Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized
Public Disclosure Authorized

SOUTH
ASIA

PAKISTAN

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

November 2022

© 2022 The World Bank Group
1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

This work is a product of the staff of The World Bank Group with external contributions. "The World Bank Group" refers to the legally separate organizations of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA).

The World Bank Group does not guarantee the accuracy, reliability or completeness of the content included in this work, or the conclusions or judgments described herein, and accepts no responsibility or liability for any omissions or errors (including, without limitation, typographical errors and technical errors) in the content whatsoever or for reliance thereon. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the World Bank Group concerning the legal status of any territory or the endorsement or acceptance of such boundaries. The findings, interpretations, and conclusions expressed in this volume do not necessarily reflect the views of the organizations of the World Bank Group, their respective Boards of Executive Directors, and the governments they represent.

The contents of this work are intended for general informational purposes only and are not intended to constitute legal, securities, or investment advice, an opinion regarding the appropriateness of any investment, or a solicitation of any type. Some of the organizations of the World Bank Group or their affiliates may have an investment in, provide other advice or services to, or otherwise have a financial interest in, certain of the companies and parties named herein.

Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of any of the organizations of The World Bank Group, all of which are specifically reserved.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank Group encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given and all further permissions that may be required for such use (as noted herein) are acquired. The World Bank Group does not warrant that the content contained in this work will not infringe on the rights of third parties, and accepts no responsibility or liability in this regard. All queries on rights and licenses should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; e-mail: pubrights@worldbank.org.

Graphic Design: Kayhan Suleman

Cover Design: Brad Amburn

PAKISTAN

COUNTRY CLIMATE AND DEVELOPMENT REPORT

TABLE OF CONTENTS

Acknowledgments iv
Abbreviations v

Preface VIII

1. CLIMATE AND DEVELOPMENT 1
- 1.1 The economic, social, and environmental context 2
- 1.2 Climate change vulnerability 4
- 1.3 National GHG emission profile 6

2. GROWTH, EQUITY, AND THE FINANCIAL IMPLICATIONS OF CLIMATE RISKS 8
- 2.1 Spatial and socioeconomic variation in hazards, exposure, and vulnerability 9
- 2.2 Economy-wide impacts of selected physical climate risks 12
- 2.3 Damage from water insecurity 15
- 2.4 Damage from air pollution 16
- 2.5 Aggregated impact of climate and environmental risks 17

3. CLIMATE CHANGE POLICY, INSTITUTIONS AND REGULATORY FRAMEWORK 18
- 3.1 Governance and policy for climate change 19
- 3.2 Climate change commitments 20
- 3.3 Institutional frameworks for climate change 21
  - 3.3.1 Federal-Level Institutions 21
  - 3.3.2 Provincial-Level Institutions 22
- 3.4 Current landscape of climate finance 23

4. PIVOTING THE ECONOMY TO AN INCLUSIVE, RESILIENT AND GREEN DEVELOPMENT PATHWAY 24
- 4.1 The Need for an Agriculture-Food System Transformation 25
  - 4.1.1 Challenges and Opportunities 25
  - 4.1.2 Key Policy Recommendations 30
- 4.2 Building Resilient and Livable Cities 34
  - 4.2.1 Challenges and Opportunities 34
  - 4.2.2 Key Policy Recommendations 38
- 4.3 Accelerating a Just Transition to Sustainable Energy and Transport 40
  - 4.3.1 Challenges and Opportunities 40
  - 4.3.2 Key Policy Recommendations 44

5. THE MACRO-FISCAL AND DISTRIBUTIONAL IMPACTS OF CLIMATE AND DEVELOPMENT POLICY ACTIONS 48
- 5.1 Policy Packages 49
  - 5.1.1 Policy Package 1: The Government's IGCEP 2021–30 49
  - 5.1.2 Policy Package 2: Carbon Taxes, Revenue Recycling, and Feebates 51
  - 5.1.3 Policy Package 3: Investments in Human Capital Development 53
  - 5.1.4 Investments in Adaptive Social Protection Policies 53
- 5.2 Financing a Resilient and Inclusive Development Pathway 54
- 5.3 The Aggregate Effects of Policy Packages on Emissions 57

6. SUMMARY OF RECOMMENDATIONS 59

7. BIBLIOGRAPHY 65

Figures, Tables and Maps

Figure 1.1: Pakistan's GDP per Capita (PPP Current International $) (left) and Poverty Headcount Ratio at US$3.20 a Day (2011 PPP) (right) Compared with SAR and Lower Middle-Income Countries 2
Figure 1.2: Projected Change in Annual Mean Temperature (left) and Days with Heat Index > 35°C (right) up to 2100 in Pakistan (Baseline: 1995–2014, Multi-Model Ensemble) 4
Figure 1.3: Total Occurrence and Average Economic Damage (percentage of GDP) from Natural Disasters in Pakistan between 1990 and 2019 6
Figure 1.4: Pakistan's National GHG Inventory in 2018 7
Figure 2.1: Real GDP Losses from Climate Damage 12
Figure 2.2: Real GDP Losses from Climate Extreme Scenarios 13
Figure 2.3: Sectoral Impacts of Climate Damage (Pessimistic Scenario) 14
Figure 2.4: Impact of Damage on Household Poverty Rate in the Pessimistic Scenario Compared to the Baseline 15
Figure 2.5: Aggregated Impact on GDP Associated with Climate and Environmental Threats by 2050 17
Figure 4.1: Final Energy Consumption 2019–2020 41
Figure 4.2: Energy Consumption by Sector and by Fuel Type in the Industrial Sector (2019–2020) 43
Figure 5.1: Impact of the IGCEP and the IGCEP + Electrification 50
Figure 5.2: Impacts of Carbon Taxes without the IGCEP, with the IGCEP, and with the IGCEP and Electrification 52
Figure 5.3: Impacts of Human Capital (HC) Development and with Other Policies 53
Figure 5.4: Indicative Estimation of Total Investment Needs for Climate-Resilient and Low-Carbon Development for up to 2030 55
Figure 5.5: Aggregated GHG Emissions Impacts of Different Policy Scenarios for 2020–2050 in Comparison to the NDC (2021) Target for 2030 58

Table 5.1: Carbon Taxes 51
Table 6.1: Criteria for Prioritizing and Sequencing the Recommended Policy Actions 60
Table 6.2: Summary of Policy Recommendations in the CCDR 61

Map 2.1: District-Level Poverty Rates in Pakistan (2004, 2012, and 2019–2020) 9
Map 2.2: Heat Hazard (left) and Population Exposure (right) 10
Map 2.3: Drought Hazards for Agricultural Land during the Kharif (left) and Rabi (right) Cropping Seasons 11
Map 2.4: Expected Annual Impact of Floods on Built-up Assets (left) and on Agricultural Land (right) 11
Map 2.5: PM2.5 Emissions (left) and District-Level Population Exposure (right) 16

ACKNOWLEDGMENTS

This Country Climate and Development Report (CCDR) is a collaborative effort of the World Bank (WB), International Finance Corporation (IFC), and Multilateral Investment Guarantee Agency (MIGA), produced by a core team led by Ghazala Mansuri (Lead Economist, WB), Abedalrazq F. Khalil (Program Leader for Sustainable Development, WB), and Shabana Khawar (Principal Operations Officer, IFC). Overall report drafting, coordination and process management was led by Yunziyi Lang. The key section contributors include Adnan Ashraf Ghumman, Asjad Naqvi, Basharat Ahmed Saeed, Catalina Ochoa, Charl Jooste, Christian Schoder, Christine Heumesser, Christopher Ward, Christopher James Warner, Derek Hung Chiat Chen, Erwin W. Knippenberg, Faizan Shamsi, Fiza Salim, Hiba Haider Zaidi, Hina Nagi, Huma Khalid, Jonas Ingemann Parby, Khyati Rathore, Lander Bosch, Lincoln Flor, Lire Ersado, Maximilian Fischbach, Mohamed Boly, Muddassir Shafique, Muhammad Bhatti, Oliver Knight, Saadia Qayyum, Sahar Etezaz, Saima Zuberi, Seher Abbas Haider, Suhaib Rasheed, Tatiana Peralta Quiros, Teuta Kacaniku, Zaheer Ahmad, and Zishan Karim. Other contributors include Ahsan Tehsin, Akmal Minallah, Aldo Defilippi, Ali Saeed Mirza, Ali Syed, Alisan Dogan, Amjad Zafar Khan, Aroub Farooq, Bilal Khalid, Gonzalo J. Varela, Hector Pollitt, Inga Afanasieva, Ira Irina Dorband, Kamwoo Lee, Khurram Mirza, Melis U. Guven, Moritz Meyer, Omair Shabbir, Pragya Shrestha, Raymond Muhula, Roland White, So Seyama, Tamer Samah Rabie, Thomas Michael Kerr, Tu Chi Nguyen, and Viera Feckova.

In addition, the CCDR received inputs from: Brent Boehlert, Kenneth Strzepek, and Diego Castillo of the Industrial Economics, Incorporated (IEc) on climate change economic damage estimation for Pakistan; Jamie Pirie and Unnada Chewpreecha of the Cambridge Econometrics (CE) on the macro-modeling of climate policies for Pakistan using the E3ME model; and Sajid Amin, Hina Aslam, and Qasim Shah of Sustainable Development Policy Institute (SDPI) on climate institutional and policy assessment.

The CCDR was prepared under the overall direction of Abhas K. Jha (Practice Manger (PM) for South Asia Region (SAR) Climate Change & Disaster Risk Management, WB), Christophe Crepin (PM for SAR Environment, WB), Gailius J. Draugelis (Operations Manager for Pakistan, WB), Josses Mugabi (PM for SAR Water, WB), Loraine Ronchi (former PM for SAR Agriculture, WB), Meskerem Brhane (former PM for SAR Urban, Resilience and Land, WB), Shabih Mohib (PM for SAR Macroeconomics, Trade & Investment, WB), Shomik Raj Mehndiratta (PM for SAR Transport, WB), Simon J. Stolp (PM for SAR Energy, WB), and Stefano Paternostro (PM for SAR Social Protection, WB).

Detailed feedback, suggestions, and comments were received from the internal peer reviewers: Hans Timmer (Chief Economist for South Asia Regional Office, WB), Richard Damania (Chief Economist for Sustainable Development, WB), Sameh Naguib Wahba (former Global Director for Urban, Resilience and Land, WB), Somik V. Lall (Lead Economist for Equitable Growth, Finance and Institutions, WB), Stephane Hallegatte (Senior Climate Change Advisor for Sustainable Development, WB), Vivek Pathak (Director for Climate Business Department, IFC), and William Young; as well as external peer reviewer: Adil Najam (Dean, Global Studies, Boston University).

The CCDR benefitted from discussions with various external stakeholders in Pakistan, including the Ministry of Climate Change, Finance Division, Ministry of Planning, Development & Special Initiatives, Economic Affairs Division, Ministry of Water Resources, Power Division, academics, civil society organizations (CSOs), the private sector, and development partners.

The CCDR was prepared under the guidance of Martin Raiser (Regional Vice President for South Asia Region, WB), Hela Cheikh Rouhou Ep Abid (Regional Vice President, IFC), Najy Benhassine (Country Director, WB), John A. Roome (Regional Director for Sustainable Development, WB), Guangzhe Chen (Regional Director for Infrastructure, WB), Lynne Sherburne-Benz (Regional Director for Human Development, WB), Zoubida Kherous Allaoua (former Regional Director for Equitable Growth, Finance and Institutions, WB), K. Aftab Ahmed (Director for Middle East Region, IFC), and Merli Margaret Baroudi (Director of Economics and Sustainability, MIGA).

ABREVIATIONS

ADS	Accelerated Decarbonization Scenario
AFOLU	agriculture, forestry, and other land use
AQLI	Air Quality Life Index
ARE	Alternative & Renewable Energy
BC	black carbon
BCM	billion cubic meters
BES	biodiversity and ecosystem services
BISP	Benazir Income Support Programme
BPKM	billion passenger kilometers
BRT	Bus Rapid Transport
BTKM	billion-ton kilometers
CCDR	Country Climate and Development Report
CCT	conditional cash transfer (program)
CCUS	Carbon capture, utilization and storage
CDPR	Consortium for Development Policy Research
CFL	compact fluorescent light
CH4	methane
CO2	carbon dioxide
CORE	Collect and Recycle Program
CPAT	Carbon Pricing Assessment Tool
CPEC	China-Pakistan Economic Corridor
CPEIR	Climate Public Expenditure and Institutional Review
CSA	climate-smart agriculture
CT	cash transfer (program)
DAP	dialkyl phosphate (pesticide)
DFI	development finance institution
DISCO	(electricity) distribution company
EE	energy efficiency
EE&C	Energy efficiency and conservation
EGI	exposed glacial ice
EPA	Environmental Protection Agency
ES	ecosystem services
ESCO	energy service company
ESRM	Environmental & Social Risk Management
ETS	Emissions Trading Scheme
EV	electric vehicle
FAO	Food and Agriculture Organization
FCV	fuel cell vehicle
FDI	foreign direct investment
FI	financial institution
FY	fiscal year
GBD	Global Burden of Disease
GCF	Green Climate Fund
GCISC	Global Change Impact Studies Centre

GCM	General Circulation Model
GDP	gross domestic product
GEF	Global Environment Facility
GF	global finance
GHG	greenhouse gas
GLOF	glacial lake outburst flooding
GOP	Government of Pakistan
GW	gigawatts
GWh	gigawatt-hours
ha	hectares
HCI	Human Capital Index
HKHK	Himalaya, Hindu Kush, and Karakorum (glaciers)
IBIS	Indus Basin Irrigation System
ICT	information and communications technology
IEA	International Energy Agency
IFC	International Finance Corporation
IGC	International Growth Center
IGCEP	Generation Capacity Expansion Plan
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change (of the United Nations)
IPS	Intended Policy Scenario
km	kilometer
KP	Khyber Pakhtunkhwa
LCOE	Levelized Cost of Electricity
LNG	liquefied natural gas
LPG	liquid petroleum gas
LT	long term
LTS	long term/low emissions development strategy
m3	cubic meters
MDB	multilateral development bank
mds	Maunds
MoCC	Ministry of Climate Change
MoF	Ministry of Finance
MPDR	Ministry of Planning, Development and Reforms
MRV	monitoring reporting and verification
MT	medium term
MtCO2e	metric tons of carbon dioxide equivalent
MTOE	million tons of oil equivalent
µg/m3	micrograms (one-millionth of a gram) per cubic meter
NADRA	National Database and Registration Authority
NARC	National Agricultural Research Centre
NBS	Nature-based Solution
NCCP	National Climate Change Policy
NCEC	National Committee on the Establishment of Carbon Markets
NDC	Nationally Determined Contribution
NDMA	National Disaster Management Authority
NDS	National Development Strategy
NEECA	National Energy Efficiency & Conservation Authority

NEP	National Electricity Policy
NEPRA	National Electric Power Regulatory Authority
NEVP	National Electric Vehicle Policy
NOX	nitrogen oxides
NPV	net present value
NSER	National Socio-Economic Registry
NTDC	National Transmission & Despatch Company
O3	ozone
OECD	Organization for Economic Co-operation and Development
OSRs	own source revenues
PKR	Pakistani rupee (also Rs)
PM2.5	fine particulate matter 2.5 micrometres or smaller
PNA	Pro Nature Alliance
PNG	piped natural gas
PPP	public-private partnership
PR	Pakistan Railway
PVs	solar photovoltaics
RAP	regenerative agriculture practice
RCP	Representative Concentration Pathway
RE	renewable energy
RISQ	Representativity Indicators for Survey Quality
RLNG	Re -gasified Liquefied Natural Gas
Rs	Pakistani rupee (also PKR)
SBP	State Bank of Pakistan
SDG	Sustainable Development Goal (of the United Nations)
SEC	Securities and Exchange Commission
SECP	Securities and Exchange Commission of Pakistan
SOC	soil organic carbon
SOE	state-owned enterprise
SP	social protection
sq. km	square kilometer
SSP	Shared Socioeconomic Pathway
ST	short term
SWM	solid waste management
T&D	transmission and distribution
TBTTP	Ten Billion Tree Tsunami Program
TFR	total fertility rate
UHI	urban heat island
UIPTs	Urban Immoveable Property Taxes
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VSL	value of a statistical life
WAPDA	Water and Power Development Authority
WASH	water, sanitation, and hygeine
WBGT	Wet Bulb Globe Temperature
WHO	World Health Organization
WWF	World Wildlife Fund
YLD	years lived with disability

PREFACE

Climate action is the most important priority for the government and people of Pakistan today

In 2022, Pakistan endured devastating droughts and floods that destroyed assets, lives, and livelihoods on a massive scale. First, a severe heatwave, previously a 1-in-1000-year event, saw temperatures rise continuously above 45 °C, resulting in crop losses, power outages, and forest fires.

Then came the unprecedented monsoon rains, the heaviest and most concentrated ever recorded. Across the south, hundreds of lives were lost, millions were displaced, and some 2 million houses were damaged or destroyed. Critical infrastructure such as roads and dams were washed away, 22,000 schools were damaged and forced to close, and for many, there was a near-complete loss of livestock and the summer (kharif) crops. The worst is not yet over: the secondary impacts from disease and lack of food and clean water are still to come, as are the knock-on effects from lost income and school closures.

The recently published Post-Disaster Needs Assessment (PDNA) of the 2022 floods estimates total damage in excess of US$14.9 billion and total economic losses of about US$15.2 billion, a near knock-out blow to growth. Estimated needs for rehabilitation and resilient reconstruction are at least US$16.3 billion, not including much-needed new investments, beyond affected assets, to support Pakistan's adaptation to climate change and build the resilience of the country to future climate shocks. As a direct consequence of the floods, the national poverty rate is projected to increase by 3.7 to 4.0 percentage points, pushing an additional 8.4 and 9.1 million people into poverty.

As the likelihood of these devastating climatic shocks continues to rise, the impacts on Pakistan's people and their livelihoods, on ecosystems and the economy, and on poverty will grow ever worse. Action is essential—and urgently so. It will require firm, clear decisions from the government and the engagement of the entire national population in the effort to turn the situation around.

Pakistan needs to act on the recommendations of this report to “build back better” and undertake the transformation of the key sectors identified. The country needs to transform its agriculture-food-water system to become more resilient, inclusive, sustainable, and climate-smart. It needs to support the development of resilient, clean, and livable cities and to accelerate a just transition to sustainable energy and low-emissions transport. And it needs to strengthen its human capital because, as hazards intensify, having a more resilient population has never been more critical to breaking the cycle of disaster-induced poverty.

An opportunity to make an immediate start is at hand. The reconstruction and rehabilitation from the floods need to be climate-resilient, inclusive, and people-centric, leveraging the power of community. At the same time, Pakistan needs to build on the lessons from these floods to build longer-term systemic resilience as a hedge against future events. The country can and should begin to act on the recommendations of this report, which proposes an agenda for maintaining and accelerating reforms in identified priority areas. Those reforms will require the government to make smart but tough decisions, even within its limited fiscal space, and create an enabling environment to raise revenue while also attracting further international finance. Pakistan must also act to correct the structural inequalities and inefficiencies in its systems, institutions, practices, and policies, that have been holding the country back from achieving its vision of equitable and sustainable growth for all. To do this, the leadership needs to ensure appropriate devolution of responsibilities and resources to local governments, including arrangements for the mobilization of revenue, and provide avenues for citizens to register their concerns and hold service providers accountable.

1.

