial role in tackling climate change impacts. They collaborate with national, regional and global research entities, and facilitate the adoption and deployment of the latest technologies and methodologies in Pakistan. They build the capacities of subnational organisations through training, joint projects and knowledge exchange. The most relevant of these include:

- Pakistan Agricultural Research Council, including the National Agricultural Research Centre and the Climate, Energy and Water Research Institute, under the Ministry of National Food Security and Research
- Pakistan Council of Renewable Energy Technologies, under MoST
- Pakistan Council of Research in Water Resources, under the Ministry of Water Resources
- Pakistan Science Foundation, under MoST.

Academic institutions, research centres and laboratories

Pakistan has an extensive network of more than 200 universities, a mix of public, private and military institutions, as well as specialised universities for medicine, engineering, management, and science and technology. There are also a number of specialised research and development centres and laboratories located within or outside universities. These institutions conduct research on new approaches and technologies for climate mitigation and adaptation, identify climate finance opportunities, develop funding proposals, and collaborate with international organisations to secure climate finance. They facilitate the transfer of technology by collaborating with industry partners and international bodies, and provide training and support for the implementation of new technologies. Educational programmes and training workshops conducted by these institutions build expertise in climate science and policy.

4.1.4 Legal and policy framework

National Climate Finance Strategy 2024

The National Climate Finance Strategy (NCFS), developed by the MoCC with World Bank assistance, envisions a climate resilient, low-

carbon economy by 2050 (GoP, 2024b). It is a framework designed to mobilise and deploy climate finance, involving a three-pronged approach: (i) a whole-of-government strategy, (ii) diversifying domestic revenue and international finance, and (iii) innovative finance mechanisms, with periodic reviews. Key objectives include identifying and overcoming barriers to climate-resilient development, and increasing investment in adaptation and mitigation. The NCFS emphasises gender responsiveness, and research and development for low-carbon growth, with a governance framework ensuring coordination and performance monitoring at the national and provincial levels. (For details on the NCFS, see Annex C.)

Pakistan Policy Guidelines for Trading in Carbon Markets 2024

The Policy Guidelines provide for the establishment of carbon markets and set out a roadmap for their operation (GoP, 2024d). They align carbon markets with Pakistan's climate goals and policy priorities, establishing two distinct market mechanisms: voluntary carbon markets and the compliance market.

The Guidelines aim to mobilise private-sector finance, drive sustainable investment and accelerate the transition to a low-emissions economy. They provide guidance on conditions for producing, exporting and trading mitigation outcomes (MOs), internationally transferred mitigation outcomes (ITMOs) and certified emission reductions (CERs), ensuring protection of the rights and interests of parties. They address eligibility criteria, monitoring, standardisation, compliance, governance, transparency, reporting and safeguards for emission reduction projects.

The Guidelines will be revised biennially to address emerging challenges, enhance effectiveness and align with Pakistan's climate goals and international commitments. Revisions will be informed by implementation experience, changing circumstances, stakeholder feedback, data analysis and international benchmarking.

5Es Framework to Turnaround Pakistan 2023

This framework presents a roadmap to achieve the goals set out in the Vision 2025 document. It emphasises the need to increase climate-responsive public investment through the revision of public investment manuals, green budget tagging, and implementation of the Resilient Recovery, Rehabilitation and Reconstruction Framework (GoP, 2022g). It also notes the need to access the Loss and Damage Fund. The Framework lists a number of initiatives to address these priorities (Figure 4.1).

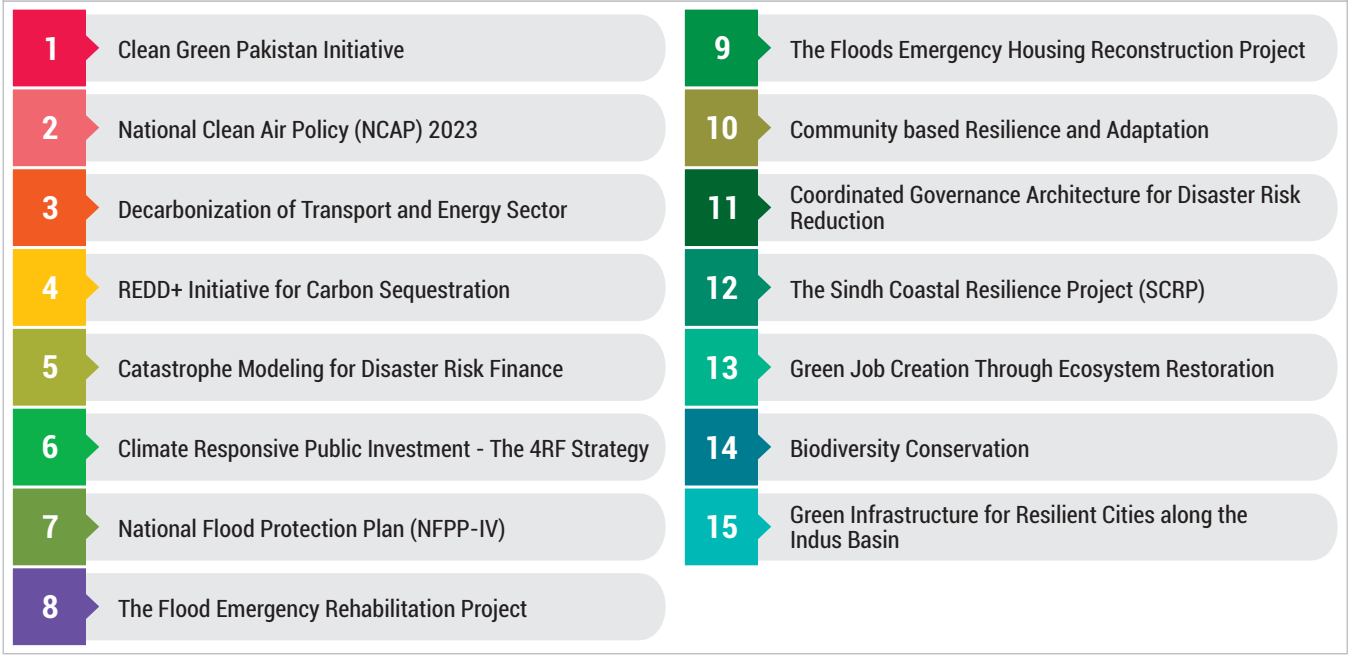
Long-Term Vision 2050 (2023)

This development strategy aims to transform Pakistan into a low-carbon, green economy by 2050 (GoP, 2023d). Recommended measures include a combination of innovative technologies, responsive policies and robust partnerships between the government, business and civil society. A recent ADB report notes that Pakistan has pledged to a target of net zero by 2050 but has no plan in place (ADB, 2024).

National Adaptation Plan 2023

The NAP seeks to establish a climate-resilient Pakistan where communities have the adaptive capacity to collaborate for prosperity, personal and national well-being, and ecosystem protection through sustainable approaches (GoP,

Figure 4.1: 5Es Framework to Turnaround Pakistan



2023b). With the financial and technical support of various development partners, Pakistan is developing district and local-level adaptation plans that will enable local actors to implement climate action in accordance with their needs and adopt nature-based adaptation solutions.

Biennial Update Report 2022

Pakistan's first Biennial Update Report (BUR) provides an overview of the country's mitigation potential and actions under the Second National Communication on Climate Change (GoP, 2018b). Underscoring Pakistan's commitment to address climate change, the BUR describes the measures being taken in sectors such as energy, agriculture, transport and waste. It discusses MRV processes, including data collection, institutional arrangements, stakeholder engagement and coordination mechanisms. The BUR emphasises the significance of international climate finance, technology development and capacity building to enhance these efforts. It identifies broad policy and implementation priorities and gaps for climate change mitigation and adaptation in energy, industry, transport, building, forestry, agriculture and waste management. However, these priorities need to be validated through an extensive consultative process.

Pakistan Vision 2025 (2022)

Developed in 2014 and updated in 2022, this document serves as the country's development framework (GoP, 2022c). Vision 2025 recognises climate change as a critical challenge for economic growth, social development and environmental sustainability, and emphasises the need to integrate climate change into the country's development agenda. It notes the importance of international cooperation to address climate challenges, calling for increased engagement with the global community to mobilise resources and greater support for implementing mitigation and adaptation measures.

National Climate Change Policy 2021

The NCCP focuses on three key areas: mitigation, adaptation and nature-based solutions (GoP, 2021a). It identifies vulnerable sectors, such as agriculture, water, energy, forestry, biodiversity and human health, and outlines adaptation measures for each sector. The policy aims to guide Pakistan towards climate-compatible development, ensuring that climate change considerations are integrated into vulnerable sectors of the economy. Key objectives include:

- Aligning climate change policy with other national policies
- Promoting pro-poor and gender-sensitive adaptation strategies
- Implementing cost-effective mitigation measures
- Building climate-resilient infrastructure
- Facilitating the transition to cleaner, low-emission and less carbon-intensive development
- Enhancing policy coherence and integration to achieve SDG targets
- Encouraging tree plantation, natural resource conservation, nature-based solutions and long-term sustainability.

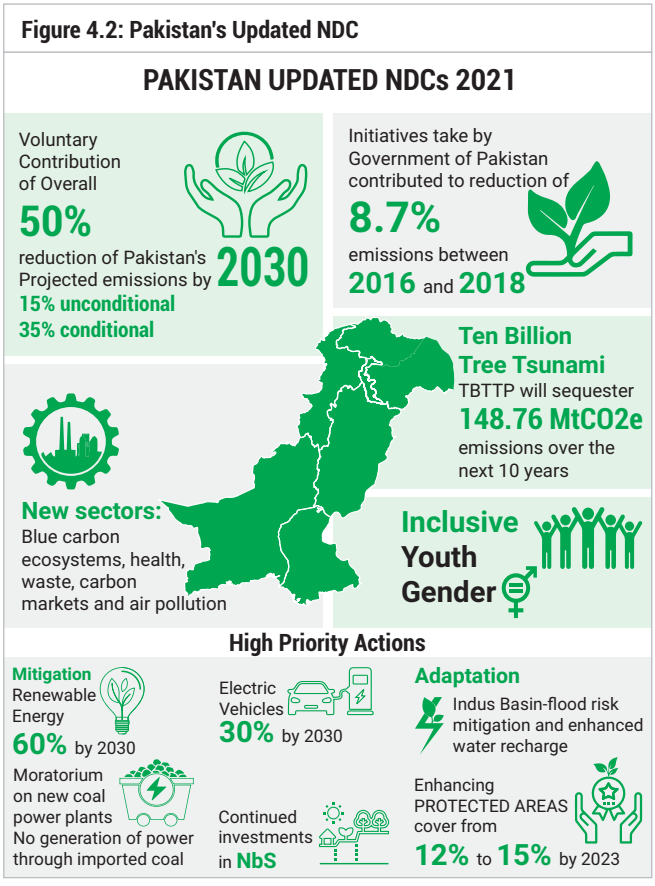
The **Framework for Implementation of Climate Change Policy 2014-2030** was released in 2013, building on an earlier National Climate Change Policy (2012) which has now been updated. The Framework emphasises the need to adapt to the impacts of climate change and contribute to mitigation. It highlights the climate vulnerabilities of various sectors, including water, agriculture, forestry, coastal areas, biodiversity, ecosystems and public health, and outlines actions for disaster preparedness, capacity building, institutional strengthening and raising awareness.

The Framework is designed to be used in the preparation of provincial and local adaptation action plans, other national policies and plans, and national reporting documents for the UNFCCC. It is intended to be a living document, with periodic review and revision to incorporate emerging concepts and issues in climate science. The Framework has not yet been updated to align with the revised NCCP (2021).

Updated Nationally Determined Contributions 2021

The updated NDC sets an ambitious target to cut projected emissions by 50% by 2030 (GoP, 2021d). Pakistan will be able to finance 15% through domestic sources but will need international grant financing for the remaining 35%. By 2030, Pakistan also intends to transition to 60% renewable energy, increase the penetration of EVs to 30% of all new sales and ban imported coal (Figure 4.2). To achieve these

Figure 4.2: Pakistan's Updated NDC



targets, Pakistan will promote nature-based solutions and strengthen its scientific and technical capacities. Pakistan recognises its financial needs and seeks to improve access to international climate finance while exploring market- and non-market-based approaches. The private sector is encouraged to play a role in implementing climate actions and developing nature-based solutions for both mitigation and adaptation.

National Electric Vehicle Policy 2019

This policy sets out objectives and targets for the adoption of EVs. It applies to vehicles without an internal combustion engine that operate solely on an onboard battery. The primary objectives of the policy are to mitigate climate change, encourage local EV manufacturing, develop associated industries such as battery manufacturing and charging infrastructure, reduce the country's oil import bill, utilise electricity during off-peak hours, and create employment through green economy initiatives (GoP, 2019c). To promote EV adoption, the government will provide incentives, tax concessions and benefits. Measures are structured in three phases over a five-year period, covering market development, fuel import bill substitution, and local adoption and export of EVs and EV components. Government support is expected to generate earnings and yield savings of approximately USD 400 million annually, with target penetration achieved within five years. The government is currently revising the policy to create the necessary ecosystem for EVs, such as charging stations, power subsidisation and tax incentives.

National REDD+ Strategy 2018

The National REDD+ Strategy sets out guiding principles and a roadmap for implementation, along with proposed institutional frameworks and strategic measures to address deforestation and forest degradation (GoP, 2018a). It calls for the establishment of benefit-sharing mechanisms at the national and provincial levels. It recommends that the PCCF should serve as the national entity responsible for receiving and distributing funds related to REDD+, and proposes a mechanism for distribution within the provinces. The roadmap outlines actions to be taken in the future, contingent on local conditions and deforestation drivers, that require substantial financial support from domestic and international sources, including private sector players interested in financing forestry or carbon forestry projects.

Pakistan Climate Change Act 2017

The Act provides for the creation of three key entities with responsibilities for climate action: the PCCA, PCCC and PCCF. The roles of the PCCA and PCCF have been discussed above. The PCCC is responsible for coordinating and overseeing enforcement of the Act. It also monitors the implementation of international agreements, approves and supervises policies, and reviews annual reports from the PCCA. While the PCCA and PCCC have been operationalised, and the PCCF is in the planning stage. Implementing rules and regulations under the Act have not yet been issued.

Technology Needs Assessment for Climate Change 2016

The Technology Needs Assessment (TNA) is a comprehensive effort to identify and prioritise technologies required for climate change adaptation and mitigation (GoP, 2016b). This series of reports analyses Pakistan's technology needs for building climate resilience, covering the following areas:

- Priority sectors and technologies: Identification of specific technologies to

help address climate-related challenges in key sectors such as agriculture, water and energy
- Barrier analysis and enabling framework: Analysis of barriers to technology adoption, with proposed enabling framework to overcome barriers
- Technology action plan and project ideas.

The TNA was prepared through a consultative process involving government, private sector and civil society stakeholders. Detailed action plans were developed for priority technologies to guide implementation. The TNA emphasises the importance of international collaboration and the need for financial and technical support to introduce and implement the identified technological solutions.

Provincial climate change policies and action plans

The following provincial and subnational climate change policies, strategies and action plans have been notified:

- AJK Climate Change Policy 2017
- Balochistan Climate Change Policy 2024
- GB Climate Change Strategy and Action Plan 2017
- GB Climate Change Adaptation Action Plan 2023
- KP Climate Change Policy 2022
- KP Climate Change Action Plan 2022
- Punjab Climate Change Policy and Action Plan 2024
- Sindh Climate Change Policy 2022.

These documents aim to integrate climate change adaptation and mitigation into vulnerable sectors. Aligned with the NCCP, these documents identify sectoral climate actions with indicative financing plans and avenues for accessing climate finance.

4.1.5 Systems and processes used to identify, track and report

The MoCC has primarily responsibility for coordinating FTC support needed and monitoring FTC support received, whether through international development financing or carbon markets. It collects information from the relevant government agencies (federal and provincial) and private sector organisations, and compiles reporting documents that are required under the ETF. These reports undergo an agreed-upon review process before being submitted to the UNFCCC.