CLIMATE AND DEVELOPMENT

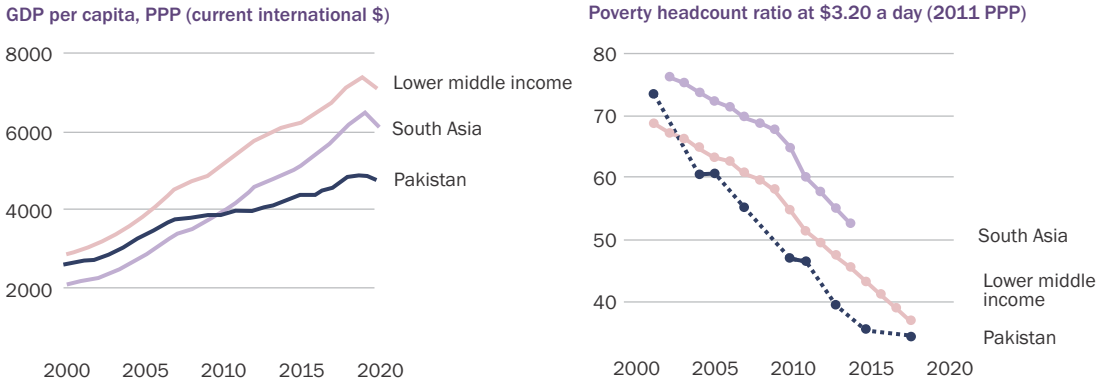
1. CLIMATE AND DEVELOPMENT

1.1 The economic, social, and environmental context

Pakistan has made significant progress over the past two decades in reducing poverty and has reached middle-income status, but it continues to face considerable macro-fiscal fragility that could place significant constraints on its ability to sustain growth and further enhance equity. Between 2001 and 2015, more than 48 million Pakistanis came out of extreme poverty. Extreme poverty, measured as US$1.90 or less per person per day, was virtually eliminated over this 14-year period, decreasing from 28.2 percent to 3.6 percent. Over the same period, poverty at the lower middle-income line of US$3.20 per person per day also declined from 73.5 percent to 35.5 percent and by 2018 stood at 34.3 percent (see Figure 1.1). This sustained decline was driven primarily by the expansion of off-farm economic opportunities and an increase in out-migration, with its associated foreign remittances. The overall pace of poverty reduction since 2001 makes Pakistan the most successful country in the South Asian Region (SAR) in reducing extreme poverty.

However, significant geographical inequalities remain. In 2018, rural poverty at 43.5 percent was more than twice as high as urban poverty (18.5 percent), Additionally, comparing district to district, there are important disparities in multidimensional poverty that extend beyond monetary poverty and include access to basic services, critical infrastructure, and employment opportunities. Pakistan ranks 38th, 22nd, 26th, and 31st below the global median on the resilience, inclusion, sustainability, and efficiency dimensions, respectively (see more details in *Annex 1: Pakistan's Performance on Development Indicators).*

Figure 1.1: Pakistan's GDP per Capita (PPP Current International $) (left) and Poverty Headcount Ratio at US$3.20 a Day (2011 PPP) (right) Compared with SAR and Lower-Middle-Income Countries



Source: World Development Indicators (NY.GDP.PCAP.PP.CD, SI.POV.LMIC)

The country's per capita gross national product (GDP) reached US$4,877 in 2020, but annual per capita GDP growth has been volatile and low at 2 percent—less than half of the regional average. Rising global commodity prices in 2022 have exacerbated the macro-fiscal risks facing the economy and highlighted its underlying structural fragility. Investment rates and the tax to GDP ratio remain low, with investment accounting for just 14 percent of GDP in 2021 and tax revenues accounting for only 10 percent of total GDP. Public expenditure on health and education has also remained low at just 1.2 percent and 1.8 percent of GDP in 2021, respectively. Additionally, there are large and unproductive subsidy regimes in the energy, agriculture, and irrigation sectors, which underlie the chronic fiscal stress faced by the country. The current account deficit worsened significantly in FY22 reaching US$17.4 billion (or 4.6 percent of GDP) due to the sharp increase in global commodity prices, exacerbated by the Ukraine-Russia war, as well as higher domestic energy demand.

These external imbalances, together with continued political and policy uncertainty, have contributed to a loss of investor confidence and a weakening currency. In July 2022 alone, the rupee depreciated 14.4 percent against the US dollar, and fell a total of 23.1 percent in FY22. Foreign reserves have also dwindled. The weakening exchange rate, together with the high energy and commodity prices as well as an overheating economy, has raised annual inflation to an average of 12.1 percent in FY22, an 11-year high. The high inflation rate prompted the government to implement an energy price relief plan from March to June 2022. As a result, fiscal expenditures that were already high ballooned further, and fiscal space has been shrinking rapidly. Accordingly, public debt has risen to more than US$200 billion, equivalent to more than three-quarters of annual GDP. Considering the difficult economic and fiscal conditions, rating agencies have downgraded Pakistan's government bonds, while bond yields have risen sharply. These factors, combined with the country's low investment rate and low export volume, have limited growth, and pose long-standing challenges to its ability to grow sustainably and further reduce poverty.

Pakistan also faces a daunting unfinished agenda on human development, which compounds its structural macro fragility. The country currently ranks 141 out of 174 countries on the Human Capital Index (HCI), with a score of 41 out of 100. The stunting rate of children under age 5, at 38 percent, remains among the highest in the world and affects even those in the highest income quintiles. This reflects the near-complete lack of public investment in the provision of safe water and sanitation. Studies have shown that between one-third and one-half of water used for drinking is bacterially contaminated with e. coli at source, and this includes piped water.

The near-absence of in-home water treatment of any type increases the bacterial contamination of water to between 60 and 75 percent when water is tested at point-of-use. Nitrate contamination is also endemic in rural areas because of the excessive use of chemical fertilizers and the lack of wastewater treatment. This is responsible for adverse health outcomes across the population but manifests particularly perniciously in the persistence of stunting among children, despite the remarkable decline in extreme poverty. The economy-wide impacts of child stunting alone are large and include reduced educational attainment, lifelong health challenges due to compromised immune systems, and attendant cognitive deficits that significantly impact lifetime earnings.[1]

Intergenerational educational mobility and labor mobility also remain extremely low, underscoring structural inequalities in opportunity. Educational attainment rates are low across the board, and an estimated 22.9 million children ages 5–16 years, or 44 percent of the age group, remain out of school, the majority of them are girls and young women.[2] At 75 percent before the pandemic, Pakistan's learning poverty rate—the percentage of children unable to read and understand a short age-appropriate text by age 10—is more than 16 percentage points higher than the average for South Asia and more than 19 percentage points higher than the average for lower-middle-income countries.

The once declining trend in Pakistan's fertility rate has also leveled off. While much of the region, except for Afghanistan, has reached replacement fertility (approximately 2.1 children per woman), Pakistan's fertility rate is still at 3.3 in 2020.[3] An accelerated decline in fertility would have beneficial impacts across the economy. It would increase the prospects for food and water security, decrease stress on natural capital and biodiversity, enhance urban resilience and basic service provision, and lower fiscal stress and macro-fiscal fragility. It would also have very significant impacts on gender equity. Studies show that with a decline in fertility, there is an increase in the educational attainment of girls and increased participation by women in income-generating activities, with beneficial impacts on household income and investments in children's education and health.[4] The country is also experiencing a youth bulge, with 2.1 million young people (ages 15–24) entering the labor pool every year, but many are poorly skilled and will increasingly face greater health (including cognitive-deficit) challenges.

---

1 Mansuri et al., When Water Becomes a Hazard: A Diagnostic Report on The State of Water Supply, Sanitation, and Poverty in Pakistan and Its Impact on Child Stunting. (Washington DC: World Bank Group, 2018), https://openknowledge.worldbank.org/handle/10986/30799?show=full.

2 World Bank, *Pakistan Human Capital Review (Draft)* (Washington, DC: World Bank Group, 2022).

3 World Bank, "Fertility rate, total (births per woman) – Pakistan," 2020, last accessed September 5, 2022, https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=PK.

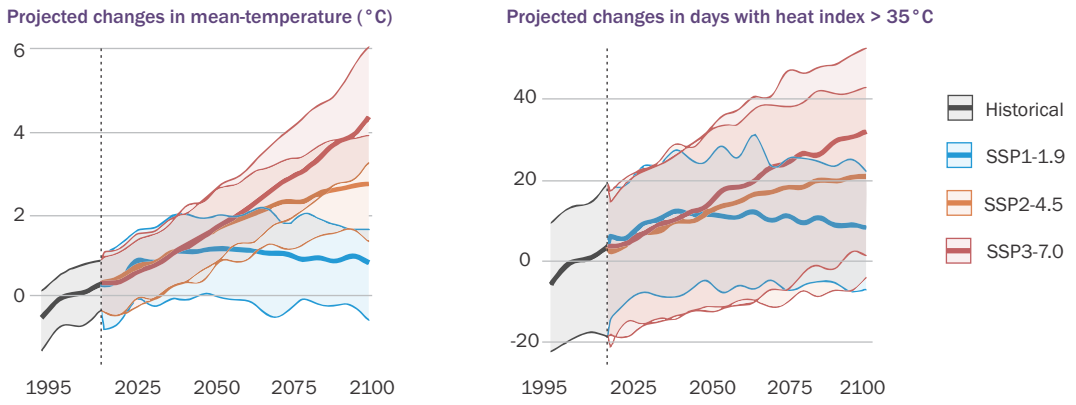
4 Pakistan has the ninth-largest labor force globally. See Government of Pakistan, Finance Division, *Pakistan Economic Survey 2020–21* (2021), https://www.finance.gov.pk/survey_2021.html.

Pakistan is endowed with considerable renewable natural capital, equivalent to an estimated 13-15 percent of per capita wealth[5] but much of it is at risk. Pakistan ranks among the top 10 countries in the world most impacted by the loss of biodiversity and ecosystem services (BES).[6] Many factors contribute to this: loss of vegetation cover has exacerbated soil degradation and diminished its water-retention capacity; unmanaged grazing has put stress on rangelands; the expansion of crop areas has destroyed ecosystem services and its ability to mitigate floods; and the excessive use of chemical fertilizers and pesticides has damaged soil fertility and biodiversity and contaminated ground water. All of these issues are compounded by extremely high levels of environmental pollution due to a lack of waste management infrastructure, unplanned urban sprawl, and unchecked pollution from industrial processes. As a result, Pakistan's high pollution levels exerts a significant drag on human health and economic performance equivalent to approximately 10 percent of GDP. [7]

1.2 Climate change vulnerability

Climate change is a risk multiplier, with potentially highly negative consequences that can have ripple effects. Pakistan ranks among the top 10 countries worldwide most affected by climate change and natural disasters.[8] The country faces further warming of its already hot climate at a rate considerably above the global average. By the end of the 21st century, the number of days a year with a heat index greater than 35 °C is projected to rise by 9–13 days under the SSP1-1.9 scenario, 16–30 days under SSP2-4.5, and 21–39 days under SSP3-7.0 scenario (Figure 1.2). There is a significant probability of ever more climatic variability and extreme events. Progressive warming of the air and soil will result in the reduced availability of water. Periodic heatwaves will intensify these effects and contribute to more severe, more frequent, and longer droughts. Climate change and deposits of anthropogenic black carbon (BC) will hasten the melting of the Himalaya, Hindu Kush, and Karakorum (HKHK) glaciers,[9] leading to changes in the flow of the vital Indus River system and seriously affecting Pakistan's economy and ecology.[10] A more variable monsoon regime, and likely more intense storm and cyclone events, will result in floods and induce landslides. Continued and accelerating sea-level rise will cause the ocean to encroach on coastal settlements and infrastructure and commit low-lying coastal ecosystems to submergence and loss.

Figure 1.2: Projected Change in Annual Mean Temperature (left) and Days with Heat Index > 35°C (right) up to 2100 in Pakistan (Baseline: 1995–2014, Multi-Model Ensemble) [11]



5 World Bank, *The Changing Wealth of Nations,* (Washington DC: World Bank Group, 2021), https://openknowledge.worldbank.org/handle/10986/36400.
6 Oliver Schelske, Bernd Wilke, Anna Retsa, Gillian Rutherford-Liske, and Rogier de Jong, *Biodiversity and Ecosystems Services Index: measuring the value of nature* (Swiss Re Institute, September 24, 2020), https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-biodiversity-and-ecosystems-services.html#.
7 World Bank, Opportunities for a Clean and Green Pakistan, (Washington DC: World Bank Group, 2019). https://openknowledge.worldbank.org/handle/10986/32328?show=full&locale-attribute=es
8 German Watch, *Global Climate Risk Index 2021*, https://www.germanwatch.org/en/19777.
9 A total of 33 glacial lakes have been assessed by Ministry of Climate Change to be prone to hazardous glacial lake outburst flooding (GLOF), which could unleash millions of cubic meters of water and debris, putting 7 million people at risk.
10 Muthukumara Mani, *Glaciers of the Himalayas: Climate Change, Black Carbon, and Regional Resilience* (Washington DC: World Bank Group, 2021), https://openknowledge.worldbank.org/handle/10986/35600.
11 World Bank, "Pakistan: Climate Projections," Climate Change Knowledge Portal, last accessed June 10, 2022, https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-projections.

Box 1.1 The Alarming Consequences of Climate Change in Pakistan: The 2022 Floods

Physical Impacts

The 2022 floods showed Pakistan's high vulnerability to climate change despite contributing less than one percent of global greenhouse gas emissions. One-third of the country was submerged under water, and 33 million people were affected. Nearly 8 million people are reportedly displaced. The floods took the lives of more than 1,700 people, one-third of them children. The total damage is estimated at US$14.9 billion, total loss at US$15.2 billion, and total needs at US$16.3 billion. Housing, Agriculture and Livestock, and Transport and Communications sectors suffered the most significant damage, at US$5.6 billion, US$3.7 billion, and US$3.3 billion, respectively. Sindh is the worst affected province with close to 70 percent of total damages and losses, followed by Balochistan, Khyber Pakhtunkhwa, and Punjab.

The scale of the disaster is unprecedented in Pakistan, exceeding the damage of the 2010 floods. The 2022 flooding has further exposed underlying institutional and systemic challenges, including poor urban planning and water resource management, lack of systems for infrastructure maintenance, complex governance, structural inequalities, and limited disaster risk reduction capacity.

Macroeconomic and Human Impact

The total damage is equivalent to 4.8 percent of FY22 gross GDP, while recovery and reconstruction needs are projected to be sizable at 1.6 times the budgeted national development expenditure for FY23. Overall decline in GDP as a direct impact of the floods is projected to be around 2.2 percent of FY22 GDP.

The disaster will have profound impact on lives and livelihoods. Preliminary estimates of the PDNA suggest that the national poverty rate will increase by 3.7 to 4.0 percentage points, pushing an additional 8.4 to 9.1 million people into poverty. Similarly, multidimensional poverty will increase by 5.9 percentage points, meaning that an additional 1.9 million households will be pushed into non-monetary poverty. The impact of the floods is likely to exacerbate already existing inequalities, revealing serious differences in safety, education, decision-making, and employment. Vulnerable groups, such as women, children, people with disabilities, and refugees, are likely to be disproportionally affected by the floods due to their limited access and availability to social protection and coping mechanisms.

Source: PDNA (October 2022): https://thedocs.worldbank.org/en/doc/4a0114eb7d1cecbbbf2f65c5ce0789db-0310012022/original/Pakistan-Floods-2022-PDNA-Main-Report.pdf

The adverse impacts of climate change on Pakistan's natural and human capital are likely to be severe. Over the past three decades, climate-related disasters have caused significant loss of life and enough socioeconomic damage to precipitate a reversal of development gains (Figure 1.3). Between 1992 and 2021, climate- and weather-related disasters in Pakistan resulted in a total of US$29.3 billion of economic losses (inflation-adjusted to 2021 US dollars) from damage to property, crops, and livestock, equivalent to 11.1 percent of 2020 GDP.[12] The flood in 2010 alone resulted in an adjusted economic loss of 4.5 percent of 2020 GDP. The full impact of the 2022 monsoon floods on GDP will emerge over time but an early assessment indicates higher impacts than 2010 (Box 1.2). Climate change will increasingly put pressure on food production and access. It will also enhance the impact of air and water pollution on human health. Further, labor productivity is likely to decline across the board because of extreme heat. Precipitation changes and declining water availability could damage riverine ecology, impair water security, and affect hydropower production. Sea-level rise will contribute to the further salinization of soils and coastal erosion, and inundation will harm fisheries and aquaculture. Over time, there is likely to be a partial collapse in the natural systems that underpin Pakistan's economy.[13]

12 EM-DAT, CRED/UCLouvain (Brussels, Belgium), last accessed April 08, 2022, www.emdat.be.
13 H.-O. Pörtner et al., eds., "Summary for Policymakers," in Climate Change 2022: *Impacts, Adaptation, and Vulnerability,* IPCC Sixth Assessment Report, ed. H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, et al. (Cambridge University Press, in press), https://www.ipcc.ch/report/ar6/wg2.

The rising levels of risks from climate change are poised to significantly compromise Pakistan's development ambitions. At the macro level, these shocks will impact all aspects of the economy and could have cascading impacts that further dampen growth projections in a country that is already fiscally constrained and that has seen relatively low growth, especially over the past few years. The GDP losses that Pakistan is already facing owing to the degradation of its environment and its low human capital will only be magnified if extreme climate-related events unravel development gains and divert limited public financing toward recovery efforts instead of growth. In particular, the agriculture sector is likely to be severely impacted, increasing the risk of extreme poverty, food insecurity, and malnutrition. This will make sustained progress in poverty reduction and human development far more challenging than it is today. These interrelated risks could also set the stage for major societal disruptions, including the displacement of people and greater pressure on cities that will be unprepared for the influx of displaced migrants on top of those they currently host.[14]

Figure 1.3: Total Occurrence and Average Economic Damage (percentage of GDP) from Natural Disasters in Pakistan between 1990 and 2019 [15]

Note: Decadal figures are measured as the annual sum over the subsequent ten-year period.
Source: The international disasters database

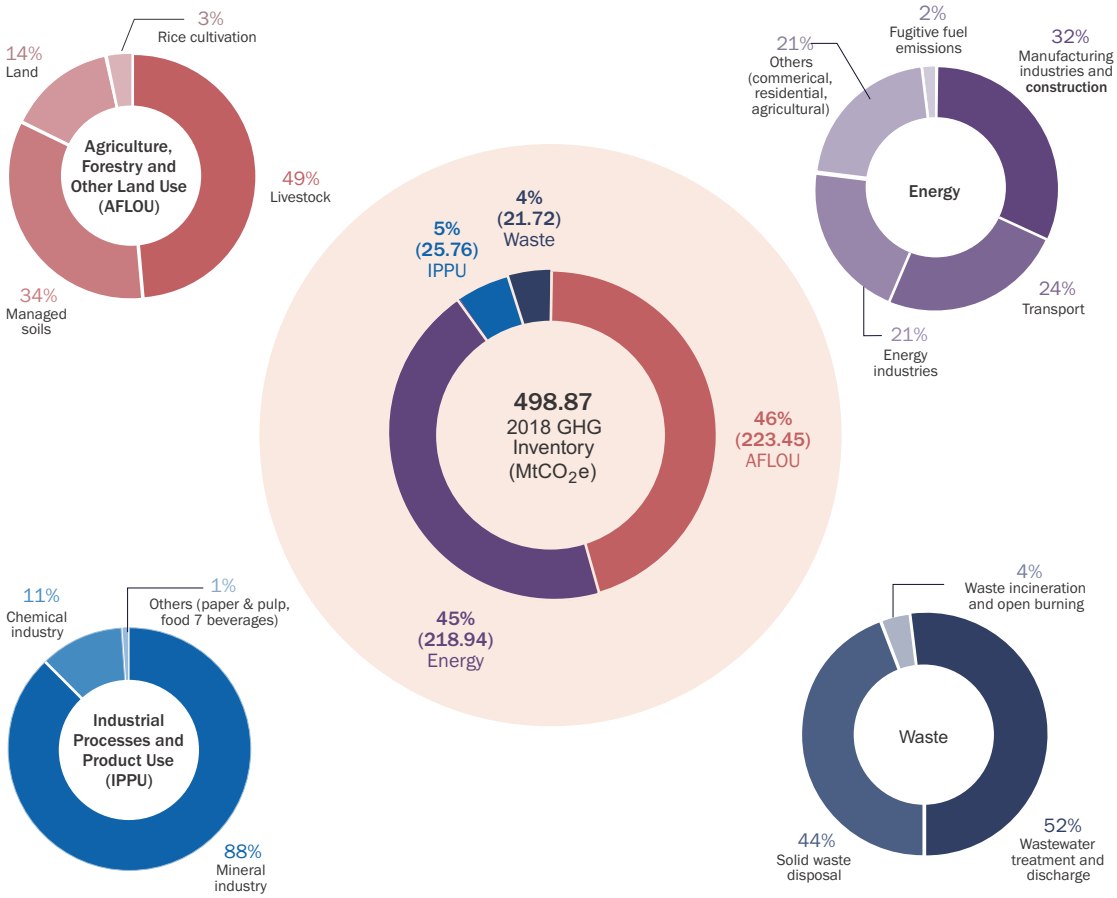
1.3. National GHG emission profile

Although Pakistan is a relatively minor contributor to climate change, it nonetheless should seize the opportunity of global decarbonization efforts to help decouple its socioeconomic growth from costly, polluting, and emissions-intensive fossil fuels. In 2018, the country's total GHG emissions were estimated at 499 million metric tons of carbon dioxide equivalent (MtCO2e), inclusive of land use and forestry,[16] which accounted for less than 1 percent of global GHG emissions. As illustrated in Figure 1.4, emissions are driven largely by two sectors: agriculture, forestry, and other land use

14 See V. Mueller, C. Gray, and K. Kosec, "Heat stress increases long-term human migration in rural Pakistan," Nature Clim Change 4(2014): 182–185, doi: https://doi.org/10.1038/nclimate2103; and Jose Luis Cruz and Esteban Rossi-Hansberg, The Economic Geography of Global Warming, Becker Friedman Institute Working Paper no. 2021-130 (2021), https://bfi.uchicago.edu/insight/research-summary/the-economic-geography-of-global-warning.
15 EM-DAT, CRED/UCLouvain (Brussels, Belgium), last accessed April 8, 2022, www.emdat.be.
16 Global Change Impact Studies Centre, National Greenhouse Gas Inventory Information for Pakistan.