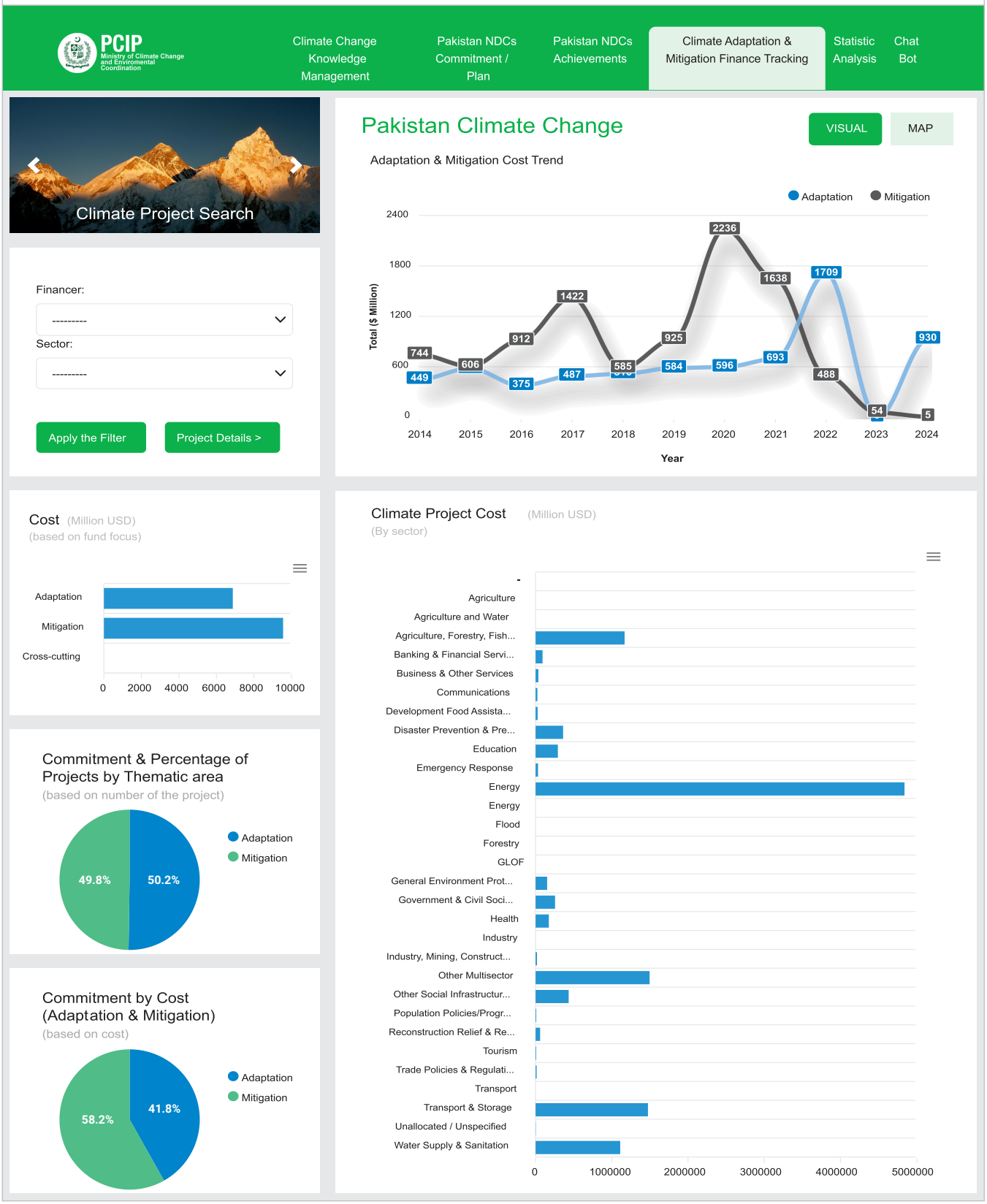
The MoCC has developed the interactive Pakistan Climate Portal (Figure 4.3) that provides detailed information on bilateral and multilateral climate-related project financing. A formal registry of climate finance has yet to be developed.

Pakistan lacks a formal MRV system for GHG emissions and FTC support, and relies instead on ad-hoc project-based inventories. In the interim, the GCISC is responsible for the compilation of GHG inventories.

The MoCC is in the process of developing standards for provincial reporting on GHG emissions and revising Pakistan's NDC. It intends to establish a single-window MRV system for coherent and streamlined reporting to the UNFCCC. Reporting on FTC support needed and received will be an integral component of the new MRV system. Based on international best practice guidance (GIZ, 2016), Pakistan's MRV system for tracking FTC support will include:

- **Defining the purpose and rationale** of the MRV system, reflecting intended contributions and actions (depending on support received) in the design of the

Figure 4.3: Pakistan Climate Portal



system, and considering the international finance architecture.
- **Measurement** of what MRV covers (e.g., financial flows, technology transfer, capacity building, supported activities, impact of supported actions), identifying indicators and assigning clear responsibilities to government departments/agencies or the private sector for measurement, according to their expertise.
- **Reporting** on the type of support (finance, technology transfer, capacity building), purpose of support, sectoral and geographical distribution, private finance leveraged, impact achieved, and comparison between donor pledges and actually disbursed support.
- **Verification** of the scale, effectiveness and impact of FTC support, ideally through independent third-party review.
- **Continuous improvement** through ongoing assessment of strengths, opportunities, weaknesses and constraints of the existing system.

The MoCC will collaborate with the Planning Commission and MoF to identify domestic and international financing sources for mitigation and adaptation programmes and activities. All organisations receiving climate support will be required to report to the MoCC the sources of financing for their climate related activities.

4.2 Assumptions, definitions and methodologies

Assumptions underlying the assessment of FTC support needed and received are as follows:

- Pakistan's climate finance needs are estimated at USD 200 billion for NDC implementation and USD 348 billion for climate-resilient development over a period of seven years (2023-2030) (GoP, 2024b).
- As a biennial report, the BTR covers a two-year period (2023 to 2024).
- This report uses the US dollar (USD) as standard currency, converted to Pakistani rupees (PKR) at the rate of USD 1 = PKR 280. Where a USD value is referenced from other reports or studies, it is cited as stated in the source document without currency conversion.
- This report is based on secondary information obtained from Pakistan's earlier submissions (including the NDC, NAP, BUR and National Communications), consultation reports and submissions of other countries at the ETF portal.

4.2.1 Definitions and methodology

This report uses the standard definitions, methodology and common tabular format (CTF) established under the Paris Agreement and subsequent guidance. FTC support needed and received is reported with respect to four key areas of work:

- GHG inventory preparation
- Vulnerability assessments
- Mitigation actions
- Adaptation actions.

From Pakistan's perspective any inward financial transfers, including financial assistance (grants), loans (concessional or commercial) and revenue earned from carbon markets, that are available to fund climate adaptation and/or mitigation activities are considered to be climate finance. However, for the purposes of this report, as guided by the UNFCCC-SBSTA, only assistance received through bilateral and/or multilateral financial channels has been reported.

Given the absence of a widely adopted methodology and mechanism for tracking and reporting on the climate components of public

and private investments in Pakistan, only official sources of information have been used.

It should be noted that climate financing, defined as local, national or transnational financing to support mitigation and adaptation actions, needs to be differentiated from green financing, which refers to financial flows for sustainable development projects from banking, microcredit, insurance and investment from the public, private and not-for-profit sectors.

4.3 Financial support needed

As the world's most vulnerable country to the effects of climate change (Germanwatch, 2025), Pakistan is in urgent need of climate financing to tackle the climate challenges it already faces, and which will intensify in the years ahead. However, Pakistan has encountered capacity barriers in accessing international and regional climate financing options. To address this issue, it has developed the **National Climate Finance Strategy 2024** and the **Policy Guidelines for Trading in Carbon Markets 2024**, which aim to strengthen its position when it comes to accessing climate finance.

As outlined in the **Climate Public Expenditure and Institutional Review** (2015), the **cost of adaptation** is anticipated to vary between 3% of GDP in 2015 and 1.5% of GDP in 2050 (GoP, 2015). This amounts to USD 6-14 billion, or an average of USD 10.7 billion annually between now and 2050. **Pakistan's NDC** commits to **reduce GHG emissions** by up to 50%, of which 35% is contingent on external green/climate financing. The NDC identifies the need for USD 101 billion by 2030 for the clean energy transition alone, and an additional USD 65 billion by 2040 to complete ongoing renewable energy projects, expand transmission and phase out coal by replacing with hydropower (GoP, 2021d). To phase out coal by 2030, Pakistan is exploring both market and non-market based strategies, including issuing green bonds and instruments for carbon pricing, to diversify financing sources for capital-intensive projects.

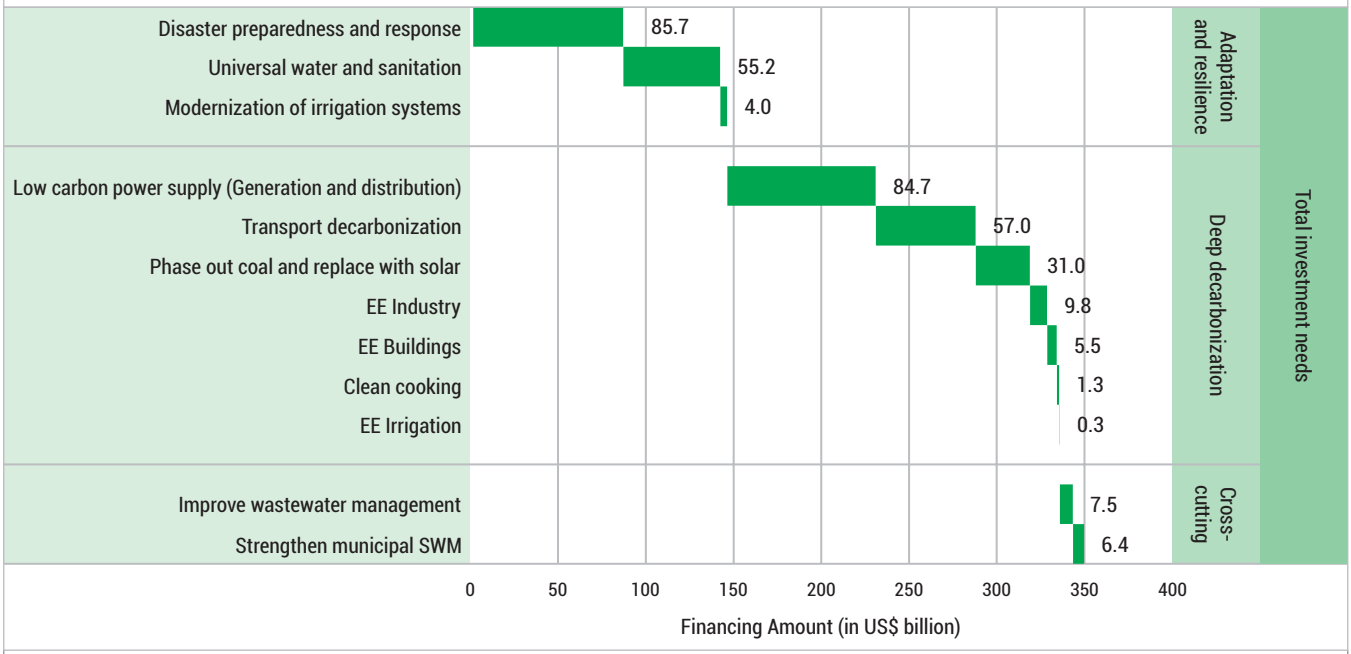
The World Bank has estimated that total investment requirements for a comprehensive response to Pakistan's climate and development challenges between 2023 and 2030 amount to approximately USD 348 billion (10.7% of cumulative GDP for the same period), including USD 152 billion for **adaptation and resilience** and USD 196 billion for **deep decarbonisation** (WB, 2022). Sectoral priorities and distribution of this financing are shown in Figure 4.4.

Similarly, the ADB has projected that Pakistan needs USD 267 billion to finance **commitments under the NDC** (ADB, 2023). As a provincial distribution is not provided by either of these reports, the National Finance Commission (NFC) formula for distribution amongst the provinces may be taken as a proxy for provincial allocations (see GoP, 2024a).

The MoCC has developed a Draft Report on Priority Actions for the Implementation of the NDC (GoP and UNDP, 2023). The plan breaks down objectives and instruments into actionable items with indicators, targets, goals, roadmaps and checkpoints. Identified priority actions have been validated through provincial consultations. The indicative cost of this umbrella initiative amounts to USD 2,367 million (Figure 4.5). The full list of projects has been entered into the ETF portal using the CTF.

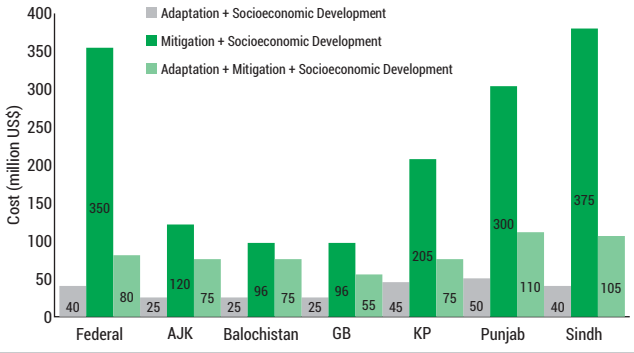
The NAP identifies 117 priority interventions to be financed under Article 9 of the Paris Agreement. Since these interventions have not yet been projectised and costed, they are not included in the CTF. These interventions are listed in Table 4.2.

Figure 4.4: Sectoral distribution of climate finance needed



Note: Sectoral needs are based on the best available data and analytics. Certain investment needs of critical sectors, such as climate-smart agriculture and integrated land management, which are identified as key priorities in the Pakistan Country Climate and Development Report, are unavailable. To avoid double counting, total recovery and reconstruction needs following the 2022 floods (USD 16.3 billion for up to 5 years) were not added because this figure falls within the range of the average disaster preparedness and response cost of USD 10.7 billion annually, based on MoCC analysis (WB, 2022).

Figure 4.5: Cost of identified priority actions for NCCP and NDC implementation



The BUR has also identified financial support needed to meet the country's climate objectives (Table 4.3).

The consultative process for the Third National Communication emphasised that in order to access climate finance through diverse funding sources, Pakistan should push for climate justice, identify needs, build stakeholders capacity and promote public-private partnerships. The national consultative workshop held in January 2025 recommended critical climate finance needs to support sectoral climate actions (Table 4.4).

A retrospective review of funding levels in recent years indicates that the **financing composition available** over the next decade will amount to approximately USD 39 billion from public finance, including multilateral development bank (MDB) financing, and USD 9 billion from public-private partnerships for infrastructure projects. MDBs have provided approximately USD 6.4 billion for climate-related investments over the 2015-2020 period (GoP, 2023a) and are anticipated to remain the primary source of international climate finance for Pakistan. For instance, a substantial portion of World Bank lending to Pakistan (44% in FY 2021) is now contingent on climate co-benefits and 50% of the portfolio of the

Table 4.2: Initiatives identified in the NAP

Sector/ theme	Objective	Initiative	Timeframe
Agriculture-water nexus	Incentivise farmers to transition to climate-smart water and land management practices	Improve agricultural research and extension services. This will include: - Focusing on climate resilient crop varieties, regenerative agriculture practices for land preparation, sowing and harvesting, efficient and sustainable fertiliser application, improved on-farm water management, intercropping and crop diversification - Tailoring extension services to agro-ecological zones, fostering inclusivity in the development process, and learning from past successful pilots (e.g., expansion of olive cultivation) and accomplishments at scale (e.g., steady increase in maize production) - Ensuring extension services related to irrigation application are informed by groundwater assessments and best estimates of projected changes in rainfall timing - Research and extension priorities specific to livestock in strengthening disease control, breeding of more productive and disease-resistant animals, and increasing access to nutrition and feed to increase productivity and reduce enteric emissions	Short term
		Support creation of forums, such as producer groups, that facilitate collaboration between small farmers and other actors in crop-specific value chains, including private sector that can help farmers access national and international markets	Short term
		Increase access to credit for on-farm technology adoption and purchase of inputs that support climate-smart agriculture, which includes establishing institutions that provide information to the farmers regarding finances available for technologies, equipment, and climate resilient crops	Short term
		Restructure existing financial tools to target smallholder farmers and repurpose them as instruments to incentivise crop diversification, improved water productivity and improved land management	Medium term
		Identify and develop a risk management system including crop insurance	Medium term
	Modernise surface and groundwater irrigation services to support the transition to climate-smart agriculture	Upgrade IBIS rehabilitation programmes to modernise surface water distribution systems. Key modernisation steps will include: - Increasing hydraulic control in the secondary distribution system to ensure sufficient delivery to watercourses under different flow regimes - Improving real-time groundwater monitoring in canal command areas to facilitate conjunctive management of ground and surface water - Developing integrated hydro-agro informatics systems to make irrigation supply responsive to crop water requirements - Developing flexible and participatory institutional arrangements and regulations to maximise equity and reliability in the operation of modernised infrastructure	Medium term
		Develop a long-term plan for asset management, and operations and maintenance with a focus on: - Maintaining conveyance efficiency - Reducing non-beneficial losses, especially leakages in saline groundwater zones and waterlogged areas - Ensuring access for tail-end users - Ensuring all measurement systems are regularly calibrated	Short term

Sector/ theme	Objective	Initiative	Timeframe
		Develop regulatory frameworks to manage groundwater use in agriculture and a programme for managed aquifer recharge	Short term
		Modernise the abiana framework by digitising the abiana assessment and collection system and creating a financial diversification programme for irrigation departments to increase revenue	Short term
	Develop long-term agriculture growth strategy with a focus on productivity improvement, climate resilience and physical expansion	Establish a coordination mechanism to reduce overlap and maximise synergies between various public sector and private institutions working on climate-smart agriculture	Short term
		Develop a dynamic dashboard for monitoring crop water requirements using a combination of remote sensing and periodic ground-truthing, linking to the action above on developing hydro-agro informatics systems	Short term
		Develop an environmental management plan for agriculture which focuses on conservation of soil and water quality	Short term
		Assess culturable wasteland and develop a long-term investment programme to identify feasible interventions that can bring land into environmentally sustainable productive use	Short term
		Reduce post-harvest losses by investing in agricultural storage, transport, and physical and communication infrastructure that integrate farmers with value chains	Medium term
	Develop a plan for managing projected river flow and rainfall variability under different climate scenarios	Develop plans for managing drought-flood cycles in areas where both hazards affect agricultural communities. Key actions in the development and implementation of these plans will include: - The most feasible and locally appropriate infrastructure options from the above list - Institutional and community-based measures for rationalising water use during periods of drought - Improving risk monitoring and early warning systems	Short term
		Develop a plan for strategic water storages across the country that minimises environmental and social harms and decentralises and devolves management of stored water. Priority will be given to: - Small rainfall and runoff capture dams for groundwater recharge or direct use - Dispersion structures with downstream storage for productive use of hill torrents - Small storage within the canal distribution system to regulate irrigation supply - Watershed restoration work that increases infiltration of rainfall and runoff into groundwater	Short term
Natural capital (land, water, and air)	Mainstream sustainable land management into ecosystem services	Prepare and implement a landscape restoration programme across the country, including innovative financing approaches and mainstreaming into provincial programmes	Short term
		Support a transition to regenerative agriculture for the reduction of agro-chemical use, which will play a crucial role in curbing water body pollution	Short term

Sector/ theme	Objective	Initiative	Timeframe
		Expand agro-forestry into smallholder farming and rangelands management across the country	Medium term
		Introduce a system to reduce and replace pesticide and chemical fertiliser use to minimum needs	Medium term
		Introduce schemes to reduce burning of agricultural crop residues and to improve soil fertility	Medium term
		Increase investment in the restoration of ecosystem services and income-generating infrastructure in priority protected areas	Long term
		Introduce right-pricing of user charges and fees for natural resources (water, fisheries, timber) and the polluter pays principle	Long term
	Promote integrated watershed management	Restore the top 20% of heavily degraded upper watersheds through re-seeding, forest planting, land reclamation structures, and livestock management and productivity improvements	Medium term
		Introduce ecosystem service payments to communities for providing clean, sediment-free water downstream and for watershed maintenance	Medium term
		Operationalise the Living Indus Initiative: - Enact the Indus Protection Act and establish the associated trust fund - Prepare a study and implement a scheme to return flows to the Indus - Promote coordination and knowledge exchange	Long term
	Improve water quality through better wastewater management	Install wastewater treatment plants in all urban sewerage systems, and develop a financing model to maintain existing combined effluent treatment plants to keep them functional and operational at full capacity	Short term
		Replicate existing best practices in anaerobic digestion technology for recycling and waste-to-energy use	Long term
	Invest in coastal and marine resources protection	Design and implement coastal management and resilience plans to restore mangroves, coastal barriers and coastal aquifer recharge	Short term
		Implement plans to reduce coastal plastic, solid and liquid pollution	Medium term
		Develop the potential of the 'Blue Economy', including the health of marine and coastal ecosystems	Long term
	Invest in the air pollution-climate change nexus	Prepare and implement clean air investment plans for priority sectors to achieve air-quality standards (domestic, cooking, transport, industry, agriculture, municipal solid waste burning)	Short term
		Prepare air governance assessments and implement strengthening plans	Medium term
		Establish and enforce air quality standards in priority sectors	Medium term
		Implement the identified programmes and periodically review and update investment plans based on new data and changing circumstances	Long term

Sector/ theme	Objective	Initiative	Timeframe
Urban resilience	Mainstream climate adaptation in urban planning across federal, provincial and local governments	Generate granular, precise and reliable data on climate risks, infrastructure and poverty to improve targeting of adaptation measures	Short term
		Incorporate climate vulnerability and risk considerations into city master plans and other urban development policies	Medium term
	Improve land regulation and land use planning to bolster resilient service provision	Introduce better land use planning and control measures to ensure that settlements are not located in flood-, landslide- and liquefaction-prone areas	Short term
		Apply land use planning and tools such as site and service instruments to enable more efficient urban anatomies	Short term
		Register peri-urban properties to make them part of the formal land management system, with land conversion controls, zoning and building codes to increase resilience in the face of disasters	Medium term
		Ensure that land records and maps are unified, accurate and digitised as the basis for improved land allocation, risk-informed spatial planning and asset management strategies to support resilience	Medium term
		Develop and adopt national and subnational urban resilience strategies and action plans	Long term
		Upgrade informal settlements based on the action plan adopted in the national urban resilience strategy and subnational adaptation plans	Long term
		Address poorly functioning land markets and onerous land use regulations to limit current low-density growth patterns	Long term
	Bolster climate-smart municipal services	Mobilise local authorities and community volunteers to proactively remove debris and garbage from drainage systems to reduce flooding	Short term
		Enhance drainage networks and promote sustainable urban drainage solutions	Medium term
		Strengthen regulations and institutions that regulate, manage and enforce the provision of infrastructure and services	Medium term
		Upgrade infrastructure and systems to provide adequate and equitable municipal services	Long term
	Leverage nature-based solutions to manage climate risks	Identify and introduce NbS initiatives to enable adaptation and to tackle urban heat, urban water scarcity and flood risks	Medium term
		Identify opportunities to scale up urban forest projects	Medium term
		Create open spaces and wetlands to help control stormwater by capturing runoff	Medium term
		Construct green roofs and permeable pavements to promote rainfall infiltration	Long term
	Develop financing instruments to ensure sustainable revenue streams for green and resilient urbanisation	Carry out concentrated policy action to facilitate public-private partnerships, including addressing gaps at the framework level and in existing standardised contracts to address climate change issues	Short term
		Introduce intergovernmental fiscal transfers focused on a multi-sectoral investment menu which targets adaptation interventions	Medium term

Sector/ theme	Objective	Initiative	Timeframe
		Improve cost recovery for urban services through the adjustment of user-charges to free up financing for green public investments and address relevant policy actions	Long term
Human capital	Mainstream climate adaptation in health policies	Conduct assessment to strengthen the understanding of climate change impacts on public health and formulate a roadmap to address such challenges	Short term
		Improve data collection, reporting, analysis and record keeping of climate-sensitive diseases	Short term
		Upgrade and extend disease outbreak monitoring and forecasting to counteract possible climate change health impacts, and support planning for effective interventions	Medium term
		Integrate climate change adaptation measures into national and subnational policies in the health sector	Long term
	Mainstream climate adaptation in education policies	Conduct assessment to strengthen understanding of climate change impacts on education, and formulate a roadmap to address such challenges	Short term
		Improve data collection, reporting, analysis and record keeping of loss to education days, student absenteeism, etc.	Short term
		Mainstream climate change adaptation into the roadmap for skills development	Medium term
		Integrate climate change adaptation measures into national and subnational policies in the education sector	Long term
	Enhance climate resilience through disaster emergency preparedness and response (health)	Develop a communications and dissemination strategy for the climate-health nexus and implement associated awareness and prevention campaigns	Short term
		Issue timely alerts and advisories on climate and disaster information to health personnel and communities	Short term
		Strengthen the capacity of federal, provincial and district level healthcare bodies to prepare for and respond to health risks during climate-exacerbated disasters	Medium term
		Ensure family planning services are available at all levels	Long term
		Expand climate-resilient WASH facilities to unserved and underserved areas and populations	Long term
	Enhance climate resilience through disaster emergency preparedness and response (education)	Develop emergency and evacuation standard operating procedures for educational institutions and associated facilities	Short term
		Provide training and simulations (or drills) for teachers, students, workers and other education personnel on emergency response and evacuation procedures	Short term
		Construct educational facilities that can serve as multipurpose shelters in the event of weather or climate disasters, especially in the most vulnerable areas	Medium term

Sector/ theme	Objective	Initiative	Timeframe
	Build workforce capacities to address climate Risks	Include climate change in the curricula of all secondary schools and offer specialised courses in colleges and universities	Short term
		Develop and implement occupational and vocational training programmes in a wide range of occupational fields, manufacturing, services and livelihoods that are directly or indirectly linked with climate change	Long term
		Provide an enabling environment for entrepreneurs and small businesses to develop environmentally friendly products and services	Medium term
Disaster risk management	Understand climate and disaster risk by investing in state-of-the-art hydromet, climate and early warning systems	Establish an open-access, credible, national climate data and information database for sharing climate-related data and information with stakeholders across various sectors	Short term
		Develop a nationwide and district-level multi-hazard vulnerability and risk assessment in a spatial-temporal format, including detailed and location-specific assessments	Short term
		Undertake GIS mapping of all existing irrigation infrastructure, especially flood embankments, for effective flood monitoring and management	Short term
		Undertake hydrological modelling and flood-plain mapping and zoning of the Indus River system using climate change scenarios to estimate various projected flood levels	Medium term
		Strengthen hydro-meteorological monitoring, forecasting and early warning systems	Medium term
		Develop capacity based on remote sensing and GIS techniques for monitoring temporal changes in glaciers and snow cover, and in land cover in different agro-ecological zones	Medium term
		Strengthen GCISC's capacity to enhance knowledge management on climate change adaptation, fostering interdisciplinary research, innovation and capacity building	Medium term
	Strengthen disaster risk governance	Prepare and upgrade the National Disaster Management Plan II and National Flood Protection Plan IV	Short term
		Formulate and approve provincial-level disaster management and climate change legislation, policies, plans and strategies	Medium term
		Put systemic functions in place to ensure that policy and regulatory frameworks are implemented and enforced	Medium term
		Enhance coordination and cooperation among entities responsible for climate change and development to identify means for risk-informed development	Medium term
	Invest in disaster risk reduction to bolster the resilience of communities and critical infrastructure	Develop robust disaster and climate risk screening tools to be integrated into public financial management processes at both the federal and provincial levels	Short term
		Mainstream disaster and climate risk screening into public investment appraisals, planning, implementation and monitoring at both the federal and provincial levels	Short term

Sector/ theme	Objective	Initiative	Timeframe
		Implement cost effective, innovative and agile DRM solutions to reduce the loss of life, infrastructure and livelihoods at all scales	Medium term
		Establish climate and DRM funds at the subnational or provincial level	Short term
		Develop and implement climate and disaster risk finance and insurance products, with a focus on the most vulnerable and marginalised communities	Medium term
		Building on existing programmes, establish a climate and disaster shock-responsive social protection system, with a focus on the most vulnerable and marginalised communities	Medium term
		Ensure that infrastructure, including telecommunications, power, utilities and transport, are resilient in the face of climate change impacts, particularly extreme weather events	Medium term
	Enhance disaster preparedness for effective response and to 'build back better' by incorporating risk-informed approaches into recovery and reconstruction efforts	Develop a Disaster Recovery Framework to institutionalise recovery, enabling the development of strategies, guidelines, capacities and institutions for proactive recovery management	Short term
		Develop a last-mile, early warning dissemination system for natural disasters using innovation and technology (e.g., radio and SMS messaging)	Short term
		Ensure community participation in early warning dissemination and DRR activities, particularly in developing evacuation plans	Short term
		Develop standard operating procedures (SOPs) that clearly define the roles and responsibilities of each relevant department during natural disasters	Short term
		Strengthen the capacities of the DRM agencies and district level actors to address multiple hazards and to raise the resilience, efficiency and effectiveness of the DRM system	Medium term
		Scale up community based disaster risk management to strengthen the adaptive capacity of communities through local level organisations	Medium term
		Upgrade public evacuation shelters and provide comprehensive awareness training to ensure their effective use	Medium term
Gender, youth, and social inclusion	Support vulnerable groups in strengthening their capacity for DRM	Map key stakeholders and identify their capacity needs for gender and socially inclusive DRM; conduct training and capacity development corresponding to their needs	Short term
		Set quotas for the inclusion of women in all district and municipal DRM authorities	Short term
		Set up a helpline for reporting gender-based violence and child marriage to protect women and girls during and after disasters	Short term
		Develop learning materials to integrate gender and social inclusion, and how they link with climate change and disasters, into school, college and university curricula	Medium term
		Develop community disaster management systems linked to existing community service delivery platforms, strengthening early warning systems	Medium term

Sector/ theme	Objective	Initiative	Timeframe
	Empower vulnerable groups through fostering climate-resilient livelihoods	Introduce energy-efficient, low-cost cooking technologies tailored to women's needs to promote sustainable cooking practices	Short term
		Provide comprehensive training programmes on climate-smart agriculture practices and regenerative agriculture	Short term
		Foster entrepreneurship in agriculture and food production by removing bottlenecks and providing financial and other incentives, such as business incubation and mentoring programmes	Short term
		Increase the representation of female extension officers and invest in safer transport to reach female farmers, particularly in rural areas	Medium term
		Identify, document and scale up indigenous water management technologies to promote sustainable water resource use	Short term
		Provide comprehensive training programmes focusing on water, sanitation and health issues at the local level	Short term
		Provide comprehensive training programmes focusing on sustainable land and watershed management, and biodiversity conservation at the local level	Short term
		Provide comprehensive training programmes focusing on fisheries and coastal management at the local level	Medium term
		Promote entrepreneurship in forestry and non-timber forest products by removing bottlenecks and providing financial and other incentives, such as business incubation and mentoring programmes	Medium term
	Promote inclusive participation of vulnerable groups in climate related policy and development planning	Conduct research and data collection to better understand the specific impacts of climate change on vulnerable groups	Short term
		Launch awareness campaigns and outreach programmes to raise awareness about the importance of including vulnerable groups in climate change decision making	Short term
		Encourage the representation of vulnerable groups in key decision making bodies related to climate change, such as climate councils, environmental agencies and advisory committees	Short term
		Integrate gender and social inclusion considerations in all climate related policies and programmes to ensure that they are inclusive and responsive to the needs of diverse vulnerable groups	Medium term

Source: GoP, 2023 b.

Table 4.3: Financial support needs identified in the Biennial Update Report

Sector	Support needed
GHG inventory preparation	Building team capacity for GHG inventory preparation
	Establishing fully equipped facilities for GHG inventory preparation
	Conducting further training on 2006 IPCC national GHG inventory guidelines for technical staff working on GHG inventory preparation
Vulnerability assessment	Field activities including assessments and training of clients

Sector	Support needed
	Projects on: - Setting up agricultural production surveillance system in various arid, semi-arid and other vulnerable areas - Installing automatic weather stations and similar monitoring systems to reduce data gaps - Delineating areas vulnerable to floods and drought
	Arranging adequate operational funds to fully utilise existing capacity of organisations
	Procuring measurement equipment
Mitigation actions	Improving grid infrastructure to enable managing large share of VREs
	Enhancing capacity of distribution network of all DISCOs to manage large share of VREs
	Supplying electricity to remote areas of the country to ensure compliance with SDG7 through various applications including RE-fed micro grids
	Financing renewable power projects across the country
	Identifying best practices in different sectors for the development of best practice manuals
	Projects on: - Promoting solar water pumping solution - Providing climate-smart agriculture projects to offset GHG emissions
	Feasibility studies and mitigation related projects
Adaptation actions	Capacity development on adaptation actions
	Projects on: - Adopting dry/aerobic rice production technology - Setting up satellite-based crop monitoring and yield estimation system - Promoting permanent raised beds for various farming systems - Introducing drought tolerant and heat resistant varieties of wheat, barley, moong and maize in arid ecologies - Promoting community based range improvement interventions for better vegetative cover, forage production and soil improvement - Improving livestock health units
	Farmer training
	Building resilient infrastructure and mechanisms that do not require costly repair and maintenance, and minimises the impact of natural disasters for the livelihoods and well-being of communities
Source: GoP, 2022 e.	