(AFOLU) and energy, which account for 46 percent and 45 percent of total national emissions, respectively. Given Pakistan's large population, high energy intensity and growth aspirations, future GHG emissions will become globally material unless actions are taken to curb the growth rate of emissions.[17]

Figure 1.4: Pakistan's National GHG Inventory in 2018 [16]



17 See World Resources Institute, "Global Historical GHG Emissions," CLIMATEWATCH (2022), https://www.climatewatchdata.org/ghg-emissions?end_year=2018&regions=PAK&start_year=1990. The total GHG emissions estimated by Climate Watch for Pakistan in 2018 was 428.62 MtCO2e. This is slightly lower than Pakistan's own estimate, prepared by GCISC.

18 GCISC, National Greenhouse Gas Inventory Information for Pakistan.

2.

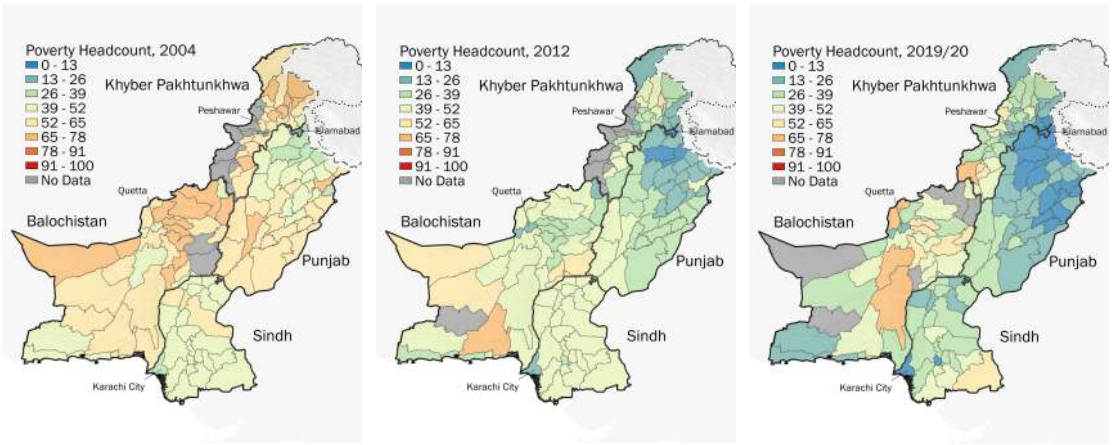
GROWTH, EQUITY, AND THE FINANCIAL IMPLICATIONS OF CLIMATE RISKS

2. GROWTH, EQUITY, AND THE FINANCIAL IMPLICATIONS OF CLIMATE RISKS

2.1 Spatial and socioeconomic variation in hazards, exposure, and vulnerability

Understanding the spatial distribution of climate risks, and the extent to which such risks intersect and interweave with other social disadvantages, is essential for ensuring equity in climate actions. Spatial disparities in poverty and socioeconomic outcomes remain significant, with large gaps not only across the urban-rural divide but also across districts within provinces. Map 2.1 shows that although poverty rates have fallen substantially since 2004, significant variation across districts persists. Districts in South Punjab and north and Sindh still have poverty rates as between 26 and 39 percent, while districts in south east Sindh, most of Baluchistan and bordering areas between KP and Baluchistan have poverty rates between 40 and 60 percent.[19] These areas are also deprived along many other dimensions—from schooling and access to health services to water and sanitation and access to electricity—making them more vulnerable to a range of hazards if and when they do strike.

Map 2.1: District-Level Poverty Rates in Pakistan (2004, 2012, and 2019–20)

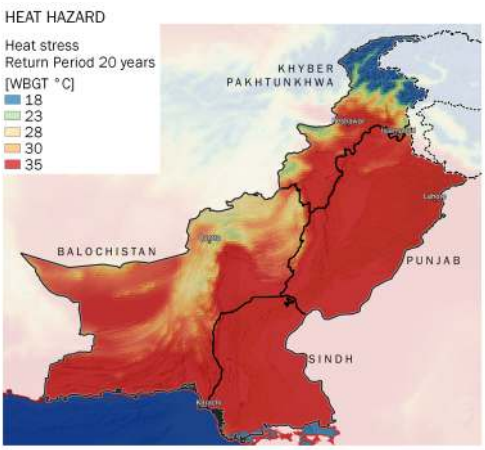


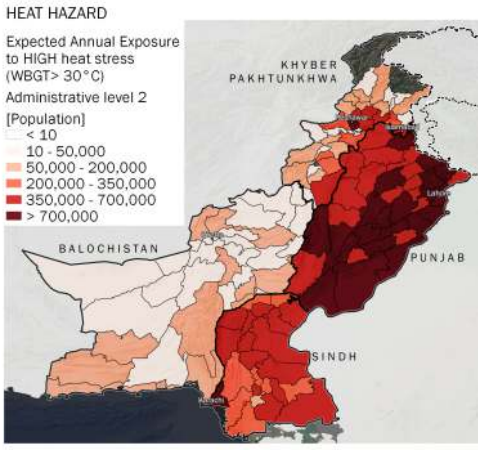
Heatwaves are a major threat to Pakistan's labor force. Pakistan has some of the highest observed temperatures in Asia. The 2022 heatwave put millions at risk of heat stress and accelerated glacier melt.[20] Even in years with average weather, temperatures in most regions exceed 30°C for several months, and maximum temperatures routinely exceed 40°C, placing human health and infrastructure at risk. But the effects of Pakistan's heatwaves have a spatial distribution. Urban heat islands (UHIs) occur in highly populated cities that lack natural cover and where dense concentrations of concrete, pavement, and buildings absorb and retain heat, compounded by heat from congested traffic and poor air quality. Extreme temperatures and air pollution can directly impact health. Indirect long-term threats such as outbreaks of malaria, dengue, and severe gastroenteritis have been observed in Pakistan in the aftermath of a heatwave.[21] Map 2.2 shows the distribution of heat stress for a 20-year return period (left) and population exposure to such hazards (right). In central and

19 Using small area estimates and the national poverty line.
20 World Economic Forum, "Record-breaking heat wave strains 'limits of human survivability' in India and Pakistan," WEF, May 9, 2022, last accessed September 4, 2022, https://www.weforum.org/agenda/2022/05/record-breaking-heatwaves-limit-human-survivability-india-pakistan.
21 Maryam Salma Babar et al., "Impact of climate change on health in Karachi, Pakistan," The Journal of Climate Change and Health 2 (May 2021): 100013, doi: https://doi.org/10.1016/j.joclim.2021.100013.

eastern Punjab, more than 700,000 residents are exposed to heatwaves.[22] The higher temperatures in the northern areas pose a grave risk to the glaciers and can lead to dangerous glacial lake outburst flooding (GLOF). Frequent landslides and soil erosion often cut off these areas and put the population at risk of isolation and resource shortages.

Map 2.2: Heat Hazard (left) and Population Exposure (right)



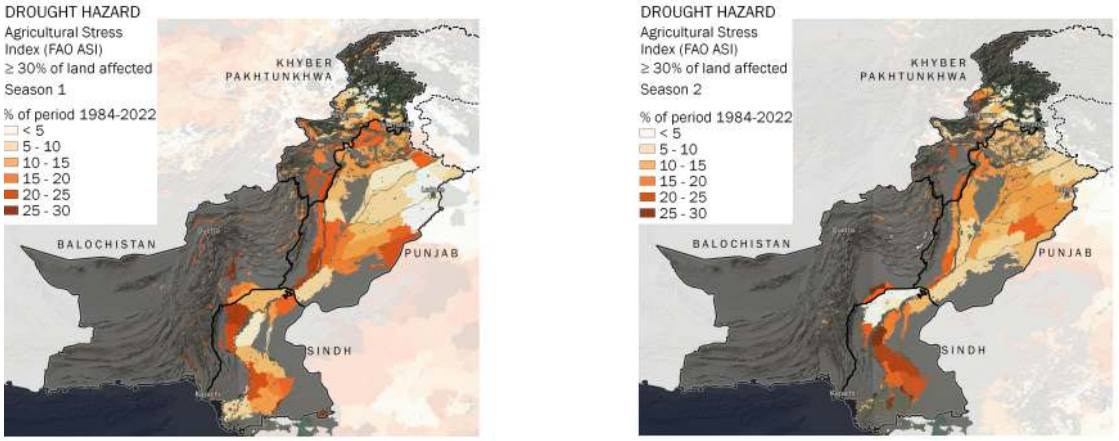


Related to the extreme heat, Pakistan is experiencing a significant increase in the frequency and severity of droughts. It ranks 43rd among countries in drought risk.[23] Droughts severely affect food security and frequently warrant humanitarian relief efforts in vulnerable districts throughout the country. In January 2019, 3 million people in Sindh and 1.8 million in Balochistan were impacted by moderate to severe droughts when annual precipitation dropped by 24.4 percent relative to the expected rainfall. The problem is longstanding but has become more severe in recent times. Two decades earlier, from 1999 to 2001, consecutive droughts resulted in crop failure, mass famine, and livestock starvation, causing US$247 million worth of damage.[24] Climate models project that drought events in Pakistan are likely to intensify in frequency.

Drought stress, felt across the country, generates immediate health, income, and food security risks. Map 2.3 shows the percentage of years during which at least 30 percent of agricultural land experienced drought stress over the two cropping seasons, Kharif (April–June) and Rabi (October–December). Although the geographic footprint of drought stress is largest in Punjab because of the concentration of both agricultural activity and population, the frequency of large-scale droughts is considerably higher in Sindh and Balochistan. In Balochistan, this frequency is higher during the Kharif season, whereas in Sindh, it is higher during the Rabi season, when canal irrigation is less available as an alternative to rain. Immediate drought impacts come from declines in crop yield and livestock productivity, which threaten the incomes of agriculture-dependent households and, broadly, food security for Pakistan.[25] Further, the resulting land degradation and the decline in groundwater reserves can increase other water stress-related risks, particularly the availability of safe drinking water.[26]

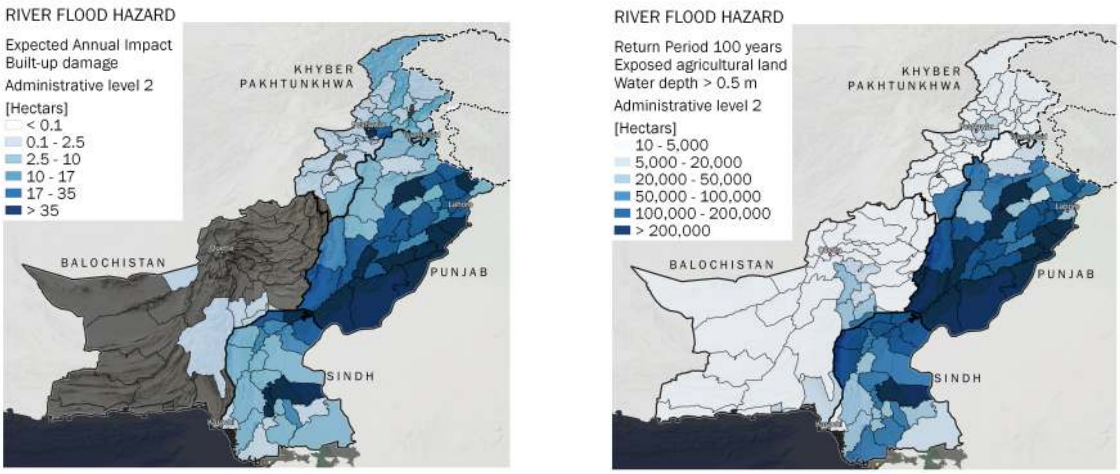
22 The WBGT measures the heat stress caused by direct sunlight to people in a local area, taking into account not only the temperature but also the humidity, sun's angle, cloud cover, and wind speed. It indicates the apparent, not the thermometer, temperature outside and therefore tells you how stressful the conditions are.
23 World Bank and Asian Development Bank, Climate Risk Country Profile: Pakistan (Washington, DC and Manila: The World Bank Group and the Asian Development Bank, 2021), https://openknowledge.worldbank.org/handle/10986/36372.
24 World Bank and ADB, Climate Risk Country Profile: Pakistan.
25 Kisan Dilip Algur, Surendra Kumar Patel, and Shekhar Chauhan, "The impact of drought on the health and livelihoods of women and children in India: A systematic review," Children and Youth Services Review 122 (March 2021): 105909, doi: https://doi.org/10.1016/j.childyouth.2020.105909.
26 Sadia Mariam Malik, Haroon Awan, and Niazullah Khan, "Mapping vulnerability to climate change and its repercussions on human health in Pakistan," Globalization and Health 8, no. 31 (2012), doi: https://doi.org/10.1186/1744-8603-8-31.

Map 2.3: Drought Hazards for Agricultural Land during the Kharif (left) and Rabi (right) Cropping Seasons



Flood-related infrastructure and other asset losses remain high. Pakistan has been experiencing significant pluvial and fluvial flooding, notably the 2022 floods, with widespread impacts on life and livelihoods, infrastructure, settlements, education, and the rural economy. The extent of the associated damage to infrastructure, crops, and livestock, and mortality and morbidity varies substantially with water depth, land use, and population density. Map 2.4 shows the spatial distribution of flood-related impacts on built-up assets and agricultural land. The largest exposure of agricultural land to floods is in the floodplains of Punjab and parts of Sindh.

Map 2.4: Expected Annual Impact of Floods on Built-up Assets (left) and on Agricultural Land (right)



Glacial melt from high temperatures and earthquakes can worsen monsoon floods and cause landslides in the northern mountains resulting in significant economic losses in KP, Gilgit-Baltistan and Azad Kashmir. An estimate for losses from nine landslides between 1900 and 2020 indicates a total cost of about US$18 million, affecting nearly 30,000 people.[27]

27 World Bank and ADB, Climate Risk Country Profile: Pakistan.

2.2 Economy-wide impacts of selected physical climate risks

Damage induced by climate-related extreme events will likely have economy-wide impacts on growth, fiscal space, employment, and poverty. Global warming and extreme events affect economic activity through multiple transmission channels: impacts on lives, on infrastructure and assets, and on livelihoods, which can result in lost economic growth, worsening poverty and longer-term threats to human capital and productivity. Existing macro models can help assess the expected scale of such events. However, because they cannot capture all the direct and indirect transmission channels due to high future uncertainty, any economy-wide climate impact assessment will be incomplete, especially since projections extend out for decades. Model results are therefore likely to show averages that may very well represent lower bound averages of expected climate damages.

The CCDR employed two climate macroeconomic models, MFMod and E3ME, to evaluate the potential impacts of the selected climate threats on infrastructure, agriculture and labor productivity, and their follow-on effects on growth, employment, fiscal stress, and poverty. The two models differ in their structure and therefore in the way that transmission channels are modeled (see more details in *Annex 2: Climate Macroeconomic Modeling Methodology and Assumptions*).