Table 4.4: Financial support needs identified at national consultative workshop

Sector	Support needed
Energy	Promotion of renewable energy, including hydrogen, wind, solar, hydel
	Projects for waste-to-energy, biogas, biochar
Transport	Promotion of EVs, establishment of charging stations
	Introduction of alternate fuels, including green hydrogen, blue hydrogen, biofuels
	Development of low-carbon cargo logistics systems
	Development of pedestrian and cycling infrastructure through subsidised incentive-based mechanisms

Sector	Support needed
Industry	Development of heat capture and reuse systems
	Introduction of circular economy
	Deployment of expanded producer responsibility mechanisms
	Introduction of subsidy for energy use
	Enhanced traceability of clean production mechanisms and resource efficient cleaner production
	Grouping of industry type, zoning of industry on circular concept
	Compliance for industrial waste water treatment systems
	Establishment of smelting zones with combined scrubbing system
	Enforcement of air exhaust filtration system in stone crushing industry
	Enforcement of on-site sprinkling system to manage air pollution in construction industry
	Promotion of zig-zag brick kilns and electric kilns
	Setting up of emission tracking system to support ETS cap-and-trade
	Establishment of voluntary reporting dashboards
	Setting of targets for black carbon and particulate matter
Agriculture and livestock	Development of methane and ammonia capture reporting system
	Development of rice/cotton production emission calculation methodology
	Development of methane emission tier-2 inventory
	Enabling environment and capacity building for water use efficiency (high efficiency irrigation system)
	Propagation and provision of climate smart seeds
	Updating of pest warning system to use integrated pest management
	Promotion of regenerative agriculture and tillage system
	Capacity building for farmers
	Development of underground water metering system to be used in solar powered underground water pumping systems
	Development and deployment of early warning systems
	Development of MRV system catering to Carbon Border Adjustment Mechanism (CBAM)
	Promotion of biogas plants
	Preparation of breed improvement projects
	MRV for entire livestock supply chain
	Introduction of GHG emission efficient feeding system to control enteric fermentation
	Improvement of vaccination system to target climate induced disease
	Livestock zoning and tagging
	Capacity building for improved animal husbandry, rangeland management/conservation, management of grazing
	Introduction of regenerative/sustainable fodder production
	Gender inclusive natural capital accounting (gender equality and social inclusion [GESI] approach)

International Finance Corporation is climate tagged. An additional influx of MDB financing will be necessary to expedite green and climate-resilient development in Pakistan (GoP, 2023a).

As evident from the various attempts to put a price tag on effective climate action for Pakistan, in the absence of any clear methodology estimates differ vastly in terms of amount, timeframe and type of climate action. This underlines the need for a systematic effort to calculate the cost of action, and inaction, to address climate change challenges.

4.3.1 Strengthening the institutional framework for financial support

Climate financing can provide valuable resources for climate action in Pakistan. The retail banking sector can lead the way in green banking by offering sustainable products and services. Pakistan needs to translate its climate action goals and targets into bankable projects for presentation to climate investment and financing institutions.

The **National Climate Finance Strategy** proposes the following approach:

- Implementing a whole-of-government strategy to enhance synergy and cohesion across national and subnational governance, integrating climate change in all sectors
- Mobilising and diversifying domestic revenue to attract international climate finance, increasing fiscal space for climate action and supporting low-carbon development
- Using innovative mechanisms to partner with the private sector and access both domestic and international climate finance and investments. This could present a more effective option for accessing climate finance compared to traditional methods such as climate fees and taxes.

Pakistan has also drafted the **Green Taxonomy** (2025) which is currently being reviewed by the relevant stakeholders. It provides clear science-based definitions of green economic activities. This will help the financial sector identify green and sustainable investments that contribute to national climate and environmental goals, should increase transparency in financial markets (GoP, 2025), and has the potential to remove barriers to capital flows and avoid greenwashing.

Initiatives needed to harness Pakistan's climate financing potential include the following:

- Simplify local regulations for green bonds and ensure that funds raised support climate change mitigation and adaptation efforts.
- Strengthen institutional and legislative frameworks for public-private partnerships to attract domestic and international investment for renewable energy projects
- Build institutional capacity to leverage available opportunities for climate financing through multilateral funds
- Improve the country's risk ranking by enhancing macroeconomic and financial sector stability and improving rule of law indicators to attract private investors
- Establish debt-for-climate and nature exchanges, such as tree plantation and reforestation initiatives, in collaboration with conservation lenders
- Collaborate with multilateral and bilateral development finance institutions to leverage Paris Agreement rules for financing the closure of large-scale coal facilities through carbon trading and cross-border mitigation investment
- Integrate environmental and climate change objectives into industry processes to reduce emissions
- Factor ecological services and benefits, such as environmental flows and land-based benefits, into the determination of the next NFC Award

- Introduce a green taxonomy for tagging public sector budget lines with climate change adaptation, mitigation or supporting components so that climate investment is identified, codified and documented through an automated accounting process.

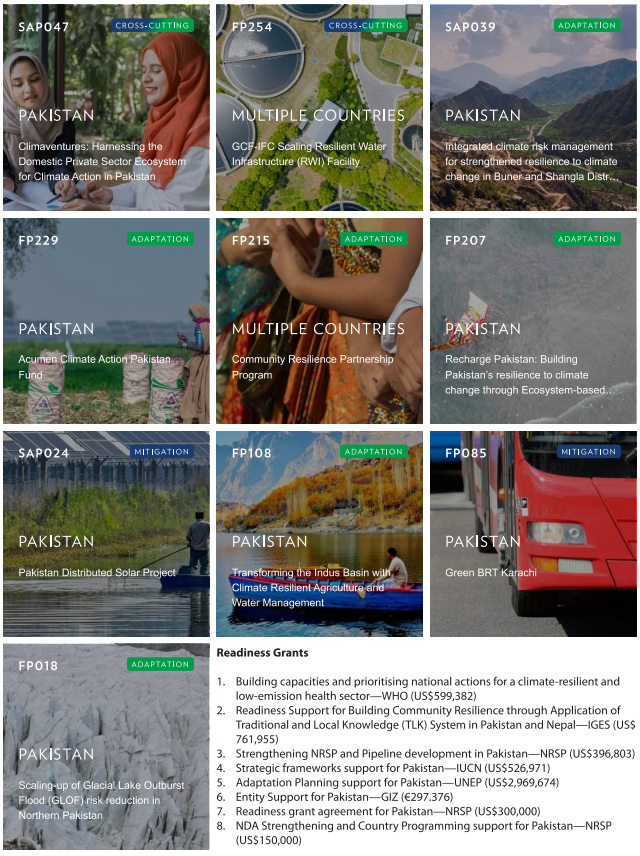
4.4 Financial support received

Pakistan's access to climate finance has so far been limited to multilateral climate financing mechanisms but the country has committed to scaling up climate financing options as part of its NDC implementation strategy. Coordination for climate finance has been strengthened by entrusting the function to a dedicated team led by an Additional Secretary within the MoCC. In order to diversify climate finance and reduce reliance on bilateral and multilateral donors, the government has issued **Policy Guidelines for Trading in Carbon Markets** (GoP, 2024d).

The GCF and GEF have so far been the two main climate financing windows for Pakistan, along with other multilateral financing mechanisms such as the AF and the Climate Investment Funds (CIF). Major bilateral donors include the United Kingdom, United States, European Union and Germany. **GCF's Pakistan portfolio** to date has been limited to 6 adaptation, 2 mitigation and 2 cross-cutting projects with a total outlay of approximately USD 304.2 million, along with 8 readiness activities of approximately USD 5.7 million, 5 of which have concluded. (Ongoing GCF projects are shown in Figure 4.6 and Table 4.6.) This constitutes around 1.94% of the total GCF disbursement of USD 16 billion to date for 286 projects across the globe (GCF, 2024b).

Other than GCF, Pakistan has accessed international climate finance through 3 projects worth USD 20 million from the **Adaptation Fund** and 60 projects worth USD 339.4 million from the **GEF**. Many of these projects have already concluded. Pakistan has not yet accessed significant funding from the CIF or major bilateral climate funds, except for one project from **CIF**. There is no publicly available consolidated data to evaluate financing from multilateral and bilateral sources.

Figure 4.6: GCF Portfolio in Pakistan



Pakistan's experience with other financing instruments, such as green bonds, has also been limited. But after raising USD 500 million for a hydro-energy project through Indus Eurobond, the Water and Power Development Authority (WAPDA) plans to launch additional green bonds for large-scale renewable energy projects.

Pakistan's current portfolio of climate-related projects funded by multilateral climate finance windows is summarised in Table 4.5. Details of the financial support received under Article 9 have been entered into the ETF portal using the CTF.

Table 4.5: Current climate financing to Pakistan through multilateral mechanisms

Project	IFI	Focal area	AE	Financing
Sustainable Actions for Ecosystems Restoration in Pakistan (SAFER Pakistan)	AF	Adaptation	ICIMOD	AF grant = USD 10,000,000
Enhance community, local and national-level urban climate change resilience to water scarcity, caused by floods and droughts in Rawalpindi and Nowshera, Pakistan	AF	Adaptation	UN-Habitat	AF grant = USD 6,094,000
Balochistan Sustainable Energy Project	CIF	Mitigation	IBRD	CIF grant = USD 570,000
Climaventures: Harnessing the Domestic Private Sector Ecosystem for Climate Action in Pakistan	GCF	Cross-cutting	NRSP	GCF grant = USD 10,000,000 GCF equity = USD 15,000,000 CF = USD 25,000,000
Scaling Resilient Water Infrastructure Facility (multi-country, including Pakistan)	GCF	Cross-cutting	IFC	GCF grant = USD 8,000,000 GCF loan = USD 250,000,000 CF = USD 1,004,000,000
Integrated climate risk management for strengthened resilience to climate change in Buner and Shangla Districts of Khyber Pakhtunkhwa Province, Pakistan	GCF	Adaptation	WFP	GCF grant = USD 8,777,141 CF = USD 1,068,200
Acumen Climate Action Pakistan Fund	GCF	Adaptation	Acumen Fund	GCF grant = USD 3,000,000 GCF equity = USD 28,000,000 CF = USD 62,000,000
Community Resilience Partnership Programme (multi-country, including Pakistan)	GCF	Adaptation	ADB	GCF grant = USD 100,000,000 GCF loan = USD 20,000,000 CF = USD 630,000,000
Recharge Pakistan: Building Pakistan's resilience to climate change through ecosystem-based adaptation and green infrastructure for integrated flood risk management	GCF	Adaptation	WWF	GCF grant = USD 66,000,005 CF = USD 11,848,391
Pakistan Distributed Solar Project	GCF	Mitigation	JS Bank	GCF guarantee = USD 9,000,000 GCF grant = USD 1,000,000 CF = USD 44,000,000
Transforming the Indus Basin with climate resilient agriculture and water management	GCF	Adaptation	FAO	GCF grant = USD 34,990,832 CF = USD 12,699,931
Green BRT Karachi	GCF	Mitigation	ADB	GCF loan = USD 37,200,000 GCF grant = USD 11,800,000 CF = USD 534,500,000
Scaling-up of glacial lake outburst flood (GLOF) risk reduction in Northern Pakistan	GCF	Adaptation	UNDP	GCF grant = USD 36,960,000 CF = USD 500,000
Building capacities and prioritising national actions for a climate-resilient and low-emission health sector	GCF	Readiness	WHO	GCF grant = USD 599,382
Readiness support for building community resilience through application of traditional and local knowledge system	GCF	Readiness	IGES	GCF grant = USD 761,955
Strengthening NRSP and pipeline development in Pakistan	GCF	Readiness	NRSP	GCF grant = USD 396,803
Accelerating low-carbon circular economy through cleantech innovation towards sustainable development in Pakistan	GEF	CC	UNIDO	GEF grant = 1,776,484 CF = 11,800,000

Project	IFI	Focal area	AE	Financing
Combating climate change through the promotion and application of sustainable biomass energy technologies in Pakistan	GEF	CC	UNDP	GEF grant = 3,439,041 CF = 21,150,446
Combating land degradation through integrated and sustainable range and livestock management to promote resilient livelihoods in Northern Punjab	GEF	Land deg	FAO	GEF grant = 2,183,105 CF = 13,102,100
Conservation and management of pollinators for sustainable agriculture through an ecosystem approach	GEF	Bio	UNEP	GEF grant = 7,810,682 CF = 18,647,321
Delivering the transition to energy efficient lighting in residential, commercial, industrial and outdoor sectors	GEF	CC	UNEP	GEF grant = 1,575,500 CF = 5,786,700
Development and application of decision-support tools to conserve and sustainably use genetic diversity in indigenous livestock and wild relatives	GEF	Bio	UNEP	GEF grant = 1,982,770 CF = 3,971,000
Development of Minamata initial assessment in three Asian countries	GEF	Chem & waste (EA)	UNEP	GEF grant = 730,594 CF = 1,702,084
Development of National Action Plan for artisanal and small-scale gold mining in the Islamic Republic of Pakistan	GEF	Chem & waste (EA)	UNEP	GEF grant = 500,000
Generating global environmental benefits from improved decision making systems and local planning in Pakistan	GEF	N/A	UNDP	GEF grant = 995,500 CF = 940,050
Global Biodiversity Framework Early Action Support (Asia Pacific 8)	GEF	Bio (EA)	UNDP	GEF grant = 1,917,811
Global project on the updating of National Implementation Plans for POPs	GEF	Chem & waste	UNEP	GEF grant = 1,321,552 CF = 993,000
Mainstreaming climate change adaptation through water resource management in leather industrial zone development	GEF	CC	UNIDO	GEF grant = 3,310,000 CF = 14,700,000
Reducing uses and releases of chemicals of concern, including POPs, in the textiles sector	GEF	Chem & waste	UNEP	GEF grant = 8,850,000 CF = 43,272,506
Reversing deforestation and degradation in high conservation value chilgoza pine forests in Pakistan	GEF	Bio, CC	FAO	GEF grant = 3,978,440 CF = 24,000,000
Snow leopard and ecosystem protection programme	GEF	Bio, land deg	UNDP	GEF grant = 4,644,521 CF = 15,130,000
Support for the revision of the NBSAPs and development of Fifth National Report to the CBD	GEF	Bio (EA)	UNEP	GEF grant = 220,000 CF = 245,000
Support to eligible parties to produce the Sixth National Report to the CBD (Global: Africa-3, Maldives, Nicaragua, Pakistan and Solomon Islands)	GEF	Bio	UNEP	GEF grant = 1,963,500 CF = 1,129,495
Support to preparation of the Fourth National Biosafety Reports to the Cartagena Protocol on Biosafety – Asia-Pacific, GRULAC, Central and Eastern Europe Regions	GEF	Bio (EA)	UNEP	GEF grant = 1,424,500 CF = 1,050,890
Support to preparation of the Interim National Report on the implementation of the Nagoya Protocol	GEF	Bio	UNEP	GEF grant = 1,430,000 CF = 1,111,321
Support to preparation of the Third National Biosafety Reports to the Cartagena Protocol on Biosafety – Asia Pacific Region	GEF	Bio	UNEP	GEF grant = 1,099,050 CF = 995,000

Project	IFI	Focal area	AE	Financing
Sustainable energy initiative for industries	GEF	CC	UNIDO	GEF grant = 3,550,000 CF = 31,200,000
Sustainable forest management to secure multiple benefits in high conservation value forests	GEF	Bio, CC	UNDP	GEF grant = 8,338,000 CF = 49,420,000
Transforming leather processing industries towards low emissions and climate resilient development paths in Pakistan	GEF	CC	UNIDO	GEF grant = 2,000,000 CF = 12,198,000
Umbrella programme for preparation of National Communications and Biennial Transparency Reports to the UNFCCC	GEF	CC (EA)	UNEP	GEF grant = 32,058,750
Umbrella programme for preparation of National Communications and Biennial Update Reports to the UNFCCC	GEF	CC (EA)	UNEP	GEF grant = 10,110,480 CF = 1,000,000
Umbrella programme for preparation of National Communications and Biennial Update Reports to the UNFCCC	GEF	CC (EA)	UNEP	GEF grant = 13,946,200 CF = 1,374,000
Umbrella programme to support development of Biodiversity Finance Plans	GEF	Bio (EA)	UNDP	GEF grant = 38,190,000
Umbrella programme to support NBSAP Update and the 7th National Reports	GEF	Bio (EA)	UNDP	GEF grant = 35,600,000
Notes: AE = accredited entity, Bio = biodiversity, CC = climate change, CF = co-financing, Chem & waste = chemicals and waste, EA = enabling activity, Land deg = land degradation				
Source: AF, 2024a; CIF, 2024; GEF, 2024; GCF, 2024b.				

4.5 Technology development and transfer support needed

Pakistan must prioritise investment in technological solutions across multiple sectors, focusing on water management, renewable energy, climate-smart agriculture, waste management and early warning systems. Investing in technologies will not only help to build climate resilience but can also drive sustainable economic growth by creating jobs in green industries. Implementing technological solutions requires strong political will, international collaboration and adequate financing. Key areas for climate technology development and transfer are discussed in the sections that follow.

4.5.1 Addressing water scarcity through advanced resource management

Pakistan is among the most water-stressed countries in the world, with per capita water availability declining rapidly due to population growth, inefficient use and climate-induced shifts in river flows. The country depends heavily on the Indus River system, which is increasingly threatened by glacial melt and erratic monsoons. To tackle these challenges, Pakistan needs to invest in **precision irrigation systems**, such as drip and sprinkler irrigation, which significantly reduce water wastage compared to traditional flood irrigation. **Desalination technologies** can boost supply, particularly in coastal cities like Karachi that face severe water shortages. **Wastewater recycling and treatment plants** can

provide alternative sources of water for industrial and agricultural use, reducing dependence on freshwater supplies.

Integrating **satellite-based monitoring** and **AI-driven analytics** into water resource management systems can improve efficiency by providing real-time data on groundwater levels, soil moisture and weather patterns. These technologies can help predict droughts, optimise water distribution and provide early warnings for floods. Pakistan can also benefit from **cloud seeding technology** to increase rainfall in water-scarce regions. Without immediate advancements in water resource management, Pakistan's agriculture and urban centres will face extreme scarcity, threatening food security and economic stability.

4.5.2 Transitioning to clean energy for a low-carbon future

Despite significant potential for renewable energy, Pakistan continues to rely on **fossil fuels** for the majority of its energy needs, leading to high carbon emissions and severe air pollution in cities like Lahore and Karachi. To reduce dependence on imported fossil fuels and lower emissions, Pakistan must accelerate the deployment of **solar, wind and hydropower** projects. The country has abundant sunshine for most of the year, particularly in Balochistan and Sindh, where large-scale solar farms can be developed. Similarly, wind corridors such as Jhimpir in Sindh can generate significant amounts of clean electricity. Expanding **run-of-the-river hydropower** projects can provide renewable energy without the environmental impact of large dams.

Besides generation, **energy storage solutions**, such as battery storage systems, are critical to ensure a stable power supply from intermittent renewable sources. Without adequate storage, surplus solar and wind energy may go unused, limiting the effectiveness of these technologies. **Smart grids and decentralised renewable energy systems** can improve efficiency by reducing transmission losses and enabling localised energy production in off-grid rural areas. Pakistan should also expand the coverage of **net metering policies**, allowing more consumers to sell excess solar power back to the grid, to incentivise widespread adoption of rooftop solar panels.

The transition to clean energy should extend to **transportation**, a major contributor to Pakistan's carbon emissions. Encouraging the adoption of **EVs** through subsidies, charging infrastructure and tax incentives can significantly reduce fuel consumption, carbon emissions and urban air pollution. **Green public transport initiatives**, such as electric buses and metro systems, can lower emissions and improve urban mobility. Without immediate and large-scale investment in renewable energy and sustainable transport, Pakistan risks worsening air quality, energy insecurity and the economic burden of fossil fuel imports.

4.5.3 Ensuring food security through climate-smart agriculture

Pakistan's agriculture sector, which employs over 40% of the workforce, is highly vulnerable to climate change. Rising temperatures, unpredictable monsoons and prolonged droughts threaten crop yields and food security. To mitigate these risks, Pakistan must transition to **climate-smart agriculture** technologies that enhance productivity while minimising environmental impact.

One such measure is the development and widespread use of **heat- and drought-resistant crop varieties**, which require less water and can withstand extreme weather conditions. Similarly, **AI-powered precision farming** can optimise

resource use by providing real-time insights on soil health, pest threats and irrigation needs. Farmers can use **internet of things (IoT)-based sensors and automated irrigation systems** to minimise water wastage and improve crop yields. **Vertical farming and hydroponic systems**, which allow crops to grow in controlled environments with minimal land and water use, should be explored, particularly in urban areas facing land constraints.

Improving **waste management and bioenergy conversion** is another critical aspect of sustainable agriculture. By converting agricultural waste into biofuel and organic fertiliser, Pakistan can reduce environmental pollution while generating alternative energy sources. Investment in **composting, biogas production and recycling facilities** can help manage agricultural and urban waste effectively.

4.5.4 Building climate resilience through early warning systems

Pakistan is experiencing extreme weather events more frequently, with devastating floods, severe heatwaves and prolonged drought in just the last decade. To minimise loss of life and damage to property, Pakistan must invest in **early warning systems** that provide timely alerts to vulnerable communities. **Climate data analytics, AI-based forecasting and improved meteorological infrastructure** can help predict and prepare for disasters more accurately. Developing **flood-resistant infrastructure**, such as elevated roads and improved drainage systems, can reduce the impact of extreme weather events.

Public awareness and community-based disaster preparedness programmes should be expanded. Training communities on **emergency response protocols, evacuation procedures and first aid** can significantly improve resilience.

4.5.5 Strengthening technological capacity across key sectors

The consultative process for the Third National Communication underlined the need to bridge technology gaps resulting from limited access to and insufficient funding for **advanced research and development**.

Pakistan conducted a comprehensive **Technology Needs Assessment** (TNA) for climate change adaptation and mitigation in 2016. Agriculture and water were identified as priority sectors for adaptation technologies. Energy (industry, buildings, renewables) and transport (road, rail, maritime, air) were identified as priority sectors for mitigation, along with agriculture, land use and forestry. Prioritised technology needs for adaptation and mitigation identified in the TNA are summarised in Table 4.6.

The technology development and transfer needs identified in the TNA were converted into actions plans, which are shown in the CTF table uploaded to the ETF portal.

The Biennial Transparency Report (2022) also identified technology development and transfer needs, although they were not costed. These are summarised in Table 4.7.

The national consultation held in January 2025 also identified technology transfer needs. These are summarised in Table 4.8.

4.6 Technology development and transfer support received

Pakistan has received limited technology development and transfer support under Article 10. One such recent initiative has been for the reduction of N2O emissions in fertiliser

production, under which Fatima Fertiliser's Multan facility is set to receive financial support to install advanced catalysts and measurement technologies.

The technology development and transfer support received so far has been entered into the ETF portal using the CTF.

The BUR (2022) also mentions technology development and transfer support received, although details are not provided. Support mentioned in the BUR is summarised in Table 4.9.

4.7 Capacity-building support needed

Lack of capacity is a critical barrier Pakistan faces in its effort to implement effective climate mitigation and adaptation measures. Key areas in which support under Article 11 is required are discussed in the sections that follow.

4.7.1 Strengthening institutions and technical expertise

Pakistan's ability to implement effective climate action is hindered by the **lack of institutional capacity** and a **shortage of technical expertise**. Many government agencies responsible for climate policy and environmental management lack resources and trained personnel. Coordination mechanisms are also required. There is a pressing need to build institutional capacity through specialised training for policymakers, managers, analysts, engineers, scientists and other staff. **Training programmes should focus on climate modelling, disaster risk reduction and climate-smart resource management** to ensure that decision makers have the knowledge and skills needed to integrate climate resilience into policies and development plans. Research institutions and universities must be strengthened to conduct **climate impact assessments, develop locally relevant solutions and collaborate with international experts** on knowledge exchange. Without an adequate knowledge base and skilled workforce, Pakistan will struggle to design and implement policies that effectively address climate change.

4.7.2 Building financial capacity to improve access to climate finance

Resource mobilisation is a critical barrier to climate action in Pakistan. The **lack of capacity to secure funding from international sources** is a major stumbling block. Climate adaptation and mitigation projects often require significant investment but Pakistan has struggled to access global climate finance mechanisms such as the GCF and the AF, as well as private-sector investments. Pakistan needs to **build expertise in preparing high-quality, bankable climate project proposals** that align with donor priorities. Strengthening transparency and accountability in the use of climate funds is essential to build trust with international donors and investors. **Public-private partnerships** should be promoted to attract private-sector investment in renewable energy, sustainable agriculture and climate resilient infrastructure. Financial institutions in Pakistan need capacity-building programmes to **develop green financing instruments** such as climate bonds and concessional loans to support climate-friendly initiatives.

4.7.3 Empowering communities through awareness and local adaptation strategies

At the grassroots level, Pakistan must invest in raising awareness and **equipping local communities with the knowledge and tools needed to adapt to climate change**. Rural farmers, who are among the most vulnerable, need **training on climate-smart agricultural practices**, such as the use of drought-resistant

Table 4.6: Prioritised needs identified in the Technology Needs Assessment 2016		
Sector	**Sub-sector**	**Prioritised technology**
Adaptation		
Water		Surface rainwater harvesting
		Groundwater recharge (managed aquifer recharge)
		Urban stormwater management
Agriculture		High efficiency irrigation systems (drip, sprinkler)
		Drought tolerant crop varieties
		Climate monitoring and forecasting, early warning systems
Mitigation		
Energy	Industry	Boiler and furnace energy efficiency improvement
		Improving performance and efficiency of boilers and furnaces (routine tune-up for air fuel ratio adjustment, steam leakage detection and reduction, waste heat recovery)
	Building	Reducing energy consumption in homes and offices (building design, air conditioning, power factor improvement)
		Improving performance of existing technology (design, air conditioning, power management)
	Energy production	Solar energy technology
		Electricity generation from micro and small hydropower plants
		Wind turbines for electricity generation
		Biogas, compressed bio-methane including waste and bagasse
		Nuclear technologies for electricity generation
		Clean coal technology (super and ultra-supercritical)
		Large hydropower plants
Agriculture	Farming	Conservation tillage
		Improved application of fertilisers, soil carbon management
		Farming practices to increase carbon sequestration
		Use of crop varieties with increased carbon sequestration
		Rice cultivation by AWD/aerobic methods
		Off-field crop residue management
		Energy efficiency improvement of tube wells
		Nutrient management (mycorrhiza)
	Livestock	Enteric fermentation management
		Biogas (compressed bio-methane including waste and bagasse)
		Manure management
		Genetic modification to produce new breeds with better digestive efficiency

Sector	Sub-sector	Prioritised technology
	Land use, land use change and forestry	Social/farm forestry as carbon sinks
		Reducing deforestation, forest degradation, overexploitation of non-timber forest products
		Sustainable forest management
		Rehabilitation of mangroves
		Fire management in forests
		Land use planning at local and provincial levels, legal support for implementation of land use and zoning regulations
Transport	Railways	Efficient railway transportation
	Mass transit	Bus rapid transport (BRT) in urban areas
	Private/ commercial vehicles	Adjustment of air-fuel mixture for better ignition, carburettor and other routine check-ups to increase fuel efficiency
		Improving performance and management of existing transport systems

Source: GoP, 2016 b.

Table 4.7: Technology development and transfer support needs identified in the BUR

Sector	Support needed
GHG inventory preparation	Technical expertise for training of national staff (training of trainers)
	Demonstration programmes on certification of facilities and personnel
	Technical equipment and tools for GHG inventory preparation
	Ongoing training for all EPAs, provision of equipment and tools
	Development of robust and accurate methodology for inventory preparation, data collection, quality assurance/quality control
Vulnerability assessment	Development of vulnerability assessment for industry, for integration into industrial policy
	Measurement/assessment tools and instruments
	Development of resource management/monitoring system for different sectors
	Agricultural production surveillance system for arid, semiarid and other vulnerable areas to categorise areas according to vulnerability to extreme climate events
	Installation of automatic weather stations and other monitoring systems to address data gaps, especially for floods and drought
	Allocation of financial resources for green productivity assessment
	Certification facilities and certification training
	Collaborative surveys of vulnerable areas by federal and provincial institutes
Mitigation actions	Technical surveys to identify gaps in ongoing and planned programmes for climate-vulnerable and priority sectors
	Technical expert services for planning and development of mitigation projects
	Promotion of solar groundwater pumping solutions
	Development of climate-smart agriculture projects

Sector	Support needed
	Customising clean climate-smart technologies in agriculture
	Providing forecasting tools, software (SCADA), digitalising power system, hardware (advance metering systems)
	Providing stabilisers, capacitors and grid system optimisers for grid stability
	Providing innovative technologies and solutions for renewable energy
	Conducting field activities to check fuel quality and vehicular emissions
	Technical training for air and water quality management, solid waste management, hazardous/infectious waste disposal
Adaptation actions	Provision of technical expert services for: - Planning and development of adaptation projects - Project risk assessments - Monitoring and evaluation
	Provision of solar drying units for preserving fruits and vegetables
	Introduction of dry/aerobic rice production technology
	Optimisation of cropping calendar for different agroecological zones
	Promoting adoption of permanent raised beds for various farming systems
	Introduction of drought tolerant and heat resistant varieties of wheat, barley, moong and maize in arid areas
	Promotion of community-based range improvement interventions to improve soil, vegetative cover and forage production
	Ensuring availability of mobile livestock health units
	Restructuring, reviewing and formulating new rules/guidelines for adaptation actions in the water and agriculture sectors
	Farmer training on use of balanced fertilisers, crop residue management and direct seeded rice
	Support sustainable, climate-smart and resilient projects

Source: GoP, 2022 e.

Table 4.8: Technology development and transfer support needed

Sector	Support needed
Agriculture	Promote climate smart agriculture technologies
	Support indigenous knowledge generation and management
	Promote value chain and post-harvest technology
	Support controlled atmospheric storage technologies (cold storages)
	Introduce biochar machinery, sustainable residue solutions, high efficiency irrigation systems, farm management software
	Mainstream use of AI models for precision agriculture and early warning systems
	Encourage parametric trigger-based insurance and microcredit for agriculture
	Provide soil testing kits and PH monitoring through public-private partnerships

Sector	Support needed
	Promote livestock monitoring through tagging, feed technology, GHG efficient feeding
	Support indigenous vaccine development
	Provide low-cost diagnostic equipment for disease surveillance and tracking
	Encourage adaptation service industry market in collaboration with research based institutions
	Encourage use of advanced machinery, AI and drone technology
Disaster risk reduction	Develop and deploy early warning systems for landslides, avalanches and floods
Education	Promote climate resilient education infrastructure (e.g., low-carbon buildings, materials and transport)
Energy	Support efficient micro-grid stations
	Introduce waste-to-energy, and green/blue hydrogen technologies
	Promote off-grid energy efficiency technologies, such as cooling systems, LED lights, green building codes, smart meters
	Enforce recently developed green buildings guidelines
	Encourage indigenous solar PV and related equipment manufacturing
	Introduce efficient cooking stoves and low emission cooking devices
	Invest in hydropower and micro dams for hydel energy generation
	Incentivise increase of energy storage capacity for off-grid systems
	Improve national transmission system to reduce line losses
	Develop strategy and guidelines for e-waste management systems
	Promote energy-efficient appliances (household, business, industry)
Forestry	Introduce AI-based and drone-based forest fire monitoring and control systems
	Introduce labour sensitive technology for women in forest matrix
	Promote use of technology for harvesting value-added non-timber forest products
Mining	Promote use of modern mining machinery to reduce environmental impacts
Transport	Encourage EV ecosystem
	Set up emission testing systems
	Proliferate hybrid BRT systems
	Integrate cell phone technologies in public transport systems
	Encourage indigenous systems for vehicle inspection and certification, testing stations for vehicular exhaust emissions
	Introduce intelligent transport systems and non-motorised transport
Water	Introduce and implement water metering for water conservation
	Promote water saving technologies including smart water monitoring for agricultural use
	Introduce nature-based waste-water treatment (such as sediment filtration and floating wet-land technology) and waste to energy systems
	Introduce monitoring technologies for emissions, surface water use, groundwater extraction and recharge
	Develop secondary-tertiary feeding systems for wastewater management plants

Table 4.9: Technology development and transfer support received as per BUR	
Sector	**Support received**
GHG inventory preparation	GHG-MI online training and certification programme on 2006 IPCC Guidelines for national GHG inventories, with financial support from the UNFCCC secretariat, conducted in 2019-20. Experts from Pakistan participated in the course.
Vulnerability assessment	Installing automatic weather stations in various ecological zones
	Delineating flood prone areas in Chaj Doab and drought prone areas in Bahawalpur, Khushab, Layyah and Rahim Yar Khan
	Installation of mobile solar pumping system for farming communities in Potohar region
Mitigation actions	Promoting crop diversification at two field sites in Potohar region
	Solarisation of public buildings, schools and mosques
	Minimum Energy Performance Standards for electric lighting products
	Solar unit for drying of dates at Pakistan Agricultural Research Council site in Sindh
Adaptation actions	Drought-tolerant and heat-resistant varieties of wheat
	launch of Ten Billion Tree Tsunami programme for promotion of forestry
	Initiation of Ten Billion Tree Tsunami programme for promotion of forestry

crops, efficient irrigation techniques and soil conservation methods. Similarly, urban communities must be educated on waste management, energy efficiency and air pollution reduction strategies to improve environmental sustainability. Schools and universities should integrate climate education into their curricula to cultivate a climate-conscious generation of young people. Civil society organisations, the media and local governments should be engaged in outreach programmes to ensure that communities are well informed, have ownership and are able to participate in climate action.