Figure 2.1: Real GDP Losses from Climate Damage

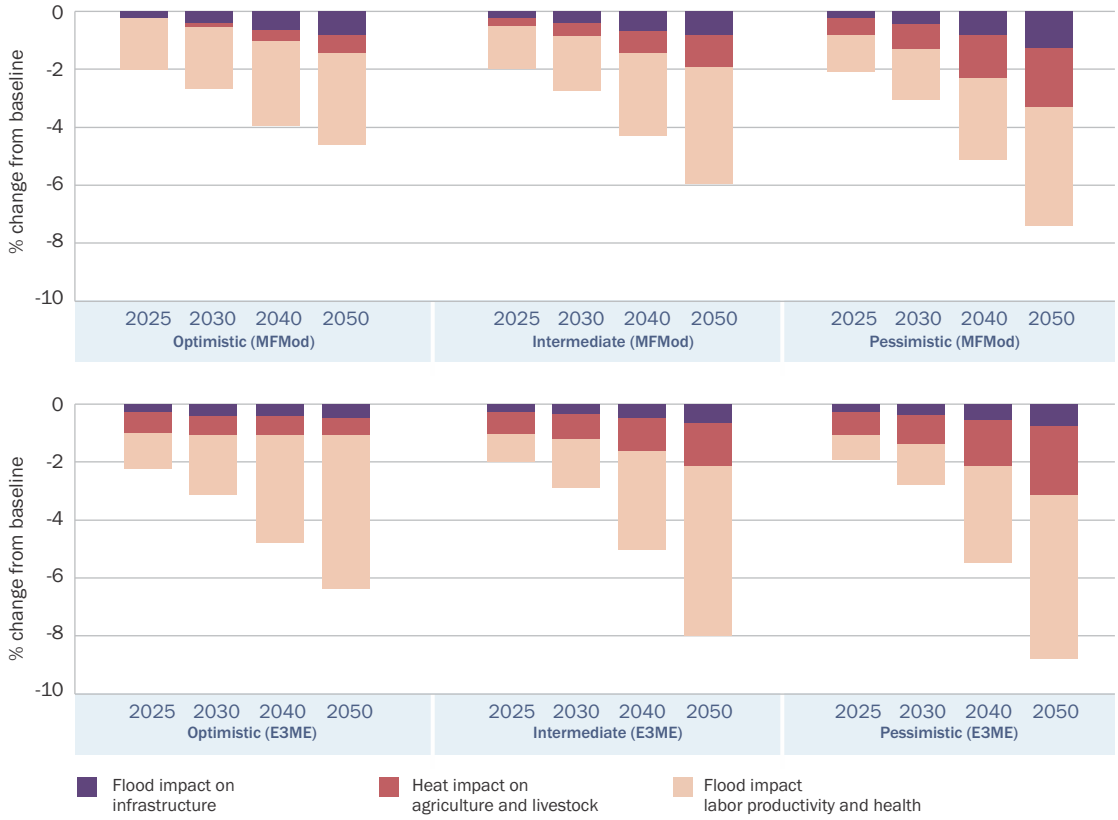
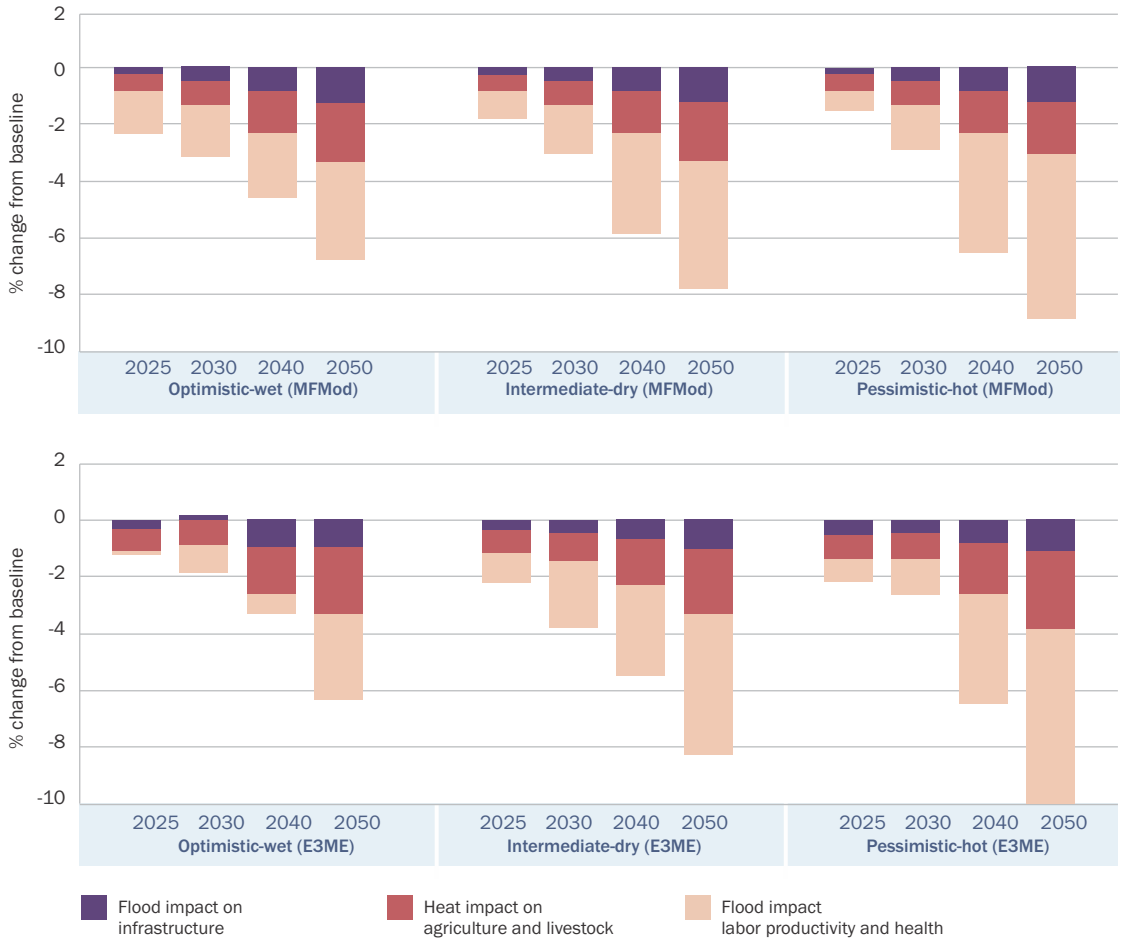


Figure 2.1 shows predicted GDP losses for three scenarios—optimistic, intermediate, and pessimistic—across the two models using three transmission channels: flood impact on selected capital stock and infrastructure, heat impact on agricultural crops and livestock, and heat impact on labor productivity and health. A consideration of these selected climate threats from heat, droughtsand floods suggests a loss of up to 9 percent of GDP by 2050 in the pessimistic scenario, relative to business as usual (BAU), which models counterfactual annual GDP growth at a steady 4% till 2050, assuming no further change in climate.

The magnitude of damages varies considerably across the three climate scenarios considered. In the *optimistic* scenario, GDP is projected to fall by 4.5-6.5 percent, under MFMod and E3ME, respectively, relative to BAU. In the *pessimistic* scenario, GDP is projected to fall by 7 to 9 percent by 2050, under MFMod and E3ME, respectively. These are sizeable impacts, given that the models consider only selected threats and transmission channels. It is also important to highlight that the most severe instances of climate damage, relative to baseline, are expected to increase exponentially after 2050. In the intermediate to pessimistic scenarios, multiple climate hazards are likely to occur simultaneously, compounding the direct and indirect risks as economic shocks cascade. These complex and nonlinear interactions cannot be fully captured because of the limitations of the models.

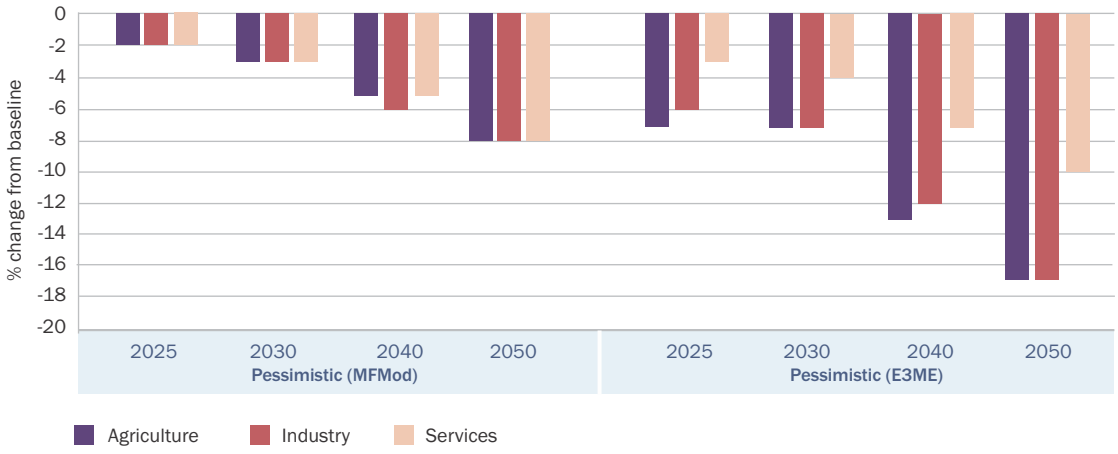
Figure 2.2: Real GDP Losses from Climate Extreme Scenarios



A focus on extreme scenarios magnifies these impacts and highlights the importance of heat related impacts on labor productivity, crop loss and health. To get a sense of what adaptation measures the country should focus on, Figure 2.2 assesses projected climate damages from three extreme pessimistic scenarios: wet, dry, and hot (as discussed in Annex 2). The effects of heat on labor productivity and health drives the decline in GDP compared to BAU. These shocks account for up to 6 percent of the loss in GDP by 2050. The impact of heat on crop loss and livestock accounts for up to 3 percent of GDP loss by 2050. Floods destroy physical capital and infrastructure, which triggers cascading effects on labor productivity. This accounts for up to 1 percent of GDP loss by 2050. In E3ME, the magnitude of the impact of the three shocks is larger than in MFMod, specially for the pessimistic hot scenario. This reflects the differences in the models. For example, E3ME can capture the impact of international trade better. Crop loss leads to higher domestic food prices, which leads to more imports and less export of food, which creates a larger crop loss related decline in GDP.

Breaking down the aggregate GDP decline by sector indicates much larger effects on agriculture and industry compared to services.[28] According to Figure 2.3, under the E3ME model, if global climate actions are delayed, sectoral GDP in both agriculture and industry could decline by 7–8 percent by 2030, and by as much as 17 percent by 2050. In contrast, the services sector, which is impacted through indirect income and saving losses, that translate into lower investment levels, declines by 4 percent by 2030 and 11 percent by 2050. Sectoral declines are more moderate in MFMod since the model assumes the economy returns to full equilibrium after 3–5 years, whereas in E3ME, structural unemployment of both labor and capital is possible over the long run.

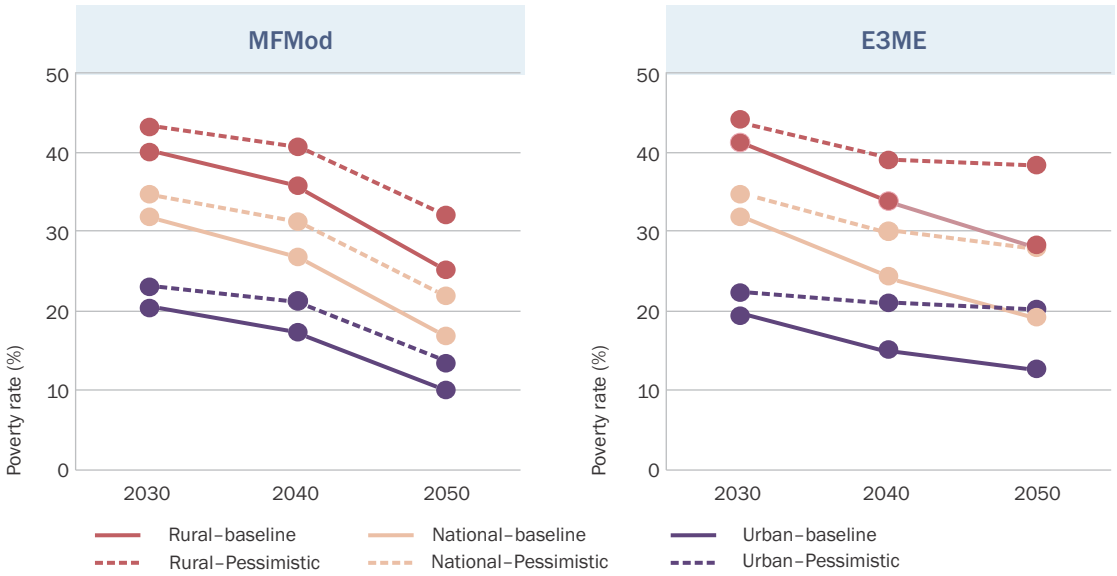
Figure 2.3: Sectoral Impacts of Climate Damage (Pessimistic Scenario)



Household poverty is expected to decline over time, but even a 9 percent decline in GDP by 2050 is enough to stall poverty reduction, with disproportionate impacts on rural households. As shown in Figure 2.4, under BAU, based on historical trends, poverty is expected to continue to fall, from 34.4 percent to 25 percent by 2040, and then to 19 percent by 2050. Figure 2.4 also highlights the disparities across rural and urban households. Under BAU, this disparity between rural and urban poverty continues. By 2030, the urban poverty rate is expected to be half that of rural areas. By 2050, urban poverty is projected to decline further, to 10 percent, while rural poverty remains in the 25–28 percent range. Under a pessimistic climate scenario, however, the decline in both urban and rural poverty slows significantly, and by 2040, under E3ME, there is no further decline in poverty as climate damages starts to intensify. This is more the case for rural poverty, where there is virtually no poverty decline between 2020 and 2050 under the E3ME model.

28 For the agriculture sector, the macroeconomic models capture only livestock, which constitutes only half of the sector's total GDP.

Figure 2.4: Impact of Damage on Household Poverty Rate in the Pessimistic Scenario Compared to the Baseline



2.3 Damage from water insecurity

The use of water for non-agricultural purposes is likely to increase significantly with climate change. Under a high-growth (4.9 percent per year) and high-warming (3 °C by 2047) scenario, water demand is projected to increase by almost 60 percent, with the highest rates of increase coming from the domestic and industrial sectors. Climate warming will account for up to 15 percent of this increase in demand. This heightened demand will result in unintended consequences that deprive downstream areas of water rights. The competition among sectors will necessitate inter-sectoral tradeoffs that will likely be made at the expense of water for agriculture. It is projected that, in the next three decades, about 10 percent of all irrigation water will need to be repurposed to meet non-agricultural demand.[29] Freeing up 10 percent of irrigation water without compromising food security will be a complex challenge that will require substantial policy reforms to incentivize water conservation and increase water use efficiency in the agricultural sector and a shift away from water thirsty crops as well as better environmental management. The projected costs of a forced reallocation of water out of agriculture, to meet non-agriculture demands, without such steps, could reduce GDP in 2047 by 4.6 percent. The losses projected here are thus the costs of forced reallocation of water to serve other urgent needs, including allocations for water, sanitation, and hygiene (WASH) and urgent environmental flows to sustain critical ecosystem services.

29 See William J. Young et al. *Pakistan: Getting More from Water* (Washington, DC: World Bank Group, 2021), https://openknowledge.worldbank.org/handle/10986/31160; and Stephen Davies and William Young, "Unlocking Economic Growth Under a Changing Climate: Agricultural Water Reforms in Pakistan," in Water Resources of *Pakistan: World Water Resources, vol. 9*, ed. M.A. Watto, M. Mitchell, and S. Bashir (Cham, Switzerland: Springer, 2021), https://doi.org/10.1007/978-3-030-65679-9_7.

Box 2.1 Precipitation Changes and Water Availability

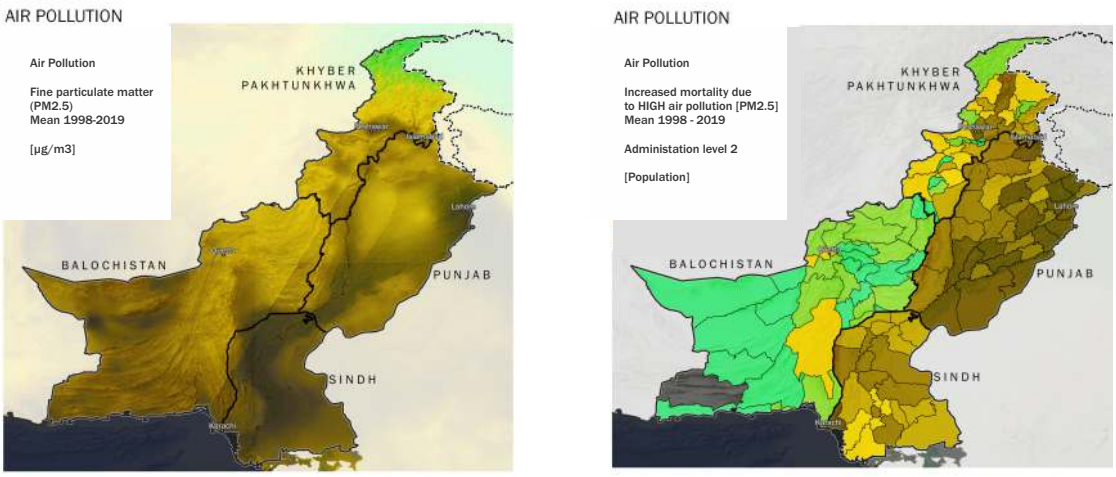
Snow and glacial melt and rainfall are the main contributors to river flow in Pakistan, and account for about 70 percent of groundwater recharge. Precipitation models show great variation in projected climate impacts. In the past, the large fraction of river runoff coming from glacial melt (about 40 percent) during the peak summer months was considered a buffer for this uncertainty. Till the middle of the 21st century this is expected to continue—with some models projecting increased river flows due to higher melting under both RCP 4.5 and RCP 8.5. However, recent modeling work shows that (i) a much larger component of "melt water" is snow (both on land and on ice)—accounting for about 73 percent of river runoff—while only 3 percent comes from EGI; and (ii) that due to increasing temperatures there will be a shift toward more liquid precipitation—that is, more rain instead of snow. Taking these findings together, it is likely that seasonal river flow patterns will change so that the western rivers rise earlier than usual to align with winter rainfall in the upper Indus Basin, but reduced snow may mean that early summer temperatures are not sufficient to generate runoff from exposed glacial ice (EGI), leading to low river flows at the start of the Kharif season.

Source: A.F. Lutz, W.W. Immerzeel, A.B. Shrestha, and M.F.P. Bierkens, "Consistent increase in High Asia's runoff due to increasing glacier melt and precipitation." *Nature Climate Change 4* (2014): 587–592, doi: https://doi.org/10.1038/nclimate2237; Richard L. Armstrong et al., "Runoff from glacier ice and seasonal snow in High Asia: separating melt water sources in river flow," *Regional Environmental Change 19* (2019): 1249–1261, doi: https://doi.org/10.1007/s10113-018-1429-0

2.4 Damage from air pollution

Air pollution shortens the average Pakistani's life expectancy by 4.3 years, relative to what it would have been if the WHO guideline on air pollution was met. The most harmful emissions are fine particulate matter, or PM2.5, and NOX. Pakistan's PM2.5 concentrations levels, on average, are estimated at 49.5 micrograms per cubic meter (μg/m^3), five times higher than the WHO's recommended limits, and pose a serious health hazard.[30] The left side of Map 2.5 highlights the concentration of PM2.5 in regions with high agricultural and industrial economic activity, mostly in the Punjab and Sindh. The right side shows population-weighted exposure at the district level. In the highly urbanized cities, especially Lahore, Karachi, and Peshawar, more than 1 million citizens are at increased mortality risk from air pollution.[31]

Map 2.5: PM2.5 emissions (left) and district-level population exposure (right)



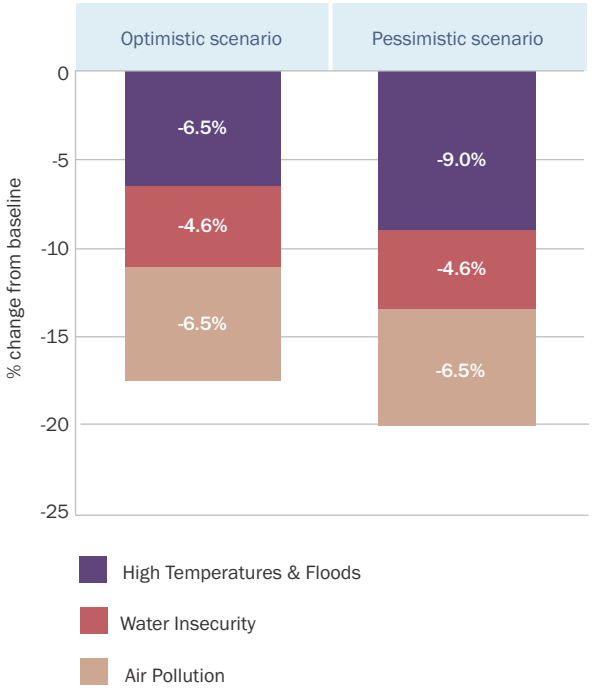
30 Air Quality Life Index, *Country Spotlight: Pakistan* (2022), https://aqli.epic.uchicago.edu/country-spotlight/pakistan/#:~:text=Pollution%20Ranking&text=Pakistan%20is%20today%20the%20world's,(WHO)%20guideline%20was%20met.
31 Air Quality Life Index, *Country Spotlight: Pakistan.*

Damage from air pollution is estimated to impose an additional loss of 6.5 percent of GDP per year. Pollution-related economic losses are assessed through two channels: (a) pollution-attributable GDP losses associated with mortality and years lived with disability[32] and (b) premature mortality using the value of a statistical life.[33] Addressing air pollution would bring significant climate co-benefits because the associated pollutants (for example, methane and black carbon) are also potent global-warming agents.