4.7.4 Improving data collection, early warning systems and disaster preparedness

Pakistan is highly vulnerable to extreme weather events but early warning and disaster preparedness systems are inadequate. Investing in modern climate data collection technologies, such as remote sensing, AI-driven climate modelling and advanced meteorological forecasting, can help predict and mitigate the impacts of climate-related disasters.

Strengthening the capacity of disaster management authorities, namely the NDMA and PDMAs, is essential to improve emergency response and recovery efforts. At the same time, **community-based disaster preparedness** programmes should be expanded, with training for community members on evacuation plans, first aid and resilience measures.

The consultative process for the Third National Communication underlined the need to develop standardised data collection methods, improve data accessibility and strengthen institutional frameworks for GHG inventory preparation. Building capacity at the provincial level for GHG data collection is essential and should be given priority.

Capacity-building requirements outlined in the BUR (2022) are summarised in Table 4.10.

Capacity-building support needs identified in the TNA (2016) are listed the CTF table uploaded to the ETF portal.

The national consultation held in January 2025 identified additional capacity building needs which are summarised in Table 4.11.

4.8 Capacity-building support received

Under Article 11 of the Paris Agreement, which emphasises capacity-building to enhance the ability of developing countries, Pakistan has received various forms of support. Recent notable initiatives include:

- World Bank Country Partnership Framework: USD 20 billion lending plan for Pakistan over the next decade, focusing on policy and institutional reforms to boost private sector growth and expand fiscal space for government investments in crucial areas, including energy, water, agriculture, access to finance, manufacturing and digital infrastructure. These reforms aim to enhance Pakistan's capacity to address climate change impacts and promote sustainable development.
- Transparency International Pakistan: Capacity building workshops on climate finance for government officials, focusing on climate-sensitive budgeting and climate finance transparency. The aim was to integrate transparency and accountability in climate financing frameworks, and to provide knowledge on tools for tracking, monitoring and evaluating climate finance.
- Supporting Preparedness for Article 6 Cooperation (SPAR6C): This programme will support Pakistan's preparedness to participate in international carbon markets under Article 6 of the Paris Agreement. By developing the necessary policy and regulatory frameworks, SPAR6C facilitates access to international carbon finance.

These initiatives underscore Pakistan's commitment to strengthen institutional and financial capacities to effectively address climate change challenges.

The BUR (2022) also discusses capacity building support received by Pakistan, as shown in Table 4.12.

Capacity-building support received so far is shown in the CTF table uploaded to the ETF portal.

4.9 Support needed and received for the implementation of transparency-related activities

Pakistan has been in compliance with all reporting requirements under the UNFCCC and Paris Agreement. There is room for improvement, particularly with respect to data deficiencies, and Pakistan needs financial and technical support to strengthen compliance with the ETF. Key areas of support required are as follows:

- The private sector needs to be meaningfully and proactively engaged in ETF reporting
- Export-oriented compliance needs to be strengthened, which will help increase export earnings and also improve reporting
- A clear policy on ETF reporting is needed, defining the roles and responsibilities of the federating units and ensuring timely reporting
- A whole-of-system approach should be applied for comprehensive ETF reporting
- As the coordinating entity for ETF reporting, the MoCC needs to develop common reporting templates for the provinces and build the capacity of provincial stakeholders on reporting

- Targets for meeting NDC commitments and/or adaptation objectives should be set using a bottom-up approach, involving proactive and meaningful engagement with the provinces, followed by a consolidation of targets at the country level. This will ensure ownership of targets and actions, resulting in better progress and reporting.

Support needed and received for implementation of Article 13 is shown in the CTF tables uploaded to the ETF portal.

4.10 Specific flexibility provisions applied

Pakistan has not yet developed a consolidated system to track FTC support received. As such, a few cells in the CTF tables are empty. Pakistan is, however, committed to strengthen its capacity in record keeping, inventory development, transparency and reporting, for which it intends to set up an MRV system under the ETF. Review of Pakistan's BTR should consider these limitations.

4.11 Information on areas of improvement in reporting

The government intends to set up an MRV system at the MoCC for transparent tracking and reporting of progress on the national climate change agenda. For this purpose, Pakistan will establish a high-level MRV Advisory Committee to oversee and undertake periodic review of the MRV system. The MRV Advisory Committee will propose corrective measures, as and when required, for the MRV system.

Table 4.10: Capacity-building support needed as per BUR

Sector	Support needed
GHG inventory preparation	Development and implementation of comprehensive capacity building programme on GHG inventory preparation and data collection
	Extension to provincial level of GHG inventory preparation and data collection training
Vulnerability assessment	Advanced training and certification of staff
	Development of management system
	Development and implementation of projects on: - Dry/aerobic rice production technology - Satellite-based crop monitoring and yield estimation system in Pakistan - Permanent raised beds for various farming systems - Drought-tolerant and heat-resistant crop varieties (wheat, barley, mung, maize) in arid ecologies - Community-based range improvement interventions for better vegetative cover, forage production and soil improvement - Improvement of livestock health units
Mitigation actions	Advanced training and certification (local/abroad) of existing team
	Capacity building in solar water pumping solutions to improve agriculture productivity
	Training in climate-smart agriculture interventions and customisation of climate-smart technologies
	Capacity building of stakeholders to manage higher share of renewable energy

Sector	Support needed
	Capacity building of stakeholders for: - Preparation of renewable power procurement plan - Development of sites for auctioning renewable energy capacity - Development of standard concession packages - Participation in competitive bidding
	Capacity building of finance sector for innovative financing models for renewable power sector aimed at consumers, SMEs, industry, agriculture and IPPs
	Capacity building of manufacturing sector for localising technology
	Capacity building of provincial and municipal departments and development authorities for low-carbon development and implementation of mitigation projects
	Improving curriculum of universities, particularly engineering
	Developing local demonstration companies for mitigation actions
	Conducting training for plant breeders to develop new varieties
Adaptation actions	Advance training and certification (local/abroad) of team
	Capacity building in adoption of dry/aerobic rice production technology
	Capacity building in satellite-based crop monitoring and yield estimation
	Capacity building in developing permanent raised beds for various farming systems
	Training in developing drought-tolerant and heat-resistant crop varieties (wheat, barley, moong, maize) in arid ecological regions
	Training in community-based range improvement interventions
	Farmer training on balanced use of fertilisers and crop residue management
	Developing local demonstration companies for adaptation actions
	Conducting training for agronomists for direct seeding technology and integrated plant nutrition management system

Source: GoP, 2022 e.

Table 4.11: Capacity building support needed	
Sector	**Support needed**
Agriculture	Facilitate access to credit for purchasing climate-smart machinery and equipment
	Conduct training and provide extension services for climate-smart agriculture
	Support research and development, build awareness, promote agriculture education by engaging the private sector
	Build capacity on oil seed farming
Disaster risk reduction	Build capacity of communities to manage community-based early warning systems
Education	Conduct teacher training on climate change, integrate climate change into school and higher education curriculum
Energy	Encourage research and development on clean energy utilisation
Forestry	Build community-level capacity on biodiversity and forestry in the context of climate change
Gender and inclusion	Increase outreach and provide climate-based skills trainings for women and disadvantaged groups
	Create awareness on climate change adaptation

Table 4.12: Capacity-building support received as per BUR	
Sector	**Support received**
GHG inventory preparation	Training on the 2006 IPCC guidelines for national GHG inventories organised by GHG-MI for international participants, supported by UNFCCC
Vulnerability assessment	Basic training on GP assessment through local resources
Mitigation actions	Local training for promotion and awareness regarding renewable energy sources
Adaptation actions	KOICA has established the Pak-Korea capacity building centre for agriculture and livestock technology in PMAS Arid Agriculture University for research and development
Source: GoP, 2022 e.	

Chapter

5

Gender-responsive climate action

5. Gender-responsive climate action

This section examines the degree to which gender considerations have been integrated into national climate policies and decision making. It presents an overview of gender dynamics in Pakistan, discusses the policy framework for gender-responsive climate action and assesses progress towards implementation of policy provisions.

5.1 Gender dynamics and climate change

Gender inequality remains a deeply rooted issue in Pakistan, impacting nearly every facet of society, including political participation, economic opportunity, education, healthcare and climate resilience. Pakistan's women are not just highly vulnerable to the impacts of climate change but are also key actors in building climate resilience. Gender inequities across the board increase women's vulnerability and limit their participation in climate action. Addressing gender dynamics in the context of climate change can address this issue and help create more resilient communities.

5.1.1 Key concepts

This section presents an overview of key concepts and international guidance on gender and climate change.

Gendered vulnerability

Three factors affect women's vulnerability to climate change: (i) access to opportunities and productive resources, (ii) control over resources, services and opportunities and (iii) equitable role in decision-making process and forums (UNDP, 2021). Climate change is not gender neutral, with women and girls bearing the brunt of its impacts:

- **Access to natural resources**. Women and girls have primary responsibility for securing food, water and fuel for the household. Climate change leads to resource scarcity, increasing their burden of work and putting pressure on girls, who may be forced to leave school to take on household responsibilities.
- **Hunger and poverty**. By 2050, climate change will push up to 158 million more women and girls into poverty (16 million more than the total number of men and boys). Even today, 47.8 million more women face food insecurity and hunger than men (UN Women, 2024a).
- **Gender-based violence**. Social and economic stresses brought on by climate change are fuelling increased levels of violence against women and girls (SI, 2025). The impacts are felt hardest in communities where women already face entrenched inequalities.
- **Disaster resilience and recovery**. Women and girls are less likely to survive natural disasters and more likely to be injured or killed. This is in part because existing gender inequalities create disparities in information, mobility, decision-making and access to resources and training. Women are less able to access relief and assistance, undermining their recovery and creating a vicious cycle of vulnerability to future disasters.
- **Maternal and neonatal health**. Climate related disasters limit access to healthcare and basic services, especially for women

(UN Women, 2025).

- **Conflict affected-areas**. The impacts of climate change increase social, political and economic tensions in conflict-affected areas where women and girls are already vulnerable to gender-based violence. The instability and poverty that often follow climate related disasters lead to more instances of sexual violence, human trafficking and child marriage.

Gender-responsiveness

According to the International Union for Conservation of Nature (IUCN) Gender Equality and Women's Empowerment Policy (2018), gender responsiveness is defined in the following terms: "To identify and understand gender gaps and biases and then act on them, developing and implementing actions to overcome challenges and barriers, thereby improving gender equality. Gender responsive has come to mean more than 'doing no harm'; it means 'to do better'" (IUCN, 2018).

Research from across the world shows that gender-responsive measures are crucial for managing natural resources, ensuring food security, investing in public goods and many other initiatives meant to increase climate resilience (FAO, 2011; WB, 2011).

5.1.2 Development indicators

Women make up 48.51% of the population of Pakistan (PBS, 2023a). They are barred from equal participation in almost every facet of life, including education, employment, leadership, politics and public service. Despite significant legal and policy advancements to ensure gender equality, including constitutional provisions and laws for the protection of women and girls, social and cultural barriers continue to impede the full participation of women in national development.

The implications of exclusion from public life go far beyond the immediate impact on the lives and wellbeing of Pakistani women and girls. The impact of social and economic exclusion also has an impact on overall human development. This can be seen from Pakistan's ranking in global development indexes:

- Pakistan ranks 145 out of 146 countries on the World Economic Forum's Global Gender Gap Report (WEF, 2021), just ahead of Afghanistan.
- Pakistan is ranked 'low' in the Human Development Index (HDI), with a value of 0.540 and global ranking of 164 out of 193 countries in terms of human development indicators UNDP, 2020).

5.1.3 Economic vulnerability and food security

Agriculture is the main source of livelihood for more than 60% of Pakistan's rural population, with women playing a key role in farming and livestock management. Approximately 67% of women in Pakistan's rural areas are involved in agricultural activities (FAO, 2011), where they face the dual challenge of managing household responsibilities alongside farm work.

The climate-agriculture-gender inequality hotspot index ranks Pakistan as the highest risk country in Asia (Lecoutere et al., 2022). Climate-induced stresses, such as irregular rainfall and temperature fluctuations, impact women's livelihoods and increase their burden. Women's roles in water collection leave them especially vulnerable to the changing climate, as water scarcity becomes more pronounced. Rural women in Pakistan spend an average of 4 to 6 hours per day collecting water, a task made more difficult by prolonged droughts and unreliable water sources (WB, 2011).

Similarly, following the devastating floods of 2022, millions of women lost their livelihoods, with agriculture and livestock activities destroyed or disrupted. Such climate impacts exacerbate pre-existing inequalities (ILO, 2021). As a result of women's unequal access to productive resources and services, driven by social and gender-based norms, they have limited resources to cope with and recover from climate disasters (FAO, 2024b).

5.1.4 Social vulnerability, health and safety

Gender disparities become more pronounced in the context of climate change. During the 2022 floods, women and children constituted the majority of the displaced population, with limited access to sanitation, healthcare, clean water, food and safe shelter (UN Women, 2022). The floods affected 1.6 million women of reproductive age, including nearly 130,000 pregnant women in need of urgent healthcare, who had limited or no access to basic services.

The floods affected education, especially for girls. Rates of early and forced marriages are known to increase in the wake of crises and disasters, further increasing the vulnerability of girls (IUCN, 2022).

In addition, the floods increased the risks of gender-based violence, with women and girls experiencing domestic violence and harassment and abuse related to displacement and the lack of security in resettlement camps.

5.2 Policy framework for gender-responsive climate action

Gender considerations and the need for gender mainstreaming are mentioned in almost all national policies and plans related to climate change and the sectors affected by climate change. To varying degrees, these policies aim to address the gender aspects of climate vulnerability. But on the ground gender mainstreaming has been slow at best.

To address this issue, Pakistan has developed a framework to integrate gender considerations into climate policy and planning. The Climate Change Gender Action Plan (ccGAP) aims to ensure that women are included and take leadership roles in climate action. The ccGAP is aligned with the NCCP and focuses on the priority sectors identified in the NCCP. It represents a significant step in accomplishing the NCCP goal of promoting gender-sensitive, pro-poor adaptation.

Pakistan's Climate Change Gender Action Plan

The ccGAP was developed by the MoCC with the support of IUCN and other partners. It serves as a framework for integrating gender considerations into national climate policies and actions. The ccGAP is designed to strengthen implementation of national climate change policies and plans. It focuses on six priority areas identified in the NCCP and seeks to operationalise NCCP commitments to ensure that women are included in all stages of planning, development and implementation of climate measures. Strategic objectives of ccGAP include the following:

- Incorporate gender into national climate policies and strategies: This includes the integration of gender-sensitive approaches into policies related to agriculture, water, energy, disaster risk reduction and climate finance.
- Promote women's participation in climate governance: Ensure that women have an active role in decision-making processes at the local, national and international levels.
- Improve women's access to climate finance: Ensure that climate finance mechanisms are gender-responsive and women, particularly

those in rural areas, have access to the funds needed to build climate resilience.
- Enhance women's capacity for climate change actions: Build skills in sectors such as sustainable agriculture, renewable energy, water management and disaster risk reduction to strengthen gender-responsive strategies for climate action.

The ccGAP targets key sectors where women's roles are crucial to climate resilience:

- Disaster risk reduction: Proposes disaster preparedness initiatives involving women to reduce vulnerability during emergencies.
- Agriculture and food security: Promotes gender-responsive agricultural practices, and recommends training programmes and the dissemination of climate-resilient technologies so that women farmers are better equipped to cope with the challenges posed by climate change.
- Forests and biodiversity: Among other measures, calls for supporting women to take up careers in forestry and biodiversity conservation can have significant positive effects on their families and communities.
- Integrated coastal management: Notes that women play an essential role in the sector but earn about one third of the wages paid to men; calls for gender inclusive policies and interventions.
- Water and sanitation: Warns that water scarcity will jeopardise women's livelihoods and the well-being of their families; includes strategies to ensure that women have equitable access water and have a say in water management decisions.
- Energy: Calls for increasing women's access to clean and affordable energy, particularly through renewable energy solutions such as solar-powered cooking stoves and off-grid solar systems.

5.3 Progress in gender mainstreaming

This section discusses progress made on gender mainstreaming, based on commitments and actions set out in the BTR and ccGAP. It highlights achievements, challenges and the way forward.

5.3.1 Gender integration in national climate action policies

Pakistan has made notable strides in integrating gender considerations into its national climate policies. The **National Climate Change Policy** (NCCP) acknowledges the gendered impacts of climate change and highlights the role of women in climate resilience. It emphasises the need for gender-inclusive decision making in climate governance and gender-sensitive budgeting for climate programmes. The NCCP explicitly references the need for gender equality in climate adaptation and mitigation strategies. It also commits to increasing women's participation in national and local climate-related decision-making bodies.

Pakistan's First Biennial Update Report (BUR) highlights the importance of integrating gender perspectives into climate action. Pakistan's **Updated NDC** includes a plan to include women and youth in climate initiatives. The **National Biodiversity Strategy and Action** Plan contains a section on gender and poverty, and the National Water Policy recognises the need to reduce the gendered impacts of water scarcity.

The NDMA has developed a **Gender-Sensitive Disaster Management Policy**, which prioritises the inclusion of women in disaster preparedness and response. The policy highlights the need for culturally appropriate disaster risk reduction mechanisms and programmes to build resilience through community based disaster risk

management. It notes the need for a systematic methodology to gather disaggregated data. Despite recognition of women's vulnerability, the document contains no plans to operationalise policy provisions for women and marginalised groups.

However, challenges remain in achieving gender parity in decision-making bodies, particularly at higher levels of government. According to official data, while women's representation in climate-related bodies has improved they still represent only 28% of members in local climate adaptation committees.

5.3.2 Gender-responsive climate finance

Pakistan has made significant progress in directing climate finance towards gender-responsive initiatives. The 2015 GCF accreditation to Pakistan allows for the mobilisation of gender-sensitive funds for climate adaptation and resilience projects targeting rural women. The MoCC's Climate Finance Unit has identified and provided financial support for several gender-responsive projects, such as those targeting women farmers with climate-resilient agricultural technologies.

However, access to these funds remains limited, particularly in remote areas, due to barriers such as financial literacy, mobility, social norms and limited access to networks. Less than 5% of rural women are able to directly access climate finance opportunities (UN Women, 2024b). Targeted interventions are needed to improve their financial literacy and entrepreneurship skills.

The **National Climate Finance Strategy** underscores the importance of gender responsiveness in climate finance. It emphasises the need to consider gender impacts in climate policy and implement targeted measures to address them. Research and development is a crucial pillar of the strategy, which emphasises the need to take a proactive role in advancing state-of-the-art solutions for low-carbon and resilient growth.

5.3.3 Capacity building and leadership development for women

National strategies and policies seek to encourage legislative actions and fortify institutional frameworks that increase women's involvement in decision making and implementation. These programmes focus on sustainable agriculture, renewable energy, water management and disaster risk reduction.

In line with the ccGAP and other national climate strategies, significant progress has been made in enhancing women's capacity to actively participate in climate change solutions. Several initiatives, such as the Women in Renewable Energy Programme and the National Rural Support Programme (NRSP), have aimed at building skills among rural women in key sectors such as agriculture and energy. These programmes have been implemented at the community level, with a focus on the following areas:

- Sustainable agriculture: Women farmers trained in climate-resilient farming techniques, including the use of drought-resistant crop varieties and water-efficient irrigation systems. These programmes have led to a 20-30% improvement in crop yields for participating women (IUCN, 2022).
- Disaster risk reduction: Women trained in disaster risk management, including early warning systems and emergency response. Over 5,000 women have participated in disaster response training, equipping them to take leadership roles during climate-related disasters (PRCS, 2025).

- Renewable energy: Women in rural communities trained to install and maintain solar-powered systems. A notable example is the Women's Empowerment and Renewable Energy Programme, which has enabled over 2,000 women to access and manage renewable energy systems (IUCN, 2022).

Despite these successes, barriers to widespread participation remain, particularly in regions where patriarchal social structures limit women's mobility and access to training opportunities. Cultural norms and gender stereotypes often prevent women from attending training programmes, accessing technologies and digital tools, and taking leadership roles. Overcoming these barriers is crucial to ensure that capacity building initiatives reach all women, especially those in remote and conservative areas.

5.3.4 Gender-disaggregated data and monitoring mechanisms

Gender-disaggregated data collection is critical to understanding the differentiated impacts of climate change on women and girls. It allows policymakers to better understand and address their specific needs, and to capitalise on women's potential for leadership in climate change mitigation and adaptation. Data on women's contributions in agriculture, water conservation, natural resource management, community-based disaster preparedness and a range of other key adaptation and resilience activities can ensure that climate action is more effective.

It is imperative to develop a standardised gender-disaggregated data collection and reporting tool in Pakistan for all climate change programme interventions and initiatives. This will also make it easier to evaluate effectiveness of gender-responsive climate policies and programmes. The NDMA's Gender Task Force has completed a gender mapping across Pakistan, which confirms that women are the most vulnerable group in natural disasters.

The MoCC and the PMD have made efforts to integrate gender-sensitive indicators into their climate monitoring systems. For example:

- Pakistan has begun to collect gender-disaggregated data on issues such as access to water, disaster impacts and meaningful participation in climate adaptation programmes (IUCN, 2022). This data is used to monitor the effectiveness of gender-responsive policies and projects and to identify areas that need further attention.
- Pakistan has also introduced gender-sensitive assessments and research for climate-related projects. The GCF supports these initiatives, ensuring that gender analysis and gender action plans are integrated into all major climate adaptation and mitigation projects.

Challenges persist, especially in rural and conflict-affected areas, where data collection is hindered by logistical difficulties, limited human and financial resources and socio-cultural barriers that restrict women's mobility and participation in data-gathering efforts. Only 20% of climate projects in Pakistan consistently use gender-disaggregated data and data gaps in areas like rural water access and agriculture remain problematic (UN Women, 2022).

5.3.5 Women's participation in climate governance

Increasing the participation of women in climate governance bodies at all levels, including the National Climate Change Council (NCCC), disaster response teams and other climate-related governance structures is crucial to efficiently combat extreme climatic events.

Over the last decade, Pakistan has made steady progress in improving women's participation in climate governance. The NCCC, a key body responsible for guiding climate policy, now includes women representatives from diverse sectors. As of 2023, 30% of the members of the NCCC are women, a significant increase from 15% in 2010. This improvement is in line with Pakistan's commitment to the UNFCCC's gender action plan, which advocates for equal representation in climate-related decision-making bodies (IUCN, 2022). Other areas where women's participation in climate governance shows progress include the following:

- Local climate adaptation committees: Women now hold leadership positions in climate adaptation committees in the provinces of Punjab and Sindh, allowing women and girls to shape local climate action.
- Community-based resilience and adaptation: The government has prioritised community-based initiatives for adaptation and resilience. This includes capacity building, awareness-raising and the promotion of nature-based solutions and green interventions to promote flood risk management, disaster risk management and climate readiness

Despite these advances, gender parity in higher-level governance remains an ongoing challenge. Women still represent a small fraction of decision-makers in ministerial positions and high-level policy-making bodies. Pakistan ranks 149 out of 156 countries in terms of gender parity in political empowerment (IUCN, 2022), reflecting the systemic barriers women face in accessing leadership roles in government.

5.3.6 Awareness raising and advocacy for gender-responsive climate action

Advocacy and awareness-raising campaigns have played a key role in promoting gender-responsive climate action in Pakistan. The ccGAP has been instrumental in pushing for greater recognition of the link between gender inequality, poverty and climate vulnerability. Other recent initiatives include the following:

- Media campaigns: The MoCC has launched several media campaigns aimed at educating both the general public and policymakers about the gendered impacts of climate change. These campaigns use television, radio and social media to reach diverse audiences. One such initiative, the Gender and Climate Change Media Initiative, has reached over 10 million people since its inception in 2019.
- Community workshops: Local-level workshops and training sessions have been conducted in rural areas to engage community leaders, including men, on the importance of gender-sensitive climate policies. These workshops have reached over 50,000 people in the past five years.

Despite these efforts, cultural resistance remains deeply entrenched and regressive views about women's roles hinder acceptance of gender-responsive policies. Male-dominated decision-making structures continue to exclude women in climate action.

5.3.7 Gender-responsive adaptation and resilience strategies

Pakistan has made significant strides in developing gender-sensitive adaptation strategies that are responsive to the specific vulnerabilities of women and girls. Some key areas of progress include:

- Agricultural adaptation: Programmes aimed at improving women's access to climate-resilient seeds and water-efficient irrigation systems have been implemented in the provinces of Punjab and Sindh. These programmes have resulted in improved food security for participating women, with 20% higher crop yields reported on women-led farms.
- Disaster risk reduction: Women's roles in disaster preparedness and response have been integrated into national and local climate adaptation strategies. For instance, the National Disaster Risk Reduction Framework now includes provisions to ensure that women and children are prioritised during emergency evacuations and relief efforts.

However, unequal distribution of resources, limited access to credit and restrictions on land ownership continue to limit women's ability to benefit from adaptation strategies. Land ownership laws in Pakistan heavily favour men, and women lack access to formal credit systems, which limits their capacity to invest in climate-resilient technologies.

5.4 Key challenges

Despite progress made in integrating gender considerations into climate policies and programmes, there are several persistent challenges that need to be addressed. This section discusses key challenges to gender-responsive climate action.

5.4.1 Gender-disaggregated data

As noted above, a significant challenge in implementing gender-responsive climate action in Pakistan is the lack of gender-disaggregated data. The lack of data also hinders the evaluation of existing programmes with respect to gender and social inclusion.

While gender-disaggregated data is being collected in certain sectors such as agriculture and water management, significant gaps remain in many key climate-sensitive sectors as well as sectors relevant for NDC implementation. Current data collection systems are often limited to the national or provincial level, leaving local-level gendered impacts largely unaddressed.

Recommendations

- Make gender analysis and gender needs assessments a mandatory requirement in the development of all policies, programmes and projects.
- Amend legislation and rules of business, requiring that all ministries and provincial departments collect and report disaggregated data by gender as well as age and disability.
- Implement a monitoring framework to ensure that data collection is comprehensive and regularly updated.
- Develop gender-responsive criteria and indicators related to mitigation, adaptation and vulnerability.
- Conduct capacity building and training of government officials on gender-responsive monitoring frameworks.

5.4.2 Access to climate finance

While gender-responsive climate finance has been directed toward women-led projects in sectors like agriculture and energy, access to these funds remains constrained by limited financial literacy, lack of collateral and social barriers that restrict women's control over financial resources. Although there are initiatives aimed at improving women's access to climate finance, many women are still unable to navigate complex financial systems or access credit due to lack of information, gendered financial exclusion and lack of economic empowerment.

As a result, women are excluded from key funding opportunities that could enhance their participation in climate resilience building. This limits women's ability to invest in climate adaptation measures such as sustainable farming techniques, climate-smart agriculture and livestock practices, renewable energy technologies, and disaster-proof infrastructure.

Recommendations

- Promote gender-responsive financial mechanisms and increase the financial literacy of women, particularly in rural areas.
- Expand microfinance programmes targeting women to include access to climate finance.
- Establish collateral-free loans for women-led projects and integrate gender equality criteria into national and international climate finance allocation mechanisms.
- Prioritise gender-responsive climate financing in all interventions for climate mitigation and adaptation.
- Implement gender-responsive budgeting to ensure equitable resource allocation in all government projects.

5.4.3 Cultural and social norms

Deep-rooted gender norms and social expectations continue to limit women's participation in climate governance, decision-making and leadership. The persistence of these barriers prevents women from contributing to the development of climate adaptation strategies and resilience-building efforts. The absence of women's perspectives in decision-making processes leads to gender blind policies and less effective outcomes.

Recommendations

- Implement wider awareness-raising and advocacy campaigns that challenge gender norms and emphasise the importance of women and girls in climate action and governance.
- Promote women's leadership training programmes and ensure that women have access to mentorship in climate-related fields.

5.4.4 Policy and implementation

While gender is now recognised in climate frameworks, translating this recognition into tangible outcomes remains a challenge. Policy fragmentation is a significant issue, with gender-responsive actions not systematically integrated into all climate-related policies and programmes. Despite efforts to mainstream gender in national policies, there is no coherent framework to ensure integration of gender-responsiveness in all sectors. The ccGAP calls for better alignment between national climate policies and gender equity objectives. Although there is a commitment at the policy level, there are gaps in enforcement and implementation.

The lack of effective implementation leads to policy incoherence and fragmentation, undermining efforts to address the gendered impacts of climate change in a holistic manner. Without clear accountability mechanisms and consistent enforcement, the good intentions of gender-inclusive policies will fail to yield results on the ground.

Recommendations

- Develop an integrated and framework to strengthen policy coordination on gender-responsiveness in all climate-related sectors.
- Ensure gender-responsive planning and budgeting to support implementation of inclusive plans, strategies and programmes
- Prepare guidelines for gender-responsive budgeting to ensure integration into national and provincial annual planning and budgeting processes (PC-1, PC-3, PC-5).
- Establish gender-responsive monitoring and evaluation mechanisms with gender indicators to track implementation of policies and programmes, and ensure accountability for outcomes.

5.4.5 Technical training and mentorship

While capacity-building efforts are underway, there remains a skills gap in terms of technical expertise and leadership training for women in climate-related fields such as renewable energy, disaster risk reduction and climate finance. In rural areas, women are often excluded from technical education and skills development programmes. The ccGAP notes that training programmes for women largely focus on soft skills (e.g., community organising, water management) rather than technical skills (e.g., solar energy installation, climate modeling, GIS mapping).

There is also a lack of mentorship programmes for women in climate-related fields, which limits career advancement and leadership opportunities. The skills gap prevents women from participating in technical climate solutions and perpetuates the gender gap in climate-related professions and decision-making bodies.

Recommendations

- Expand technical training programmes for women, particularly in STEM fields related to climate action, such as renewable energy and climate data analysis.
- Create mentorship networks to provide support and guidance for women aspiring to take on leadership roles in climate action.
- Engage with local women-led organisations and women's rights groups to build their capacity for climate action.

5.4.6 Institutional capacity and coordination

Multiple governmental agencies work on issues related to climate change and gender without alignment or coordination. This leads to duplication of efforts and missed opportunities for synergies. There is a need to improve coordination between national, provincial and local-level institutions. Fragmented institutional efforts lead to inefficiency and misallocation of resources, and limiting the impact of climate policies.

Recommendations

- Improve inter-agency coordination at all levels of government to ensure aligned efforts and the effective implementation of gender-responsive climate actions.
- Make women's participation mandatory in all development planning and budgeting phases.

5.5 National stakeholder consultations

The National Stakeholder Consultation on the BTR provided a platform to address the gendered dimensions of climate change. The workshop emphasised the importance of gender-responsive strategies and highlighted the need for gender analysis and gender-disaggregated data to better understand the vulnerabilities and contributions of women and girls in the context of climate change.

Through collaborative discussions, stakeholders recognised the critical role of women as agents of change in climate resilience, especially in sectors such as agriculture, water management, disaster risk reduction and energy. They identified the need for gender-disaggregated data systems, stronger institutional coordination and the mainstreaming of gender in national climate and development planning processes.