2.5 Aggregated impact of climate and environmental risks

The combined risks from the intensification of climate change and environmental degradation, unless addressed, will further aggravate Pakistan's economic fragility; and could ultimately reduce annual GDP by 18 to 20 percent per year by 2050, based on the optimistic and pessimistic scenarios, respectively. Between 6.5 and 9.0 percent of GDP will likely be lost due to climate change (in the optimistic and pessimistic scenarios, respectively) as increased floods and heatwaves reduce agriculture and livestock yields, destroy infrastructure, sap labor productivity, and undermine health. Additionally, water shortages in agriculture could reduce GDP by more than 4.6 percent, and air pollution could impose a loss of 6.5 percent of GDP per year. Although this is a simplified view that aggregates the modeled impacts of selected climate threats, water insecurity, and air pollution on real GDP, the above modeling exercise does highlight the potential magnitude of impacts, laying out some transmission channels. That the risks and possible impacts are a very real threat to Pakistan's sustainable and equitable growth path has been demonstrated by the immediate and likely longer-term costs of the tragic floods of 2022.

Figure 2.5: Aggregated Impact on GDP Associated with Climate and Environmental Threats by 2050



32 India State-Level Disease Burden Initiative Air Pollution Collaborators, "Health and economic impact of air pollution in the states of India: the Global Burden of Disease Study 2019," *Lancet Planet Health 5, no. 1* (January 2021): e25-e38, doi: https://doi.org/10.1016/S2542-5196(20)30298-9.

33 See Urvashi Narain and Chris Sall, *Methodology for Valuing the Health Impacts of Air Pollution: Discussion of Challenges and Proposed Solutions* (Washington, DC: World Bank Group, 2016), https://openknowledge.worldbank.org/handle/10986/24440; and Organization for Economic Co-operation and Development, Mortality Risk Valuation in Environment, Health and Transport Policies (Paris: OECD Publishing, 2012), doi: https://doi.org/10.1787/9789264130807-en. The VSL does not represent the value of individual lives. Rather, it is a measure of the rate at which individuals are willing to exchange money to reduce small risks of death within a certain period. This concept is used in benefit-cost analysis to assign a monetary value to averted mortality due to a carbon price policy.

3.

CLIMATE CHANGE POLICY, INSTITUTIONS AND REGULATORY FRAMEWORK

3. CLIMATE CHANGE POLICY, INSTITUTIONS AND REGULATORY FRAMEWORK

3.1 Governance and policy for climate change

Globally, a gradual but observable evolution is taking place in the governance, policy, and political economy of climate change. More and more countries and international actors gained awareness that climate change, fundamentally, is a multiplier of environmental threats and therefore needs to become a central component of both global-, national- and subnational-level development policy. The structural shortcomings in governance and policy in Pakistan that were highlighted in Chapter 1, will need to be addressed to strengthen the country's capacity to respond to climate challenges.

Part of Pakistan's challenge is a lack of consistency and continuity within the policy space. Policies, budgets, and programs related to climate risk have thus far been subject to changing political currents. The result is that, although climate-change issues have indeed featured in Pakistan's overall development policies since the 2012 *National Development Strategy* (NDS), specific actions or implementation steps have been lacking. The first *National Climate Change Policy* (NCCP 2012) provided guidelines for developing national adaptation and mitigation plans across sectors, but in practice, it had little impact on sectoral programs. Three years later, in its first *Intended Nationally Determined Contribution* (INDC 2015),[34] Pakistan made a handful of very limited commitments to mitigation and adaptation but since then has not moved significantly beyond that point.

One reason is that, government ownership of climate change policy and responsibilities for action has been fragmented. For the past several years this has shifted between different institutions and levels, tossed from one agency to another, with blurred lines of responsibility and weak forms of accountability. The institutions that were meant to be established under the 2017 *Climate Change Act*, for example, have never come into existence, partly because of the lack of technical capacity, financial resources, and an institutional framework.

In recent years, however, the government has assumed a strongly proactive stance toward climate change, and as a consequence, climate change-relevant policy is being strengthened. Despite its infancy, Ministry of Climate Change (MoCC), established in August 2017, has already assumed major responsibilities, and gained oversight of key functions of environmental action and disaster risk management. Provincial governments, which are closer to rural and poorer subpopulations, are also by and large committed to addressing the adverse impacts of climate change.

In 2021, a revised NCCP[35] **was launched, linking climate action and economic growth, with a strong focus on mainstreaming and integrating climate change policy with other policies.** There have been several other meaningful developments. For example, a number of new sectoral policies that support decarbonization efforts have been adopted. For instance, the 2019 *Alternative Renewable Energy* (ARE) *Policy* aims at creating an environment and framework for the sustainable growth of Pakistan's ARE sector. The promotion of energy efficiency and conservation are now supported by the *Strategic Plan for Energy Efficiency & Conservation* (2020–2023), and the 2019 *National Electric Vehicle Policy* (NEVP) for 2020–2025[36] promotes the development of the transport supply chain (for example, reduced import duties on batteries and charging equipment) and the use of electric vehicles (EVs). Taken together, these initiatives, reforms, and policy changes clearly signal new momentum toward taking fuller ownership of the climate change related challenges and crises the country faces.

34 United Nations Climate Change, *Nationally Determined Contributions Registry* (2021), https://unfccc.int/NDCREG.
35 Government of Pakistan, Ministry of Climate Change, Policies: Final Updated National Climate Change Policy (2021), http://www.mocc.gov.pk/Policies.
36 Government of Pakistan, Ministry of Climate Change, *Policies: National Electric Vehicle Policy* (2019), http://www.mocc.gov.pk/Policies.

It is crucial that Pakistan sustain the momentum toward implementing transformative policy actions that simultaneously address both development and climate challenges. To strengthen public engagement, national discourse, and thus official accountability, the benefits of these comprehensive policy shifts need to be better conveyed and explained to the public. The combination of a favorable political economy and increasing awareness—both within the government and in the broader society—of the risks, reality and gravity of climate change suggests that Pakistan is ready to move to a new level of commitment and action on climate threats. The updated *Nationally Determined Contributions* (NDC 2021), presented at COP26 in Glasgow, bears witness to this high-level commitment. It is hoped that this trend will be strengthened by recent events, particularly the 2022 drought and floods.

Nonetheless, risks remain owing to the tightening fiscal space and the country's pattern (at least in the past) of frequent and discontinuous political transitions. There is also the risk that the challenges of the environment and climate change could outpace and overwhelm the implementation agenda for several of these governance reforms. These risks underline the need to tie environmental and climate actions closely into the green-growth agenda in order to bring sustainable and broad-based benefits, including improving both human and natural capital. In tandem, there is a critical need to strengthen both public engagement and official accountability. Which levels of government have what mandate for climate action, and who should be held accountable for what, need to be clarified.[37]

3.2 Climate change commitments

Pakistan's updated 2021 NDC represents a paradigm shift toward an inclusive, innovative, whole-of-economy approach to tackling climate change challenges through targeted adaptation and mitigation actions. The high-priority adaptation actions include (i) the Recharge Pakistan Program (reducing flood risk and enhancing water recharge at six sites in the Indus Basin, building the resilience of 10 million people, and strengthening vulnerable ecosystems) and (ii) expanding protected areas from 12 percent of Pakistan's geographical area to 15 percent by 2023. Pakistan has committed to unconditionally reducing its overall emissions by 15 percent by 2030, relative to its projected emissions. It has also committed to reducing emissions by an additional 35 percent conditional on the availability of climate finance (see Figure 5.5). High-priority mitigation measures include (i) expanding renewable energy (RE); (ii) greening transportation (30 percent of all new vehicles sold in Pakistan in various categories must be EVs by 2030); and (iii) reducing dependence on coal (there is a moratorium on new coal power plants from 2020 onward, a ban on imported coal, the shelving of plans for two new coal-fired power plants in favor of hydro-electric power, and a focus on coal gasification and liquefaction for indigenous coal). The NDC has commits the government to continue investments in nature-based solutions (NBSs) such as the Ten Billion Tree Tsunami Program (TBTTP), a four-year project that will have the quadruple benefits of natural capital restoration, carbon sequestration, and livelihood improvements, especially for poor households.

There are compelling indications that the government recognizes that its success in implementing the 2021 NDC will in part depend on improving the measurement and transparency of climate action achievements, gaps and needs. To regularly track the implementation status of the NDC in compliance with the Enhanced Transparency Framework—a core component of the Paris Agreement—the government has developed a broader GHG monitoring reporting and verification (MRV) system called RISQ (Representativity Indicators for Survey Quality). This is a web platform for the compilation of a national MRV database, with support from the Global Change Impact Studies Centre (GCISC) under the MoCC. The RISQ platform will be deployed through agreements with key data-providing national agencies. Similarly, efforts are underway to create a national adaptation monitoring and evaluation (M&E) system by developing a roadmap for its future setup, based on a pilot experiment in the agriculture sector.

37 World Bank, *Opportunities for a Clean and Green Pakistan: A Country Environmental Analysis* (Washington DC: World Bank Group, 2019), https://openknowledge.worldbank.org/handle/10986/32328. Priorities include (i) ensuring greater and more transparent disclosure of environmental and climate data and of data on the health impact of air and water pollution; (ii) strengthening the capacity to engage citizens on climate and environmental issues, urban development, and broader planning processes; and (iii) supporting education and awareness-raising to empower citizens, including schoolchildren, parents, and rural dwellers.

Box 3.1 Pakistan's Methane Pledge

In 2021, Pakistan signed the Global Methane Pledge to curb its methane emissions by 30 percent from the 2020 level (141 million MtCO2e), to about 99 million MtCO2e, by 2030. To achieve this methane emissions target, Pakistan could adopt a mix of investment and policy options across different transition pathways, as discussed in Chapter 4. In 2018, methane accounted for 28 percent (or 138.23 MtCO2e) of the total annual GHG emissions of Pakistan. Livestock is the single-largest contributor (99.99 MtCO2e), followed by solid waste (12.53 MtCO2e), wastewater treatment and discharge (8.96 MtCO2e) and rice cultivation (7.83 MtCO2e). According to the IPCC Sixth Assessment Report, methane is a short-lived climate pollutant with a global warming potential (GWP) of 81–83 over 20 years and 27–30 over 100 years–significantly more potent than carbon dioxide, which has a GWP of 1 regardless of time period. Reducing methane emissions as rapidly as possible will therefore be especially effective in addressing climate change and air pollution.

The government also recognizes that mainstreaming decarbonization, resilience, and green growth across all sectoral and provincial-level programs is vital for enabling climate mitigation and adaptation. Although mainstreaming has, in principle, been government policy for over a decade, there has been no institutional mechanism for effecting it across sectors or coordinating policy between federal and provincial governments. To address this, the NDC (2021) proposes the development of a *National Action Plan* (NAP) to provide the framework for mainstreaming medium- and long-term climate-change actions into national sectoral policies, strategies, and programs to enable a coordinated approach among the different tiers of government.[38] Launched in March 2021, the two-year NAP is under preparation through support from the UN Environment Programme (UNEP), with total funding of US$2.7 million from the Green Climate Fund (GCF). It will be developed along with its constituent Provincial Adaptation Plans for each of the provinces. After experiencing some delays, the implementation of the NAP was finally initiated in August 2022. Furthermore, the government has begun the process of formulating its long-term, low-emissions development strategy (LTS) in response to Article 4.19 of the Paris Agreement and the Glasgow Climate Pact, with support from the 2050 Pathways Platform.

3.3 Institutional frameworks for climate change

3.3.1 Federal-Level Institutions

Although Pakistan is one of the few countries that has a dedicated climate change ministry, the MoCC, to date this ministry has had limited influence on outcomes primarily because of capacity and resource constraints. The MoCC is responsible for climate change policymaking and acts as a facilitator and coordinator, encouraging the mainstreaming of climate-change policies and programs within federal and provincial departments. It is also charged with monitoring progress on international climate-change agreements and accessing funding from the international community. Additionally, it has federal-level oversight of environmental protection and disaster risk management. However, because the responsibilities of policy implementation are devolved from the federal government to the provinces (see Section 3.3.2 for further information), the influence of the MoCC is somewhat limited. The MoCC has been given an ambitious role but, in practice, it is poorly placed and inadequately resourced to influence outcomes. It has a limited budget and program execution capability and lacks the weight to lead and coordinate federal ministries and provincial departments. The mainstreaming of climate change actions into sectoral policies, such as through the Planning and Development Departments, might prove more effective, for example, through the incorporation of climate considerations into project and program development during the preparation of the government's Annual Development Plans and Budgetary Framework.

38 Government of Pakistan, Updated Nationally Determined Contributions 2021 (Government of Pakistan, 2021), https://unfccc.int/sites/default/files/NDC/2022-06/Pakistan%20Updated%20NDC%202021.pdf.

3.3.2 Provincial-Level Institutions

Devolution has the potential to enhance provincial and local ownership of climate policies and actions in Pakistan. The government's ambitious devolution scheme was designed to strengthen local ownership and action. The 18th Amendment to the Constitution in 2010 significantly increased provincial autonomy and devolved many key service delivery functions to the provinces. These include education, health, water, sanitation, and solid waste management as well as support to major economic activities such as agriculture, irrigation, industry, and business, together with responsibility for environmental and climate change. Policies are coordinated across the country by the Council of Common Interests, which consists of the Prime Minister and provincial Chief Ministers. Fiscal-transfer decisions are made by the National Finance Commission.

However, the process of devolution is still a work in progress. There has been no effective devolution of responsibilities or budgets to local or municipal governments below the provincial level. This continues to pose a significant constraint on the effective management and development of cities and has left rural villages without either the resources or the governance necessary for critical investments in municipal services or climate resilience. There are also fiscal challenges: provinces rely mainly on the federal transfers for their budgets, with little revenue-raising effort or capacity at the provincial level and therefore lack the budgets needed to deliver on the scale needed for devolved tasks. The mechanisms and incentives to induce cooperation and joint action are weak, across sectors within provinces as well as between the federal and provincial levels. Additionally, there is often a lack of coherence between federal and provincial spending plans. This lack of policy and financial coordination significantly constrains Pakistan's ability to operate as an integrated economy. Due to this, there are also challenges in managing transboundary issues, such as environmental and water resource management. Institutional and capacity challenges also limit policy formulation and implementation. These constraints are more binding at the provincial level and there has been virtually no investment in building capacity below the provincial level. Taken together, these structural impediments severely undermine the country's ability to design and implement the kind of sustainable green-growth policies that it needs to adopt a coordinated response to climate threats, including addressing important transboundary issues.

Additionally, challenges exist in transferring environmental, water, agriculture and climate-change policies and programs from the national level down to the provincial level, and across sectors. With the advent of devolution in Pakistan, the provinces became responsible for sectoral policies and implementation within their respective jurisdictions. As a result, although the MoCC has the overall mandate for climate change policy, each province has its own Environmental Protection Agency (EPA) responsible for environmental policy and programs within that province. This includes climate-change mitigation and adaptation measures. Two provinces have also set up climate-change centers under their EPAs. However, provincial capacity remains weak. In addition, because almost all climate and environmental challenges are multifaceted and multisectoral, most climate and environment actions require close coordination and coherence across departments within the provincial governments, as well as across provincial boundaries and with federal departments, but the capacity and skill to develop that level of coordination and coherence are lacking. The same applies to the irrigation and agriculture departments.

In recent years, nevertheless, three of the country's four provinces—the exception is Balochistan —have developed specific policies, strategies, or action plans to address climate change, and encouraging examples of provincial action exist under green-growth programs and the national afforestation program. Khyber Pakhtunkhwa's *Green Growth Initiative* and Punjab's *Punjab Green Development Program* both provide compelling examples. Both programs include some measure of alignment between provincial and national policies and with the private sector. The cabinet in Sindh recently approved the Climate Change Policy 2022 and set up a dedicated Directorate under the Sindh Environment, Climate Change & Coastal Development Department. The lesson that emerges here is that substantial change can occur under the influence of strong, determined political leadership. Provincial-level commitment, especially when triggered by real and urgent problems such as Punjab's appalling smog, can begin to overcome preexisting institutional constraints and drive the implementation of broad-based environmental action.

3.4 Current landscape of climate finance

The NDC (2021) estimates that, by 2030, the total cost of NDC implementation will reach nearly US$200 billion. It is estimated that the clean energy transition alone will require US$101 billion. The cost of adaptation associated with disaster response and recovery is at present hard to gauge—one estimate from the MoCC[37] using a top-down approach is about US$10.7 billion a year, with a total estimation of US$85.6 billion for 2022–2030. The PDNA for the 2022 floods has proven that this estimation for disaster recovery needs is sensible, but it could potentially rise if no timely and effective adaptation and mitigation measures take place. Chapter 5 attempts to build on this cost estimation, integrate the cost of additional resilience measures across critical sectors, and identify potential financing sources.

Overall, public spending on climate actions has been low, but relatively higher at the provincial level. Between 2011/2012 and 2014/2015, actual public spending on climate actions went up from 6.6 to 8.3 percent of total federal and provincial expenditures.[40] During the same 3-year period, the average climate-related public expenditure was 6.9 percent (US$4.1 billion out of US$59.4 billion) of total expenditure, including both development and current expenditure. Several provinces made significant financial commitments to climate action within a green-growth approach. For example, Khyber Pakhtunkhwa (KP) allocated close to 9.7 percent of its 2014–2015 expenditure and 8.9 percent of its 2015–2016 expenditure to climate-related activities. Punjab allocated 9.3 percent of its 2014–2015 expenditure and 13.7 percent of its 2015–2016 expenditure to climate change-related activities.

Green bonds are an increasingly important climate financing instrument worldwide but relatively new in Pakistan and require macro-fiscal stability as a precondition. In 2021, the Water and Power Development Authority (WAPDA) launched the country's first-ever 10-year green bonds and so far has raised US$500 million to support hydropower generation. Given the encouraging market response, WAPDA is considering launching additional green bonds. Pakistan may launch additional bonds in other sectors. The Securities and Exchange Commission of Pakistan (SECP) has approved national guidelines for the issuance of green bonds or *sukuk*[41] financing by the corporate sector, that will encourage innovative financing mechanisms in several sectors for both adaptation and mitigation. For the development of the domestic bond market, macro-fiscal stability is a precondition. Considering the current macro-fiscal and external position of the country, its access to global capital markets is likely to remain limited.

Although Pakistan has received only relatively low levels of concessional international climate finance, it has received significant climate-related financing from multilateral development banks (MDBs). The main source of international climate finance for Pakistan has been from MDBs, which provided about US$6.4 billion for climate-related investments over the 2015–2020 period. A large share of World Bank lending to Pakistan (44 percent in FY21) is now linked to climate co-benefits, and 50 percent of the portfolio of International Finance Corporation (IFC) is climate-tagged.

The role of the private sector is clearly indispensable to meeting the investment needs of NDC commitments, but overall investment level has been low.[42] Pakistan's total investment-to-GDP ratio remains around 15 percent, compared to South Asia's regional average of over 30 percent, and private investment has remained at around 10 percent of GDP over the last decade. The ratio of foreign direct investment (FDI) to GDP, at 0.7 percent in 2020, is also low compared to South Asia's regional average of 2 percent, because of an unfavorable investment environment and the elevated perception of risk.[43] In 2019, the total private sector investments from households, corporations, and commercial financial institutions (FIs) in climate actions, mostly in mitigation, was US$1.4 billion, or 0.5 percent of GDP.

39 Aslam Amin Malik, et al., *National Economic and Environmental Development Study* (NEEDS) (Ministry of Climate Change, Government of Pakistan, 2011), https://unfccc.int/files/adaptation/application/pdf/pakistanneeds.pdf.
40 Pakistan CPEIR (2017).
41 A *sukuk* is a sharia-compliant, bond-like instrument used in Islamic finance.
42 IFC (2021). *Creating Markets in Pakistan: Country Private Sector Diagnostic* (CPSD). (Washington, DC: World Bank Group, 2021). https://www.ifc.org/wps/wcm/connect/publications_ext_content/ifc_external_publication_site/publications_listing_page/cpsd-pakistan.
43 World Bank, "Foreign Direct Investment, Net Inflows (% of GDP) – Pakistan" (World Bank website, 2020), https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS?locations=PK.