Addressing these key challenges is essential for achieving meaningful gender equality in climate action in Pakistan. By focusing on data gaps, financial barriers, cultural constraints, policy implementation gaps, capacity-building deficits and institutional weaknesses, Pakistan can ensure that women not only benefit from climate initiatives but can also be leaders in shaping climate resilience.

As the way forward, there is a clear call to implement the ccGAP, strengthen capacity building for women, and promote research and partnerships that centre gender equity in climate change mitigation and adaptation efforts.

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Annexes

Annexes

Annex A: Climate adaptation projects in Pakistan

Ongoing projects				
No.	Project	Funding	Implementing agency	Cost [USD million]
1	Scaling-up of Glacial Lake Outburst Flood (GLOF) risk reduction in Northern Pakistan.	GCF	UNDP	36.9
2	Transforming the Indus Basin with Climate Resilient Agriculture and Climate Smart Water Management.	GCF	FAO	34.9
3	Recharge Pakistan	GCF	WWF	66
4	Community Resilience Partnership Regional Program	GCF	ADB	24
5	Acumen Climate Action Pakistan Fund	GCF	Acumen Fund Inc.	28
6	Mainstreaming Climate Change Adaptation through Water Resource Management in Leather Industrial Zone Development.	GEF	UNIDO	3.3
7	Addressing the Drivers of Deforestation: Reducing the pressure on the High Conservation Value Forests of Chilgoza Pine of Pakistan	GEF	FAO	4.5
8	Combating Land Degradation Through Integrated and Sustainable Range and Livestock Management to Promote Resilient Livelihoods in Northern Punjab.	GEF	FAO	2.5
9	Enhance community, local and national-level urban climate change resilience to water scarcity, caused by floods and droughts in Rawalpindi and Nowshera, districts	AF	UNHABITAT	6
10	Capacity Building on Water Quality Monitoring SDG 6 (6.1)and Reporting	PSDP	MoCC/ KOICA	PKR 1,289
11	Climate Resilient Urban Human Settlements Unit	PSDP	MoCC	PKR 90.158
12	Upscaling of Green Pakistan Programme (Revised)	PSDP	MoCC	PKR 125,184.3
13	Pakistan Bio-Safety Clearing House (Pak-BCH) for GMOs Regulation	PSDP	MoCC	PKR 200.00
14	Strengthening NRSP and Pipeline Development in Pakistan	GCF	NRSP	0.3
15	Building Capacities and Prioritising National Actions for a Climate-Resilient Health Sector through the Development of a Road Map for Four Priority Areas	GCF	WHO	0.6
16	Readiness support for building community resilience through application of traditional and local knowledge (TLK) system"	GCF	IGES	0.6
17	National Adaptation Plan (NAP)	GCF	UNEP	2.9
18	Third National Communication (TNC)	UNEP	MOCC	0.5

Hard pipeline projects				
No	Project	Funding	Implementing agency	Cost [USD million]
1	Kalar Kahar Lake Cleanup	Mashreq Bank		0.2
2	Development of SME Models for Waste Management and Waste Management Strategy	IECT/ UNEP		0.29
3	Combating Land Degradation Through Integrated and Sustainable Range and Livestock Management to Promote Resilient Livelihoods in Northern Punjab	GEF		2.1
Pipeline projects				
No	Project	Funding	Implementing agency	Cost [USD million]
1	Integrated Climate Risk Management for Strengthened Resilience to Climate Change in Buner and Shangla Districts of KP	GCF	WFP	10
2	[Multi-Country] GCF-IFC Scaling Resilient Water Infrastructure (RWI) Facility	GCF	IFC	258
3	Harnessing the Domestic Private Sector Ecosystems for Climate Action in Pakistan	GCF	NRSP	50
4	Climate Smart Villages: Fostering Climate Resilience and Livelihood Security in Water Scarce Rural Communities in Pakistan	GCF	NRSP	50
5	Community-Led Health Resilience in a Changing Climate	GCF	NRSP/ Pathfinder	50
6	Water Resource Management and Development, Ground Water Recharge and Digital Monitoring Mechanism.	GCF	CGIAR	30
7	Upscaling Sustainable Forest Management Project	GCF	IUCN	25
8	Building Khyber Pukhtoonkhwa Climate Resilience through Adaptive Livelihoods and Rehabilitation of Watershed, Forest Resources and Wildlife Habitats.	GCF	IUCN/ Wildlife Department KP	48.56
9	Indus for People and Biodiversity	GCF	IUCN/Forest Department KP	47
10	Strengthening Community Managed Protected Area for Conserving Biodiversity and Improving Local Livelihoods in Pakistan.	GEF	UNDP	2
11	Strengthening Governance and Capacity for Combating Illegal Wildlife Trade in Pakistan.	GEF	IUCN	3.8
12	Sustainable and Regenerative Management of Rice Production in Pakistan	GEF	FAO	5.8
13	Bananas in Pakistan's Bioeconomy: Transforming Waste into Textile	GEF	FAO	5
14	Mainstreaming Natural Capital Accounting into Planning and Implementation of Sustainable Landscape Management in Pakistan.	GEF	UNEP	2
15	Integrated Management of Land and Water Resources for Strengthening Climate Resilience in Flood Affected Areas of Balochistan, Pakistan	GEF	UNDP	2.24
16	Marine Biodiversity Conservation in Pakistan (Maritime Department,	GEF	FAO	3
17	Strengthening Technical Capacities (STC)	WB	MoCC	1
18	Institutional Capacity Enhancement to Implement and Promote Precision Agriculture for Climate Resilience in Punjab (Pakistan)	GCF	ADPC	0.3

Annex B: Paris Agreement (2015)

Article 9

1. Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention.

2. Other Parties are encouraged to provide or continue to provide such support voluntarily.

3. As part of a global effort, developed country Parties should continue to take the lead in mobilising climate finance from a wide variety of sources, instruments and channels, noting the significant role of public funds, through a variety of actions, including supporting country-driven strategies and taking into account the needs and priorities of developing country Parties. Such mobilisation of climate finance should represent a progression beyond previous efforts.

4. The provision of scaled-up financial resources should aim to achieve a balance between adaptation and mitigation, taking into account country-driven strategies and the priorities and needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints, such as the least developed countries and small island developing States, considering the need for public and grant-based resources for adaptation.

5. Developed country Parties shall biennially communicate indicative quantitative and qualitative information related to paragraphs 1 and 3 of this Article, as applicable, including, as available, projected levels of public financial resources to be provided to developing country Parties. Other Parties providing resources are encouraged to communicate biennially such information on a voluntary basis.

6. The global stocktake referred to in Article 14 shall take into account the relevant information provided by developed country Parties and/or Agreement bodies on efforts related to climate finance.

7. Developed country Parties shall provide transparent and consistent information on support for developing country Parties provided and mobilised through public interventions biennially in accordance with the modalities, procedures and guidelines to be adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement, at its first session, as stipulated in Article 13, paragraph 13. Other Parties are encouraged to do so.

8. The Financial Mechanism of the Convention, including its operating entities, shall serve as the financial mechanism of this Agreement.

9. The institutions serving this Agreement, including the operating entities of the Financial Mechanism of the Convention, shall aim to ensure efficient access to financial resources through simplified approval procedures and enhanced readiness support for developing country Parties, in particular for the least developed countries and small island developing States, in the context of their national climate strategies and plans.

Article 10

1. Parties share a long term vision on the importance of fully realising technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions.

2. Parties, noting the importance of technology for the implementation of mitigation and adaptation actions under this Agreement and recognising existing technology deployment and dissemination efforts, shall strengthen cooperative action on technology development and transfer.

3. The Technology Mechanism established under the Convention shall serve this Agreement.

4. A technology framework is hereby established to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of this Agreement, in pursuit of the long-term vision referred to in paragraph 1 of this Article.

5. Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development. Such effort shall be, as appropriate, supported, including by the Technology Mechanism and, through financial means, by the Financial Mechanism of the Convention, for collaborative approaches to research and development and facilitating access to technology, in particular for early stages of the technology cycle, to developing country Parties.

6. Support, including financial support, shall be provided to developing country Parties for the implementation of this Article, including for strengthening cooperative action on technology development and transfer at different stages of the technology cycle, with a view to achieving a balance between support for mitigation and adaptation. The global stocktake referred to in Article 14 shall take into account available information on efforts related to support on technology development and transfer for developing country Parties.

Article 11

1. Capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness and the transparent, timely and accurate communication of information.

2. Capacity-building should be country-driven, based on and responsive to national needs and foster country ownership of Parties, in particular, for developing country Parties, including at the national, subnational and local levels. Capacity-building should be guided by lessons learned, including those from capacity-building activities under the Convention and should be an effective, iterative process that is participatory, cross-cutting and gender-responsive.

3. All Parties should cooperate to enhance the capacity of developing country Parties to implement this Agreement. Developed country Parties should enhance support for capacity-building actions in developing country Parties.

4. All Parties enhancing the capacity of developing country Parties to implement this Agreement, including through regional, bilateral and multilateral approaches, shall regularly communicate on these actions or measures on capacity building. Developing country Parties should regularly communicate progress made on implementing capacity-building plans, policies, actions or measures to implement this Agreement.

5. Capacity-building activities shall be enhanced through appropriate institutional arrangements to support the implementation of this Agreement, including the appropriate institutional arrangements established under the Convention that serve this Agreement. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall, at its first session, consider and adopt a decision on the initial institutional arrangements for capacity-building.

Article 13

1. In order to build mutual trust and confidence and to promote effective implementation, an enhanced transparency framework for action and support, with built-in flexibility which takes into account Parties' different capacities and builds upon collective experience is hereby established.

2. The transparency framework shall provide flexibility in the implementation of the provisions of this Article to those developing country Parties that need it in the light of their capacities. The modalities, procedures and guidelines referred to in paragraph 13 of this Article shall reflect such flexibility.

3. The transparency framework shall build on and enhance the transparency arrangements under the Convention, recognising the special circumstances of the least developed countries and small island developing States and be implemented in a facilitative, non-intrusive, non-punitive manner, respectful of national sovereignty and avoid placing undue burden on Parties.

4. The transparency arrangements under the Convention, including national communications, biennial reports and biennial update reports, international assessment and review and international consultation and analysis, shall form part of the experience drawn upon for the development of the modalities, procedures and guidelines under paragraph 13 of this Article.

5. The purpose of the framework for transparency of action is to provide a clear understanding of climate change action in the light of the objective of the Convention as set out in its Article 2, including clarity and tracking of progress towards achieving Parties' individual nationally determined contributions under Article 4 and Parties' adaptation actions under Article 7, including good practices, priorities, needs and gaps, to inform the global stocktake under Article 14.

6. The purpose of the framework for transparency of support is to provide clarity on support provided and received by relevant individual Parties in the context of climate change actions under Articles 4, 7, 9, 10 and 11 and, to the extent possible, to provide a full overview of aggregate financial support provided, to inform the global stocktake under Article 14.

7. Each Party shall regularly provide the following information:

    a. A national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases, prepared using good practice methodologies accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties serving as the meeting of the Parties to this Agreement; and

    b. Information necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4.

8. Each Party should also provide information related to climate change impacts and adaptation under Article 7, as appropriate.

9. Developed country Parties shall and other Parties that provide support should, provide information on financial, technology transfer and capacity-building support provided to developing country Parties under Articles 9, 10 and 11.

10. Developing country Parties should provide information on financial, technology transfer and capacity-building support needed and received under Articles 9, 10 and 11.

11. Information submitted by each Party under paragraphs 7 and 9 of this Article shall undergo a technical expert review, in accordance with decision 1/CP.21. For those developing country Parties that need it in the light of their capacities, the review process shall include assistance in identifying capacity-building needs. In addition, each Party shall participate in a facilitative, multilateral consideration of progress with respect to efforts under Article 9 and its respective implementation and achievement of its nationally determined contribution.

12. The technical expert review under this paragraph shall consist of a consideration of the Party's support provided, as relevant and its implementation and achievement of its nationally determined contribution. The review shall also identify areas of improvement for the Party and include a review of the consistency of the information with the modalities, procedures and guidelines referred to in paragraph 13 of this Article, taking into account the flexibility accorded to the Party under paragraph 2 of this Article. The review shall pay particular attention to the respective national capabilities and circumstances of developing country Parties.

13. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall, at its first session, building on experience from the arrangements related to transparency under the Convention and elaborating on the provisions in this Article, adopt common modalities, procedures and guidelines, as appropriate, for the transparency of action and support.

14. Support shall be provided to developing countries for the implementation of this Article.

15. Support shall also be provided for the building of transparency-related capacity of developing country Parties on a continuous basis.

Source: UNFCCC, 2015.

Annex C: National Climate Finance Strategy of Pakistan 2024

For over a decade, Pakistan has been one of the top ten nations most affected by climate change. The super floods of 2022 alone caused an estimated USD 30 billion in damage and affected over 33 million people. Such events continue to strain our communities, infrastructure and economic resilience. Given these realities, Pakistan faces significant climate finance needs, with estimates ranging from USD 200 billion for NDC implementation to USD 348 billion for climate-resilient development by 2030. Current climate finance flows, while increasing, fall short of these needs, with only about USD 4 billion invested in climate related activities in 2021.

Pakistan envisions a transformational change for climate-resilient and low-carbon economy by 2050 by building robust infrastructure and agricultural systems to withstand extreme weather, prioritising water, food and energy security for all**.** The National Climate Finance Strategy (NCFS) developed by the Ministry of Climate Change & Environmental Coordination in consultation with the World Bank provides a comprehensive framework for mobilising and deploying climate finance and aligning it with national priorities and international commitments (see

The NCFS is a time-bound, robust and living document that will be periodically reviewed and updated. It will be revised every two years based on progress review and feedback from monitoring and evaluation (M&E) reports from the line ministries and the provinces. The initial review is scheduled for FY27.

NCFS pursues a three-pronged approach centred on three main strategic objectives:

a. Adopt a whole-of-government strategy to create synergy and cohesion across all tiers of governance at both national and subnational levels, thereby accelerating the mainstreaming of climate change in all sectors and tiers of governance.

b. Mobilise and diversify domestic revenue and investments in order to leverage them to attract international climate finance thereby increasing fiscal space for climate action and supporting climate-resilient, low-carbon development and

c. Diversify finance sources through innovative mechanisms. to facilitate partnerships with the private sector and access both domestic and international climate finance and investments.

The key objectives include identifying key market and policy barriers to scale up finance for priority climate and development objectives and develop potential financing and other interventions to scale up climate finance, both domestic and private and international action.

The three main areas identified are climate proofing sectoral policies, clarifying institutional roles post-18th Amendment and improving understanding of global climate finance mechanisms. By focusing on these areas, the strategy aims to overcome barriers to climate-resilient development and increase investments in adaptation and mitigation.

The framework is built on seven pillars, with five core pillars supporting the overall structure and two cross-cutting pillars integrating activities across sectors. This design ensures a comprehensive approach to climate finance, addressing governance, capacity building and the integration of climate considerations into broader development processes. The NCFS builds upon the NCCP while focusing on creating new frameworks through supportive actions and policies.

The Strategy provides a critical analysis of Pakistan's sectoral policies and their alignment with climate commitments highlighting the need for a more comprehensive approach to addressing climate risks across sectors. The NCCP, NDC and NAP have provided a foundation for common themes in adaptation and mitigation actions for prioritising interventions and investments.

The governance and coordination framework proposes the creation of four key bodies: the Committee of the Secretaries as the Steering Committee, the Technical Committee on Climate Finance, Provincial Technical Committees and a Climate Finance Monitoring and Evaluation Unit. This multi-tiered approach aims to ensure effective coordination, technical expertise and performance monitoring at both national and provincial levels.

The strategy underscores the critical importance of gender responsiveness in climate finance. It emphasises the need to consider gender impacts in climate policy and implement targeted measures to address them, recognising that women are disproportionately affected by climate hazards. Research and development is highlighted as a crucial pillar of the NCFS. The strategy emphasises the need for Pakistan to take a proactive role in advancing state-of-the-art solutions for low-carbon and resilient growth, tailored to its unique needs.

The way forward for implementing the NCFS include aligning the strategy with the NDC Implementation Plan, setting measurable targets, developing detailed financial projections and conducting regular monitoring and evaluation.

Source: GoP, 2024b.

Pakistan's Biennial Transparency Report (BTR) 2024

To the United Nations Framework Convention on Climate Change (UNFCCC)

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