4.

PIVOTING THE ECONOMY TO AN INCLUSIVE, RESILIENT AND GREEN DEVELOPMENT PATHWAY

4. PIVOTING THE ECONOMY TO AN INCLUSIVE, RESILIENT AND GREEN DEVELOPMENT PATHWAY

Pakistan's development challenges and its high exposure to climate change related risks highlights the importance of three broad sectoral transitions, in addition to the imperative of strengthening its human capital. The first is a transformation of the agri-food system which requires a transformation of the way crops are grown, harvested, stored, and marketed. It also entails a transformation of irrigation and the management of water, surface and ground, since agriculture absorbs more than 80 percent of all water withdrawn. Finally, it entails a shift to a climate resilient management of pastures and livestock. The second, is needed changes in urban development to make cities livable and climate resilient. The third is a shift to domestically sourced sustainable energy and low carbon transport.

There are challenges in the path of each of these transitions, but they also present enormous opportunities. The focus overall is on a no-regrets approach. The recommended actions are needed to cope with the development and fiscal challenges the country is already facing and the climate and environmental related damages it is already enduring. These will remain and will intensify over this century regardless of the speed at which climate is addressed globally. They will also help accelerate the achievement of Pakistan's 2021 NDC targets for adaptation and mitigation.

4.1 The Need for an Agriculture-Food System Transformation

The agri-food system is vital to Pakistan's economy—to growth, jobs, poverty reduction and food security. The agriculture sector contributes over 40 percent of Pakistan's labor force, including most employed women. It contributes 23 percent to the country's GDP[44] and is the largest source of export earnings. More than 63 percent of Pakistan's people reside in rural areas[45] and are largely dependent on agriculture. Livestock, including pastoral livestock, contributes more than 50 percent of agriculture GDP and about 12 percent of national GDP. It also provides income security for many rural households, especially those with insecure rights to land. Pakistan has the world's fifth-largest beef herd and produces 6 percent of the world's milk supply, but access to animal protein and dairy is both inadequate and highly unevenly distributed. The overall ecosystem services value of rangelands in Pakistan is US$724 billion.[46] Pakistan has also lost a great deal of its vegetation cover including shrubs and forest over the past few decades. This carries large environmental and biodiversity costs. Both provide numerous ecosystem services, including the regulation of water flow, the conservation of soil, protection from land erosion, the conservation of biodiversity and carbon sequestration (0.5 ton per ha per year). They are also an economic resource that needs to be managed sustainably. Rangelands and forests combined contribute services estimated at 13 percent of GDP. The extreme climate vulnerability of the food system to the loss of natural vegetation cover and the associated regulation of water flows was highlighted in the catastrophic floods of 2022.

4.1.1 Challenges and Opportunities

Inefficient and wasteful use of water, environmentally damaging agronomic practices and crops, and inadequately developed value chains have diminished the agriculture-food system's contribution to sustainable growth, poverty reduction, and food security. Distortionary and inequitable fiscal policies, highly unequal land ownership, tenure insecurity, and vested political interests have locked smallholder farmers in low-value, low-nutrition production and hindered the large-scale adoption of

44 World Bank, "Agriculture, forestry, and fishing, value added (% of GDP) – Pakistan" (World Bank website, 2021), https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=PK.
45 World Bank, "Rural Population (% of total population) – Pakistan" (World Bank website, 2021), https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=PK.
46 Assuming an asset life of five years and a discount rate of 5 percent.

improved agronomic practices, crop diversification and water conservation. This, compounded by negligible investment in research, extension, and the development of markets, has resulted in virtually no improvement in seed quality, production methods or farm machinery and technology for years. This lack of progress disproportionately disadvantages smallholder farmers, who constitute the bulk of farm households, yet suffer from inadequate access to finance and high-quality affordable inputs and face unfair farm gate prices. Smallholder farms and farmers have limited resilience in the face of climate- and disaster-related shocks. The disproportionate focus on the development of irrigated crop agriculture has also limited investment in the management of rangelands, pastures, wetlands, and marine landscapes, thus limiting their contribution to the agriculture-food system.

Livestock accounts for more than half of agriculture GDP and has traditionally buffered the impacts of economic and weather shocks on low-income and land-poor households, but livestock productivity is low. While livestock numbers are increasing at an estimated 3 percent per year, the sector is ill-equipped to meet the growing demand for animal products sustainably. The genetic pool of Pakistan's dairy animals has been deteriorating and is compounded by poor animal health, limited access to vaccines and veterinary extension services, lack of technical skills among farmers. and inadequate feed. Over 40 percent of livestock feed comes from pastures and rangelands, which are facing accelerating degradation, raising serious concerns about ecosystem integrity and functionality. Rangeland productivity has slumped to just 25–50 percent of its potential, diminishing a wide range of other ecosystem services. Inefficiencies in off-farm value addition and commercialization further impair livestock productivity because of poor aggregation, processing, storage, and farm-to-market transport.

The inefficiencies of the agriculture-food system have historically been compensated for by Pakistan's abundant water and arable land, which have thus far enabled the system to keep pace with demand without making productivity and efficiency improvements. Agricultural growth has been driven not by technological change or innovation but by the intensification of water, fertilizer, and pesticide use, and by bringing new land under cultivation. This process is rapidly approaching its natural limits. It is under stress from environmental degradation and the increasing need of water and land for non-agricultural uses. Post-harvest losses worsen the wasteful use of resources. Some 35–40 percent of harvested fruits and vegetables, 10–15 percent of cereal grains, and 20 percent of milk never reach the market.

Agricultural productivity and poverty reduction statistics reflect these chronic issues. The yields of major crops are 1.5 to 4.2 times below their field potential, and 2.1 to 5.6 times below international best practice. Sectoral growth, at 2.1 percent per year, has been sluggish over the last decade and the level of labor productivity in agriculture has been virtually stagnant over the past three decades. Rural poverty has also declined much more slowly than urban, opening up a large rural-urban poverty gap. At the same time, there is a significant structural shift under way within the sector. As men move to non-farm work, women are taking on more decision-making roles on the farm. This increasing feminization of agriculture is set to pose new challenges unless there is a clear pivot toward providing unbiased agricultural services to women, such as training in agronomic practices and technologies, gender-sensitive and female-led extension services, formal land titles, access to credit and markets and, where feasible, machinery that is appropriate for use by women.

Climate change has introduced significant new risks into this already unsustainable state of affairs. The prolonged and early heat wave in Spring 2022 sounded an advance warning of the potential impact of rising temperatures on crop yields. The wheat crop across South Asia was seriously impacted. Further, the monsoon caused widespread flooding that washed away precious topsoil and disrupted the growth of Kharif season crops. Over the coming decades, the threat of hydro-climatic disasters is expected to intensify—with uncertain shifts in monsoon onset and duration, attendant floods and droughts, and an increase in the severity and frequency of extreme heat events.

This has enormous implications for food and water security. Crop yields are projected to further decline, by between 14 and 50 percent under some climate change scenarios. Climate warming will also add to the already rising demand for water, pushing it to a projected 60 percent increase over current levels by 2047. Livestock productivity is expected to decline further because of reduced water availability, deterioration in fodder and feed quality and quantity, the increased risk of disease

epidemics, and increased costs of feed, water, energy and cooling systems. A further loss of ecosystem services is also likely, while demand for these same services will increase because of population growth, economic growth, and urbanization.

These climate change related risks are poised to impose an additional layer of stress on a chronically underproductive agri-food system. To avoid unmanageable levels of water and food insecurity, environmental decline, and deepening poverty, a transformation is imperative. Investment in water management and regenerative and climate-smart agriculture (CSA) practices could reverse the decline in productivity and enhance the viability of the agri-food system by revitalizing the degraded ecosystems on which it depends. This will also build a more equitable sector where smallholder farmers and livestock herders earn higher and more sustainable incomes, and poor urban consumers have better access to a more diverse range of foods.

The national emphasis on building climate resilience through NBSs provides an entry point for scaling up water management and climate-smart practices. Regenerative agriculture and livestock management focuses on improving farm and rangeland productivity through practices that reverse soil degradation and increase biodiversity. The increase in soil organic carbon (SOC) enhances soil's water-holding capacity and hydrological function, as well as its resistance to temperature extremes, floods, and droughts. Regenerative practices can therefore increase agricultural productivity and exports while reducing the need for irrigation water and purchased chemical inputs. A shift to a climate smart regenerative agri-food system thus has enormous potential for enhancing farm incomes and reducing rural poverty. It could also contribute significantly to reducing GHG emissions.[47]

The agri-food sector provides perhaps the strongest opportunity for a development-resilience-mitigation triple win. The needed policy actions are also immediately implementable. To realize these triple wins, Pakistan must pivot away from its current policy practices, which have systematically eroded the agri-food system's resilience and development potential.

Agriculture and Water: A Wasteful and Environmentally Unsustainable Nexus

Pakistan's annual total supply of water will likely remain fixed for the next several decades, but its timing will become more variable because of climate change, and its availability for agriculture will decline with rising non-agricultural domestic, industrial and environmental demand. At 37 cents per cubic meter, the productivity of agricultural water in Pakistan is in the lowest decile globally. Irrigation productivity is particularly low for major crops. It is estimated that under a high global-warming scenario (3°C by 2047), agriculture could maintain its current levels of surface water consumption only up to 2037. Beyond that, it will have to give up water to meet industrial and domestic needs.

The outlook for groundwater is bleaker. Current levels of use in agriculture can be sustained only up until 2030 without taking away from other sectors. Further, maintaining the current levels of groundwater overuse in agriculture will limit its role as a buffer during water-scarce and drought years. About one-tenth of current irrigation withdrawals—12 billion cubic meters (BCM)—will need to be reallocated in the next three decades. The performance of the Indus Basin Irrigation System (IBIS) will be a critical lever for that.

The services of the IBIS are poorly designed and financially unsustainable. Surface water entitlements are tied to land size–disfavoring smallholder farmers–, and water is supplied during pre-determined time slots. As a result of chronic water shortages and endemic water theft upstream, the system penalizes farmers at the tail (downstream) end of canals. Further, the structure of the irrigation tariff (*abiana*) provides no incentive for conserving water. The water tariff is a flat-rate levied per unit of cultivated area, not per amount of water used, and therefore does not account for water consumption or—in Punjab and KP—the crops grown. In Punjab and Sindh, the current estimated annual indirect

47 This would occur in several ways, the main ones being: carbon sequestration in soil; reduced enteric fermentation through managed grazing and feed improvements; repurposing of manure to support soil restoration, biofertilization, and the production of biogas to replace longer-lasting fossil fuels currently used in agriculture; reducing the use of chemical fertilizers and pesticides, which would reduce nitrous oxide emissions and the contamination of ground water; using crop-residue in conservation agriculture systems to keep soil covered instead of burning it; using improved rice cultivation and water management practices such as alternate-wetting-and-drying (AWD); reducing or even eliminating the use of diesel-powered tube wells and diesel powered agricultural machinery; and eliminating fossil fuel intensive agricultural practices such as the seasonal tilling of land.

subsidy to the irrigation sector is about US$66 million: the Sindh government collects only 6 percent of operations and maintenance costs, and Punjab collects 25–30 percent. The resulting deferred maintenance of the system, coupled with the need to modernize the infrastructure, will require annual capital investments of up to US$100 million over the next two or three decades. Yet, current revenue patterns do not even cover routine maintenance.

The tariff collection system is archaic and nontransparent. Irrigation departments provide the service and assess the tariff, but it is collected by revenue officials and transferred to provincial revenue departments. The distributional incidence of the collected tariffs therefore remains obscure, raising concerns about inequity. Additionally, the collection rates of assessed *abiana* vary from year to year. Overall collection rates have been improving in Punjab: While only 39 percent of assessed charges were collected in FY15, close to 100 percent were collected in FY19, with some year-to-year volatility. In Sindh, collected *abiana* remains chronically low, reaching just 40 percent in FY20.

The supply-driven design and operation of the IBIS infrastructure make it harder to transition to flexible and demand-responsive service delivery and to equitable use-based charges. Yet without this transition, crop diversification and CSA could be difficult to scale, especially in areas that depend primarily on surface water. In Punjab, farmers work around the rigidity of surface water supplies is typically addressed by accessing groundwater, which accounts for over 50 percent of irrigation. In the IBIS, surface water and groundwater are not two independent systems, and leakages account for two-thirds of groundwater recharge. Excess supply in some areas causes waterlogging, while shortages in others contribute to depletion. Flexibility in surface water delivery is critical for conjunctive management.

There are also distortions in groundwater management. Unsustainable usage is encouraged by the absence of regulations to limit extraction. The electricity tariff subsidy for tubewells compounds the problem and creates a fiscal sink. Stored groundwater in the Indus Basin is a buffer against low precipitation, unreliable surface water flows, and drought. The need for this will increase with rising temperatures and irregular precipitation patterns, but unregulated pumping is threatening the resource, creating depletion and increased salinity. The fiscal cost to the federal and provincial governments is high—some US$420 million each year. Yet the subsidy benefits only the few, better-off owners of electric tubewells (see more details in *Annex 3: Groundwater Irrigation in Punjab*). In Balochistan, only a tiny fraction of the population (0.3 percent) benefits, yet the cost of rapidly depleting groundwater levels (estimated at 30-40 feet per year in some areas) is borne by all.

Agriculture-linked degradation is pushing water and land resources beyond the threshold of safe use and causing ecosystem decline across landscapes. Some 35 percent of irrigated land is waterlogged and 30 percent highly saline, making it unfit for agricultural production. Uneven, inefficient, and excessive use of synthetic fertilizer, dominated by urea (nitrogen), has culminated in soil nutrient imbalances and low levels of soil organic matter. Additionally, excessive pesticide application (especially for cotton) harms biodiversity. High surface water withdrawals and polluted return flows affect river ecology and reduce the water available for downstream environmental use. The formerly productive Indus Delta marine fisheries have been reduced in productivity. While the area of mangrove forests initially shrunk, they are now being actively replanted and expanded.. The annual cost of environmental damage to the delta is estimated at between US$1 billion and US$2 billion. Marine and inland fisheries could add more value to the agri-food system, but with the degradation of wetlands and marine-coastal ecosystems, the resource is unsustainable. Unmanaged grazing together with fuel wood harvesting is impairing the health of rangelands and diminishing a wide range of other critical ecosystem services, including the regulation of water flow, the conservation of soil and biodiversity, protection from land erosion, and carbon sequestration. Rangeland productivity has slumped to just 20–50 percent of its potential,[48] and it is estimated that 25 million hectares (ha) of land are degraded.[49]

48 Food and Agriculture Organization. Rangelands of Pakistan. Current Status, Threats and Potential. Food and Agriculture Organization, 2016. https://www.fao.org/3/I5660E/i5660e.pdf.
49 Khan, Amir Nawaz and Ali, Amjad. Desertification Risk Reduction Approaches in Pakistan. Springer, 2014. https://link.springer.com/chapter/10.1007/978-4-431-55369-4_9.

Agriculture-to-urban land conversion is a concern in all provinces, driven by poor land-use planning, the low profitability of agriculture, and higher land prices offered by urban developers. It is projected that, by 2030 all agriculture land on the fringes of Lahore will have been converted. In the last two decades, urban housing in Multan and Hyderabad has replaced more than 7600 ha of cultivated land. This has taken place in the context of a weak land policy framework, poor regulation, and inadequate protection of the interests of local people's interests.

Costly and poorly targeted subsidies drive the sector's poor performance

The agri-food system is awash with inefficient, costly, inequitable subsidies that are an economic burden and create a distorted incentive structure, which plays a significant role in the sector's poor performance. In recent years, direct and indirect subsidy support to agriculture and irrigation in Punjab and Sindh has amounted to about US$2.2 billion to US$2.7 billion in public spending per year. This includes direct subsidy programs, tax relief for inputs, import and export subsidies, and revenue gap financing.

Support to wheat production[50] **was originally intended to help achieve national self-sufficiency, ensure a steady supply of flour to urban consumers, support poor farmers, and maintain price stability.** In practice, it has brought scant benefit to smallholder farmers, has discouraged diversification into higher-value crops, and is a significant drain on fiscal resources. The Government of Sindh spent over US$60 million in 2019–2020 to support wheat production (265 percent of the province's investment in agriculture that year). Similarly, the Government of Punjab spent over US$454 million in 2020–2021 (407 percent of the province's investment in crop agriculture that year). The wheat procurement system benefits mainly large and medium farmers, commercial banks, and millers. Cumulative outstanding debt from wheat commodity operations is at nearly U$4.5 billion[51] —creating a circular debt-like situation. Poor smallholders benefit little because most of their production (about 95 percent in Sindh, for example) is for subsistence. The procurement system also incurs losses through poor storage, which costs Punjab an estimated US$1.6 billion annually. Wheat is Pakistan's primary cereal crop, so its production inevitably absorbs large subsidies. Given its dietary importance, steady growth in wheat output will remain necessary to maintain food security. However, this needs to be done through substantial improvements in productivity and less intensive use of chemical inputs, land, and water, rather than the further expansion of conventional production methods. At the same time, for sustained improvements in human capital, a shift is needed in diets and agricultural production toward a more diverse, more and nutritious basket of foods, including more vegetables and fruits, which could contribute to both higher productivities, not to mention greater health.

Support to sugar production is equally fraught with inefficient and inequitable distortions. The benefits of public intervention in the sugar sector accrue almost entirely to sugar mills and large farmers, yet the costs are borne broadly by smallholder farmers, urban consumers, and high levels of pollution. High import duties help keep domestic sugar prices higher than international market prices; export subsidies to sugar farmers have the effect of transferring virtual water out of Pakistan; and licensing restrictions prevent the free entry of new millers which, coupled with mobility limitations, binds farmers to sell to the regional mill under quasi-monopoly conditions. These *de facto* regional monopolies lead to high farmer-to-factory ratios (on average 6000–8000 farmers per mill), causing long wait times. Excessively long intervals between when sugarcane is harvested and crushed—up to 6 days— lead to post-harvest loss. The embedded environmental cost of these losses is high because sugarcane has the highest per hectare water requirement and fertilizer use. The social cost of it is compounded by the public health footprint. Pakistan has the highest rate of diabetes globally. The consumption of sugar, and processed foods containing sugar, has risen significantly across the country, at the cost of more diverse, more nutritious foods.

48 Food and Agriculture Organization. Rangelands of Pakistan. Current Status, Threats and Potential. Food and Agriculture Organization, 2016. https://www.fao.org/3/I5660E/i5660e.pdf.
49 Khan, Amir Nawaz and Ali, Amjad. Desertification Risk Reduction Approaches in Pakistan. Springer, 2014. https://link.springer.com/chapter/10.1007/978-4-431-55369-4_9.
50 Typically, Provincial Food Departments and Pakistan Agriculture Storage and Services Corporation Limited (a state-owned company) purchase a pre-determined quantity of wheat at a support price. A fraction of it is stored as a strategic reserve and the remainder is released to flour mills at a subsidized rate. This unprofitable arrangement is supported mostly through borrowing from commercial banks.
51 This is around PKR 800 billion. The average exchange rate was US$1 = PKR 177.81 in FY21/22, according to the IMF.

Fertilizer subsidies are another problematic practice. Excessive fertilizer use in agriculture is driven by distortionary and outdated policies that were initially introduced to lower production costs and food prices. Today, they deliver negligible monetary benefit to households, degrade resources, generate high GHG emissions, and impose a heavy fiscal burden on the government. This is expensive—about US$1.1 billion per year through subsidized natural gas, tax relief, and import subsidies—yet households receive a fraction of the benefit (US$4.70 per household per year). This has crowded out the space to promote the balanced and efficient use of chemical fertilizers as needed, and to promote less environmentally harmful, natural alternatives, such as biofertilization based on composted animal, human and household organic waste, and crop residues.

A shift away from these inefficient, costly, and inequitable subsidy regimes is critical for sectoral transformation and strengthened resilience of systems and households. There are deep political and policy challenges that must be met for such a reform to succeed, first and foremost being that a range of vested interests benefit from the status quo. Land ownership remains highly unequal, especially in Sindh and Southern Punjab, and tenancy and labor laws are weak and poorly enforced. This leaves the bulk of rural households with uncertain land access and extreme economic dependency. Large landowners use land to buy political leverage, with little investment in their land or in the development of rural areas, entrenching poverty and human capital deficits and deepening societal divides. Industries, such as sugar mills, linked to this system benefit from the monopoly power of large landowners and the lack of options for smallholder farmers and poor rural households.

Changing this entrenched power structure is necessary but will require broad political consensus. In the meantime, much can be done to improve both development outcomes and climate resilience by starting with a reorientation of the policy and investment focus. For instance, small-scale pilots have been initiated to test specific regenerative-farming methods and some have begun to show very encouraging results, though more research is needed (see more details in *Annex 4: Regenerative Agriculture Practices in Pakistan*). There is now a need to systematically test methods and their scalability through carefully performed on-farm experiments. Regenerative agriculture can greatly strengthen the long-term resilience of agriculture amid climate change.

4.1.2 Key Policy and Investment Recommendations

This policy package for transforming agriculture-food system consists of four higher-level policy recommendations and several suggested priority actions.

Policy Recommendation #1: **Repurpose existing subsidies to introduce efficiency without burdening vulnerable and smallholder subsistence farmers and utilize freed-up fiscal resources to remove barriers to transformative, climate-smart, on-farm investment and value-chain improvements.**

The subsidy structure across federal and provincial governments should be revised to prioritize direct and targeted subsidies to poorer farmers to promote resilient farming practices.

The wheat support system needs to be gradually phased down. This will reduce direct financial costs to the government and indirect economic losses to the economy, free up fiscal space, arable land, and irrigation water, and create the enabling economic environment needed to induce large-scale crop diversification and CSA. Freed-up fiscal resources could be invested to improve wheat production systems and value chains. Modeling work indicates that removing support to wheat production could free up 1.4 BCM of irrigation water per year. This could be used to grow higher-value crops to substitute for agricultural imports for which demand is rising. Furthermore, with improved agronomic practices and seed quality, total wheat production could increase through gains in productivity, with much lower land and water use.

Public support for sugar cane needs to be restructured. The key entry point is the removal of licensing restrictions that prevent the entry of new mills. Proposed by the Sugar Sector Reform Committee and

the Ministry of Planning Development and Special Initiatives, this would reduce the wasteful post-harvest losses induced by monopsony, which allows a handful of buyers to control the market and prices. A second entry point is the removal of import duties and export subsidies. While some of these changes would benefit smallholder farmers, the removal of import duties and export subsidies could also induce some exit out of sugarcane toward higher value, more environmentally beneficial crops. Switching to less environmentally harmful alternatives such as sugar beets to supply the food, confectionary, sweets, and soft-drinks industries would ease the transition and may reduce demand-side resistance to reform.

The natural gas subsidy for chemical fertilizer production urgently needs to be phased down. Fiscal savings from the reform could be rechanneled as "smart subsidies" to smallholder farmers to promote resilient farming practices. Channels for this are already at an advanced stage of development—for example, Kisan/Hari cards.[46] This would also provide an entry point to encourage more judicious use of chemical fertilizers, promote natural alternatives, and incentivize public and private agriculture research and extension to help farmers safely shift toward more beneficial and regenerative agronomic practices.

Some of the fiscal space that would open up through wheat and sugarcane reform could also be used to direct income support or subsidized inputs to smallholder or landless farmers for undertakings actions that increase their climate resilience. A tested system for regular fiscal transfers to small farmers would also enable the provincial governments to swiftly make emergency relief cash payments in the aftermath of disasters such as the 2022 floods. Other options include subsidies for credit and risk sharing to encourage commercial banks to lend directly to small farmers for CSA, including new regenerative practices, and to support private sector investment to fill gaps in value-chain investment. Subsidy and risk-sharing interventions would need to be carefully targeted at identified market failures and subjected to adequate oversight and monitoring arrangements to prevent leakage, capture, waste, or broader market distortions.

The political economy of this reform would need to be managed through a multi-avenue strategy of clear, compelling, and consistent communication that lays out the rationale and imperative of potential benefits to incomes, productivity, climate resilience and adaptation in agriculture, water availability and safety, and soil restoration and conservation. Key to this will be the government's engagement with local communities. Additionally, removing perverse incentives in the agriculture sector must be introduced as part of a portfolio of measures where farmers are provided technical and financial support to enable the transition. This would require an enabling environment for the adoption of new agronomic practices, the subject of the next recommendation.

Policy Recommendation #2: Support the sustained adoption of CSA and regenerative agriculture practices.

Improving research, extension services, and access to credit, machinery, and technology can mitigate the risks and uncertainties of adopting new CSA and regenerative agriculture (RA) practices. It is expected that smallholder farmers would benefit from adopting CSA and RA practices, which focus on soil restoration, but they will need support and incentives to increase their uptake of such practices. Policy coherence is needed to ensure that research, extension services, and access to finance and to appropriate technology and machinery all converge toward the objective of creating a high-productivity, climate-resilient agriculture and water sector that can also help reduce GHG emissions and ensure natural capital conservation. This would also offer the opportunity to strengthen access to resources for women and smallholder farmers.

Strengthening the enabling environment for the adoption of CSA and RA practices by smallholder farmers as key partners in adaptation and resilience requires a three-pronged approach. First, a knowledge-building agenda needs to be prioritized. The initial focus should be on (i) action-research

52 Kisan/Hari Cards are issued to smallholder farmers. They use the cards to access various agricultural subsidy programs and receive relief payouts.

conducted jointly with farmers; (ii) modernization of extension services, including farmer-to-farmer and e-extension services, and ICT-based access to information. Second, coordination across research projects and adequate dissemination in the public and private sectors needs to be improved to support the uptake of CSA and RA practices. Third, an existing organization should be tasked or, alternatively, an independent research coordination board with a single-point agenda should be established to promote and scale up CSA and RA practices. This organization can set the agenda for research on localized and context-specific issues such as (i) alternatives for field preparation to support the regeneration of soil health and reduce crop-residue burning; (ii) alternate wetting and drying rice management to achieve emission reductions; and (iii) forage seed multiplication or customized livestock-feeding rations.

Participatory multi-stakeholder forums should be strengthened to improve the uptake and promotion of CSA and RA practices. This can include boosting the membership of smallholder and landless farmers in unions and cooperatives and building relations across value chains through producer groups that bring together farmers, service providers, research institutes, and commercial and corporate businesses for information exchange, capacity building, entrepreneurial support, market access, and technology uptake. These platforms can promote contracts and licenses that make CSA and RA practices binding. This approach has already shown impressive results in Pakistan—for example, the Better Cotton Initiative (BCI) has helped 400,000 BCI-licensed farmers (30 percent of cotton farmers) to save 15 percent of irrigation water, reduce pesticide use by 10–15 percent, and cut GHG emissions in half.

The scaling up of climate-smart practices in dairy and pastoral systems, including improving access to markets, can be supported by participatory approaches and institutional collaboration interventions that aim to improve productivity and reduce the sector's GHG emissions intensity. Productivity in smallholder and semi-commercial livestock systems can be increased by (i) strengthening disease control to reduce morbidity and disease outbreaks; (ii) supporting the breeding of more productive and disease-resistant animals; (iii) improving access to adequate nutrition and feed to reduce enteric fermentation emissions, and (iv) strengthening the enabling environment to facilitate the adoption of CSA and RA practices, for example, through participatory approaches. In pastoralist systems, community strengthening, and the development of grazing management plans could support the uptake of CSA and RA practices, and the restoration of communal lands. This needs to be supported by capacity strengthening, planning, and coordination among relevant provincial departments. Finally, improving market access, particularly for small- and medium-size producers, and reducing post-harvest losses, will also be important to reduce emissions from the livestock sector.

Policy Recommendation #3: **Improve and modernize irrigation and drainage to provide climate-resilient, predictable, and flexible services in response to changing demand.**

IBIS infrastructure and operations need to be modernized to make groundwater use sustainable, reduce distributional losses and inequity, facilitate rapid surface water reallocations, respond to largescale shifts in cropping patterns without increasing water withdrawal, and enhance drainage capacity to prevent waterlogging and flood water retention in cultivated areas. The immediate objective should be to make the surface-water system more demand-responsive to allow for better conjunctive management of surface water and ground water. There is a need to ensure alignment with and support for the implementation of the Fourth National Flood Protection Plan for 2015-2025 (NFPP-IV), while considering the operationalization of the recently adopted NCCP 2021, National Water Policy (2018), and National Food Security Policy (2018). This requires investment in three key areas.

First, investments in infrastructure to improve hydraulic control and flow measurement across all tiers of the distribution network, together with the automation of the outlets that supply watercourses and farms, and the construction of water storage both within the distribution system and on-farm. This must be complemented with adequate development and maintenance of drainage infrastructure, especially in low-lying and flood-prone areas of the lower Indus Basin.

Second, improvements in water allocation practices, with a flexible system of surface water withdrawals at barrages to ensure a balance between demand and environmental flow requirements. Other factors to improve allocation practices must include the monitoring of groundwater and the modeling of surface-groundwater interactions to rationalize water allocations between the head and tail reaches of canals, and remote-sensing to measure in-field crop coverage and crop water requirements.

Third, improvements in water measurement, billing, and collection, starting with the digitization and automation of *abiana* collection and moving toward volumetric charging, as monitoring and control over distribution increases through modernization. *Abiana* reform should also include ring-fencing collection responsibility and delegating the control of revenue to the irrigation departments. For groundwater, the ongoing development of a tariff system for home and industrial users (notably in Punjab) needs to extend to agriculture users as well. A transparent and efficient tariff system, coupled with improved service quality, could create space for higher tariffs using a structure that is progressive and equitable and has room for differentiated rates in order to incentivize climate-smart irrigation practices.

The first three sets of policy recommendations primarily address issues in irrigated crop agriculture, even though the natural capital conservation, improved productivity, and increased fiscal space will have impacts beyond just crop production. The final recommendation goes beyond irrigated crops and looks at other important but neglected aspects of the agri-food system.

Policy Recommendation #4: Strengthen ecosystems and landscape restoration.

Ecosystem and landscape restoration is a foundational necessity that needs to be a policy and investment priority. Without it, the natural capital required to sustain an agri-food transformation will not exist. Priority actions include the following:

(i) In partnership with local communities, assess ecosystems and develop a roadmap to restore high-priority ecosystem services, supported by a system of natural capital accounts. To make this actionable, landscape modelling is required, coupled a to a decision support system and accessible, open, and user-friendly land use and land degradation monitoring system.

(ii) Build institutions and capacity, including strengthening community governance of natural resources and reinforcing the planning and technical capacity of public institutions and pastoral and forest communities to design and implement programs to restore ecosystems.

(iii) Strengthen economic incentives for community action to conserve and restore ecosystems: restoration grants, and a livelihoods program based on agro-forestry, silvo-pastoral systems and fisheries-related activities.

(iv) Links to jobs, livelihood and value chain development.

The outputs of these actions will be critical inputs to improving (i) land-use planning, especially at the interface of natural and agro and urban landscapes where there is increasing competition for land and water resources; and (ii) integrated watershed management, which is crucial for water regulation including reducing stormwater runoff and, storage, consequently reducing flooding in downstream areas.

4.2 Building Resilient and Livable Cities

Roughly 37 percent of Pakistan's population resided in urban areas in 2020.[53] Cities are growing fast, at 2.7 percent annually, with 59 percent of the population expected to live in urban areas by 2050. Managed well, the concentration of people and production in urban areas increases productivity and facilitates service provision through economies of scale.[54] But in Pakistan, urbanization has been characterized by urban sprawl, air pollution, poor waste management, low mobility, inadequate housing, and uneven and low access to safe water and sanitation—but most fundamentally, by urban sprawl, which negates the efficiency, serviceability, and productivity potential of urban densification. Karachi ranks as one of the least livable cities globally, with about 50 percent of inhabitants living in slums. Lahore, the country's second-largest city, is among in the world cities with the worst air quality.

Urban areas are increasingly exposed to climate and disaster threats and are major contributors of GHG emissions. Climate change creates threats for urban areas because of the concentration of assets, jobs, and human capital. These threats include pluvial and fluvial floods, rising temperatures, and heatwaves. Cities also account for a large share of CO2e from energy use, transport, industry, and waste. They contribute significantly to air pollution, posing significant health and productivity threats to urban dwellers.

Pakistani cities will need to undergo a transformation to become livable and climate-resilient spaces and fulfil their role as catalysts of inclusive growth. Urban sprawl, the absence of green spaces, and the poor state of basic services accentuate people's vulnerability to shocks if, and when, they occur. Rapid urbanization puts stress on municipal services, which are critical to strengthening the resilience of vulnerable urban communities. Most cities in Pakistan lack the fiscal resources, governance, and institutional capacity to invest in much-needed infrastructure and services. Measures to strengthen climate resilience need to be an integral part of city investment and management. Improving planning, service delivery, and municipal finance is essential to set cities on a resilient, low-carbon, sustainable growth trajectory. The 2022 flood reconstruction and rehabilitation process needs to wholly embrace the approach of "Building Back Better" to reduce the cost and impact of the extreme events expected from future climate change. Key to this will be action to resolve the fundamental structural problems cities face.

4.2.1. Challenges and Opportunities

Implications for Policy and Investments

In both primary and secondary cities, climate action needs to be folded into broader improvements in urban planning and management. Weaknesses in urban planning and management, and in the provision of basic urban services, create vulnerabilities that intensify climate risks and the negative health and productivity effects of those risks. Strengthening urban development and services through a climate lens would be an optimal way to address climate change in the country. In the medium to long term, a national strategy for improving urban resilience and provincial- and city-level adaptation plans needs to be developed.

Primary cities stand out in terms of risk exposure. Lahore has the largest settlement area exposed to fluvial flooding (163 sq. km) and to pluvial flooding (129 sq. km) in Pakistan. Karachi has the second-largest settlement area exposed to pluvial flooding. These vulnerabilities are compounded by low-quality infrastructure.[55] Secondary cites are growing fast, often into terrain exposed to climate risks, and have more pronounced levels of poverty. These cities host an increasing influx of migrants, who tend to settle where land is cheap but also disaster-prone, increasing their exposure to risks and shocks.

---

53 World Bank, "Urban Population (% of total population) – Pakistan" (World Bank website, 2021), https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=PK.

54 Pakistan's ten largest cities contribute more than half of national GDP and generate 95 percent of federal tax revenues.

55 Pakistan ranks 105 out of 140 countries in the quality of its infrastructure (see the WEG Global Competitiveness Index). The index takes into account utility infrastructure such as water and electricity supply, and transport infrastructure such as roads. See World Bank, Leveling the roads. See World Bank, *Leveling the Playing Field: Pakistan Systematic Country Diagnostic* (Washington DC: World Bank Group, 2020), https://doi.org/10.1596/34549.

Densification of secondary cities is a key to managing climate risks and improving livelihoods. Most Pakistani cities are experiencing lower-density expansion on their fringes. The average city has grown spatially at 6.8 percent annually but at just 1.9 percent in population.[56] Low-density expansion hinders the emergence of the "agglomeration economies" necessary to create more productive cities and reach the critical levels of productivity that, among other things, make international exports and integration into global supply chains commercially viable. Low-density expansion leads to the transformation of agricultural land into peri-urban land, increasing carbon generation. It also makes the provision of utilities and other services more costly per person. Furthermore, travel and commuting costs across large, sprawling cities are high in terms of energy costs, time requirements, and emission levels. Increasing the density of the low-density areas of secondary cities, without incurring the health and other costs of excessively dense, unplanned urban areas, is therefore especially important for addressing climate risks.

Climate resilience will require improved land use planning and regulation, which will better guide urban expansion and create efficient, productive, livable cities. In the primary cities, better land use planning and control measures should be introduced to ensure that settlement does not occur in flood-prone areas. Efforts should also be focused on upgrading informal settlements, given that the primary cities have large built-up areas. However, land regulation efforts should prioritize the expanding secondary cities that provide opportunities to apply land use planning tools to enable densification. Low-density growth is in part a result of poorly functioning land markets and burdensome regulations. For example, zoning regulations hinder mixed-use development, making urban property prices unaffordable to most. Land titles are difficult to register and transfer, making it hard to repurpose land. Densification can be supported by reforming and streamlining zoning restrictions, encouraging mixed-use development, promoting high-rises, and formalizing slums. Reducing the costs of property transfers and construction permits will also support more efficient land use.

Further, improved land use planning can help better manage peri-urban areas in the interest of climate mitigation and adaptation. The design of segregated areas, vegetative barriers, and nature reserves can reduce cities' carbon footprints. Registering peri-urban properties makes them part of the formal land management system with land conversion controls, zonation and building codes. This increases resilience to disasters and enables more control over urban expansion and sprawl. Land use regulations need to be developed alongside urban transport planning to reduce congestion, which reduces urbanization-driven economic gains, and to improve impaired mobility. However, improved land use planning relies on integrated, reconciled, and accurate land records and maps. For this, property records need to be digitized and be comprehensive. This will allow better land allocation, risk-informed spatial planning, and strengthened asset management strategies to support resilience. It will be important in these processes to ensure the protection of indigenous communities and those in informal housing settlements and to respect customary land use rights.

NBSs should be prioritized in all urban areas. NBSs support mitigation through carbon sequestration, local climate regulation, and the reduction of air pollution. NBSs can also enable adaptation, cool down UHIs, relieve water scarcity, and lessen flood risk by facilitating thermal regulation, rainwater harvesting, and stormwater management. For instance, bioretention areas and open spaces such as parks can help control stormwater by capturing and retaining runoff; and green roofs and permeable pavements promote rainfall infiltration. NBSs can also be integrated into river flood control systems. Floodplains and bypasses, inland wetlands, stream beds and banks, and upland forests can help regulate flood volumes and river flow.[57]

Urban transport presents a significant opportunity for climate mitigation, which could help reduce air pollution. The transport sector represents about 23 percent of the country's total GHG emissions, 57 percent of which is urban. Passenger transport emissions in Pakistan are currently low compared to global averages, but this is rapidly starting to shift with the increased use of private, single-owner cars and motorcycles in cities. Passenger transport is responsible for nearly 68 percent of transport

56 World Bank, Secondary Cities Analytics (Draft). (Washington DC: World Bank Group, 2021)
57 World Bank, *Nature-Based Solutions for Disaster Risk Management* (Washington DC: World Bank Group, 2018), http://documents1.worldbank.org/curated/en/253401551126252092/pdf/Booklet.pdf.

emissions because less carbon-efficient passenger modes such as private vehicles are displacing more efficient modes like public transport.[58] Total passenger demand, currently estimated at 1,206 motorized billion passenger kilometers, is expected to more than double by 2050, driven by population and economic growth. High passenger demand and more vehicles in the cities will aggravate congestion, air quality, and health risks. The associated CO2 emissions are expected to grow at around 6 percent per year, reaching 69 million MtCO2e by 2030.[59] It is estimated that inefficiencies in the urban transport sector cost Pakistan 4 to 6 percent of its GDP every year.

The establishment of a comprehensive Clean Air Scenario (CAS) for Pakistan[60] would have a substantive impact on ensuring improved health conditions and significantly reducing GHG emissions. A World Bank analysis shows that a reduction in PM2.5 concentrations through the CAS could contribute to reductions in CO2 and in short-lived climate pollutants (SLCPs), such as black carbon (BC) and methane (CH4). These are warming agents and reductions in these would contribute to slowing down rising temperatures. If it followed such a scenario, Pakistan could reduce premature deaths from air pollution by 41–53 precent (95,000 to 122,500 cases a year) up to 2030 compared to the business-as-usual (BAU) scenario and embark on a path toward the complete elimination of mortality and morbidity from air pollution by 2040.[61] With concerted political will to set short-, medium-, and long-term air quality targets, substantive reductions in SLCPs could already be achieved by 2025, particularly in BC. The reduction in BC will largely be achieved through reducing biomass burning in the residential household sector, reducing diesel use in the heavy-duty vehicle fleet, and reducing energy combustion in industry.

Climate-Smart Municipal Services

Improving solid waste management (SWM) could make a significant contribution to both mitigation and adaptation targets. Pakistan generated an estimated 36 million tons of solid waste in 2020, which is projected to increase to 85 million tons by 2050.[62] In 2020, emissions linked to the solid waste sector exceeded 32 million MtCO2e. Modeling for three core urban areas in Pakistan has demonstrated that with even modest improvements in SWM, GHG emissions can be reduced significantly. SWM emissions are projected to increase to 50 million MtCO2e by 2035 under a BAU scenario, but reducing waste dumping by 25 percent would reduce emissions to just 26 million MtCO2e by 2035. If waste dumping were reduced by 50 percent, overall total emissions from SWM would fall to 21 million MtCO2e by 2035. In addition, improving SWM would contribute to climate adaptation by reducing the clogging of drains and thereby flood risk. Modeling shows that clearing stormwater drains in Karachi would reduce annual average damage resulting from flooding by more than 30 percent.[63] Better SWM would also reduce health risks.

However, reorienting Pakistan's SWM sector will require several specific actions in the short, medium, and long term. Actions are needed to strengthen institutions and raise capacities, tighten regulatory frameworks, build critical infrastructure and systems, introduce sustainable technologies, and encourage changes in behavior and attitudes to reduce waste generation. Investing in landfills that have methane gas capture is a first entry point, starting with the largest cities. But a low-carbon scenario that deploys a wide range of technologies to minimize CO2 and methane (CH4) emissions across the value chain may become feasible only when cost recovery and revenues have improved.

58 Buses, which in 2010 served about 70 percent of BPKM, in 2022 carry only about 55 percent of BPKM. By 2035, nearly 90 percent of households in Pakistan are expected to own a motorcycle, which would double the current number of motorcycles to more than 40 million. Additionally, it is expected that, by 2035, 15 percent of all Pakistani households will own a car, increasing the number of cars to 7 million.

59 National Transport Policy of Pakistan, 2018, Planning Commission. https://www.pc.gov.pk/uploads/downloads/policy.pdf Projection based on Pakistan Bureau of Statistics (PBS) forecasts.

60 The goal of the Clean Air Scenario is to achieve the WHO Interim Target I for fine particulate matter PM2.5 and ground-level ozone O3 by 2030, and then work toward achieving WHO's guideline values for PM2.5 and O3 by 2040.

61 A CAS that substantively reduces emissions of both BC and CH4 may also improve the yield of stable crops, even in the heavily air-polluted Indo-Gangetic Plain.

62 Lisa Yao Silpa, Perinaz Bhada-Tata, and Frank Van Woerden, What a Waste 2.0 – *A Global Snapshot of Solid Waste Management to 2050* (Washington, DC: World Bank Group, 2018), and World Bank. "What a waste 2.0: A Global Snapshot of Solid Waste Management to 2050" World Bank website, last accessed September 5, 2022, https://datatopics.worldbank.org/what-a-waste.

63 To identify the impact of solid waste and debris blocking the channels, this assessment was done using a HEC-RAS hydraulic model to calculate a first-order estimate of damage and potential reductions from the clearing of stormwater drains for various return periods. Two scenarios were modeled: a) a baseline scenario estimating inundation and damage, with reduced conveyance capacity of drains; b) an improved scenario reflecting reasonably free-flowing drains without blockages.

Municipal governments in the country do not have enough capacity to address waste management issues. It is therefore essential that the domestic and foreign private sectors be incentivized to become involved. There are several small, local, private companies[64] that are developing and scaling up sustainable models to curtail the waste that goes into landfills and contributes to GHG emissions. In addition, creating concessions for integrated waste management and recycling in larger cities could attract the interest of regional and international companies, with the facilitation of the development finance institution (DFI) community. However, the scalability of private sector solutions is limited by the absence of the requisite regulatory environment, the failure to segregate waste at source, and the lack of information and networks.

Sustainable Revenue Streams for Green and Resilient Urbanization

Facilitating mitigation and adaptation measures in Pakistan's urban areas will require sustainable revenue streams. The costs of mitigation and adaptation will be substantial for all levels of government yet funding mechanisms to systematically allocate financing to cities to combat climate change are very limited. Developing new financing instruments is thus a priority.

Pakistan's local governments have constrained fiscal space and will continue to depend on intergovernmental fiscal transfers in the medium term. Enhancing own source revenues (OSRs) is important for ensuring sustainability. However, OSRs currently amount to only one-third of revenues in Pakistan's provinces, and city governments have limited regulatory space for revenue development. This is insufficient to plan and finance climate-smart infrastructure at a scalable level.[65]

Intergovernmental fiscal transfers are a useful instrument for improving the funding available to cities. They are the most important revenue source for local governments. In all four provinces, federal transfers account for two-thirds of all provincial financial resources. They can be used to target the most vulnerable areas in terms of climate impacts, channeled to a broad range of recipients, and combined with larger funding for individual projects. They can be used as incentive systems for local governments. The overall goal of a performance-based, resilience-focused, grant-financing mechanism that targets adaptation and mitigation interventions would be to increase the climate change response capabilities of cities.

Leveraging property taxes effectively presents another opportunity to expand financing at the local level. Analyses from Sindh and Punjab indicate that, with targeted interventions, the collection of Urban Immoveable Property Taxes (UIPTs) could double and, over time, increase by sixfold.[66] Currently, UIPTs, at 0.13 percent of GDP, are very low compared to other low- and middle-income countries.[67] Increasing UIPTs will require administrative improvements in tax base growth, control of exemptions, improved collection and enforcement, and the willingness to review policies for tax rate setting. However, it would lead to enhanced urban climate action if combined with measures on budget planning and expenditure that ensure that the increased revenue yields are used for climate-oriented investments and actions.[68]

Strengthening cost recovery for urban services would further improve service provision and attract investment. At present, only a fraction of service costs is being recovered. This has impaired the financial viability and investment potential of service providers and made them unattractive to private investors. Low tariffs also foster waste and pollution. Improving cost recovery is a priority because it would free up resources to improve public services, unlock opportunities to attract private funding, and disincentivize excess resource consumption. Higher charges could provide the funding for expenditures on the services for which they are charged, creating some scope for financing climate-relevant investments and services.

64 They include TrashIt, Davaam, Saaf Suthra Sheher, Waste Busters, Green Earth Recycling, and Novatex.
65 Given the country context, local government green bonds and green taxes also have limited potential in the short to medium term.
66 World Bank, Overview of the Urban Immovable Property Tax in Pakistan and Revenue Simulations (Draft). (Washington DC: World Bank Group, 2021).
67 Where UIPT generates 0.3–0.6 percent of GDP on average.
68 Note that UIPT performance can and certainly should be improved in Pakistan. However, given the low base—on aggregate, UIPT constitutes less than 1.5 percent of provincial revenues—and the magnitude of the country's overall fiscal difficulties, it is implausible that improvements in UIPT could have much impact on the country's broader fiscal position even under optimistic assumptions.

Public-Private Partnerships (PPPs) and IFC's subnational financing program could promote investment in climate-smart infrastructure and service delivery. Pakistan's federal and provincial governments have created comprehensive frameworks and regulations for PPP projects. However, such frameworks need to be strengthened by integrating climate costs in project designs and in the form of compensation payments in contracts in the scope of technical studies. These need to make resiliency part of the evaluation criteria for tenders, including climate experts on project approval committees, and foster partnerships with the insurance industry and engineering firms on the use of climate screening and risk forecasting tools. Achieving this will require concentrated policy action by the authorities. PPPs would also make it necessary to have basic funding mechanisms. Further, considering the IFC lends to subnational governments without requiring a sovereign guarantee and given the fiscal constraints at both federal and provincial levels, it is therefore critical to place adequate frameworks at the provincial levels to catalyze private sector financing.

4.2.2 Key Policy and Investment Recommendations

This policy package for building resilient and livable cities consists of four higher-level policy recommendations and several suggested priority actions.

Policy Recommendation #5: Strengthen urban planning and management capabilities.

Basic urban development and management actions are the most critical actions for addressing climate change impacts. The immediate priority is to address weaknesses in urban planning and management and in basic urban service provision that create vulnerabilities and raise the stakes of climate risks. A national urban resilience strategy and provincial- and city-level adaptation plans are needed. In the primary cities, mitigation and adaptation efforts in the medium term will need to involve better landuse planning and control measures. This will, for example, help to discourage human settlement in flood-prone areas. Another area of focus should be the upgrading of informal settlements. In many secondary cities, these efforts will need to include finding ways to enable greater population density, which would help address climate impacts and lower GHG emissions. Better land regulation, land use planning, and tools such as sites and services instruments will be important to guide this expansion and to facilitate the development of a more compact urban form.

NBSs should be prioritized in both the primary and secondary cities. NBSs can support mitigation through carbon sequestration and the reduction of air pollution. They can also enable adaptation, reduce the effects of UHIs, decrease the cooling needs of buildings, and manage flood risk by reducing stormwater runoff. Cities should also scale up the national urban forest initiative headlined in the 2021 NDC.

Policy Recommendation #6: Pursue green urban mobility.

Interventions to decarbonize passenger transport can support the sustainable development agenda—with improved access to jobs and services—and set cities on a low-carbon development trajectory. Transport and land use integration (that is, transit-oriented development) can make cities compact and livable and lessen the need for long-distance trips and motorized travel. Integration can reduce GHG emissions per unit of activity and infrastructure costs and enhance climate resilience by freeing up resources that could be invested more strategically. Studies in large cities such as Chongqing have estimated that an urban land use form organized and designed around the use of private vehicles would not only increase emissions by 60 percent compared to one that is focused on transit-oriented development principles but it would also have a hard-to-reverse, lock-in effects that last for decades.

Interventions in the area of urban mobility should also foster a shift toward carbon-efficient modes such as public, shared, and active transport—for example, walking and bicycling. Although cars carry only 10 percent of passenger trips today, they are responsible for 15 percent of emissions and account for a lion's share of the growth. Substantial investments in public transport, parking management,

complete streets (streets designed and operated to enable safe use and support mobility for all users), bike paths, and mobility-as-a-service (technology platforms that facilitate access to shared transport options) are some key levers. The evidence from an impact evaluation of a Bus Rapid Transit (BRT) intervention in Lahore, Karachi, and Peshawar shows that the introduction of the BRT corridor reduced the travel time and costs of commuters and caused a substantial modal shift from private to public transport (40 percent in Lahore).

The priority is to keep cities from becoming locked into planning decisions that reinforce the need for private mobility because this has costly, long-term, lock-in effects that are not easy to reverse. This can be achieved by substantially scaling up mass-transit systems and enabling compact city development. Over the 2022–2027 period, the most important steps would be to invest in urban public transport systems and improve rail infrastructure and operations. Investing in the project currently under consideration to construct 570 kilometers of BRT lines across the country by 2030 could deliver emission reductions of about 8 million MtCO2e in the next 10 years if it is complemented with appropriate urban mobility policies. This would also put Pakistan on a path to reduce annual emissions by about 62 million MtCO2e by 2050.

Favorable policies, incentives and instruments that link national targets with provincial, local, and private sector investments could accelerate the transition to low-carbon transport modes such as EVs. Pakistan's 2019 National EV Policy has set ambitious sales targets. Yet EVs are still a nascent transport mode in Pakistan, with only about 2,000 fully electric cars and a few e-buses in Karachi and Punjab. The limited penetration means a small impact on emissions—less than a 1 percent reduction by 2030. It will be at least 15–20 years before e-mobility can make a significant impact. By 2050, however, EVs could yield about 57 percent of the emissions reduction (relative to a BAU baseline) in the passenger sector. Given the influence of government in public transport, e-buses represent low-hanging fruit for the e-mobility transition agenda.

Policy Recommendation #7: Promote climate-smart municipal services and circularity.

Better waste management would reduce GHG emissions and flood risk. In the primary cities, the recommended starting point is investing in landfills with gas capture to replace the current open dumps. Given the primary cities' large carbon footprint, greener modes of transport and climate-smart service delivery could contribute to mitigation and improve health and well-being. Further, the expansion of climate-smart service delivery will require more private financing. For that, developing legal frameworks is necessary for enabling private investment in resilient urban infrastructure, and better regulation is necessary for outsourcing.

Policy Recommendation #8: Create sustainable revenue streams for green and resilient urbanization.

Climate action in urban areas will require improved revenue streams. There is some scope to improve tax yield and cost recovery at the local level. It could create space for public investments in climate-smart services, improve the financial sustainability of services, and create opportunities for crowding in private investments. However, in the medium term, local governments will continue to depend on intergovernmental fiscal transfers. One innovation could be to develop an urban, performance-based, climate-resilience-focused grant-financing mechanism.

Another avenue would be for local governments to borrow directly, for which secondary legislation would need to be developed to enable direct subnational borrowing from commercial lenders. There is considerable opportunity for the domestic and foreign private sectors to invest in urban infrastructure and services, green buildings, transportation, water and sanitation, waste management, and renewable energy. Structured and transparent procurement models under bankable concessions will help catalyze private investment. Finally, concentrated policy action is also required to close the numerous gaps at the PPP framework level and in existing standardized contracts in order to address climate issues.

4.3 Accelerating a Just Transition to Sustainable Energy and Transport

Energy is a critical enabler of economic development and poverty reduction in Pakistan. However, the energy sector is not adequately fulfilling this role as a result of persistent fiscal, reliability, and security challenges. It is estimated that power shortages result in lost economic output of more than US$8 billion a year.[69] Additionally, the country imports around 43 percent of its total energy supply, requiring around US$13 billion of foreign currency per year, which is likely to increase over time based on current trends. There is significant use of imported coal, especially in industry, and the country suffers from relatively high energy intensity of GDP. Furthermore, Pakistan's transport sector is on an unsustainable expansion path and there are major gaps in the provision of universal access to modern energy. Energy sector emissions are the largest contributor to GHG emissions and air pollution in Pakistan. However, there is enormous potential for transitioning to more secure, environmentally sustainable, lower-cost sources of energy that take advantage of Pakistan's hydropower, solar and wind resources, especially if combined with an improvement in supply- and demand-side efficiency, efforts to decarbonize industry and transport, and sustained structural and fiscal reforms.

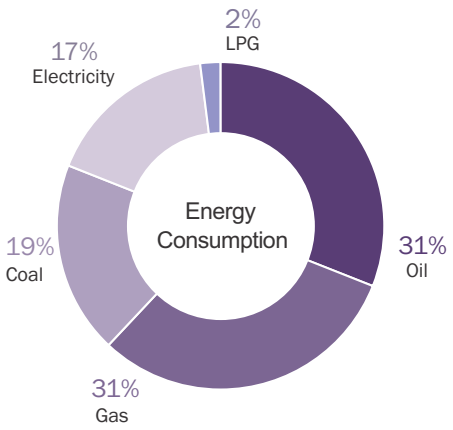
4.3.1 Challenges and Opportunities

Pakistan's energy sector suffers from multiple challenges in achieving the Sustainable Development Goal of affordable, reliable, sustainable, and modern energy for all (SDG7). Five key challenges are: (i) heavy dependence on fossil fuels, which comprise 86 percent of the primary commercial energy supply[70] and expose Pakistan to high prices, energy insecurity (including price shocks and supply disruptions), and air pollution and GHG emissions; (ii) growing financial deficits due to energy prices that do not reflect costs, misaligned subsidies, and the poor performance and inefficiencies of the electricity and gas distribution companies,[71] which place a heavy fiscal burden on the government and disincentivize private investment in the sector; (iii) electricity and gas supply interruptions that stem from electricity transmission bottlenecks, aging equipment, and managed load-shedding of electricity and gas for commercial reasons,[72] leading to additional costs to households and firms in lost productivity and heat stress, and increasing the potential for widespread “grid defection”; [73] (iv) relatively high energy intensity of GDP, with low rates of improvement, which places additional cost burdens on households and businesses and further exacerbates energy insecurity; and (v) persistent gaps in the provision of universal energy access, with significant rural-urban and regional disparities

69 Fan Zhang, In the Dark: How Much Do Power Sector Distortions Cost South Asia? South Asia Development Forum (Washington, DC: World Bank Group, 2019), https://openknowledge.worldbank.org/handle/10986/30923.
70 This excludes highly uncertain estimates of the use of traditional biomass and waste.
71 The issues include theft, losses (including methane leakage from the gas network), inaccurate consumer billing, and incomplete collections and arrears.
72 Some consumers systematically do not pay their bills, and the distribution companies respond to this by providing limited supply to those consumer groups to try and stem their losses.
73 Some consumers find it cheaper and more efficient to generate their own electricity. The loss of such profitable, paying consumers can create a spiraling problem for the DISCOs because the less revenue they are able to collect, the less electricity they are able to supply, and the more erratic the electricity service becomes, which compels more customers to leave the grid, which further diminishes the revenue of the DISCOs.

Heavy reliance on fossil fuels, combined with the expected growth in demand, threatens to exacerbate many of the current challenges of the energy sector. Although considerable focus is given to the electricity sector, only 17 percent of Pakistan's energy consumption is in the form of electricity, with the balance coming primarily from the direct consumption of coal, gas, and oil in the domestic, industrial and transport sectors (see Figure 4.1). Total energy supply is likely to increase from 84 million tons of oil equivalent (MTOE)[74] in 2019 to 115 MTOE in 2025, at an annual growth rate of 5.8 percent under a BAU scenario, much of which will come from fossil fuels under the current policies

Figure 4.1: Final Energy Consumption 2019–20



Structural issues, poor planning, and substantial subsidies have resulted in huge inefficiencies across the energy sector that affect the reliability of electricity and gas supply and generate huge fiscal deficits referred to as "circular debt".[75] Pakistan has the highest subsidies on energy products in South Asia. Energy subsidies in 2020 accounted for 2.6 percent of the country's GDP, two-thirds of which were for electricity consumption, with the remainder for natural gas.[76] The notified tariff continues to be below cost-recovery level and 62 percent of residential and all agriculture consumers are subsidized. While the progressivity of the subsidy to residential consumers has improved with the recent tariff notification in July 2022, the subsidy to electric tubewells continues to be regressive. As a result of the absence of cost-reflective tariffs, combined with operational and technical inefficiencies within the state-owned electricity and gas distribution companies, revenue collection does not fully cover the cost of energy supply, which leads to deficits.

The circular debt has continued to accumulate, especially in the last few years, and as of the end of June 2022, stood at roughly US$11.3 billion in the electricity sector and US$7.5 billion in the gas sector, creating barriers to future investment.[77] The situation has been exacerbated by the recent addition of large coal and imported gas power plants with "take-or-pay" contracts that have increased capacity payments by 50 percent and increased the country's exposure to international fossil fuel price volatility—as witnessed over 2022. The inefficiencies in the electricity and gas distribution companies, include outdated metering practices, low collection rates, high technical losses, rampant theft, and gas leakages as a result of old and poorly maintained pipelines and sabotage.[78]The impact of persistent circular debt is a lack of investment in the gas and power distribution networks, the inability of both sectors to operate at full capacity due to fuel shortages, and the likely difficulty of attracting investors to support future power sector requirements.

Resolving the energy sector's debt requires the government to maintain its commitment to a comprehensive reform and accelerate a transition away from fossil fuels. For the power sector, this requires reducing the cost of generation while at the same time reducing overdependence on imported fossil fuels, bringing end-consumer tariffs closer to the cost recovery level, and improving supply-side efficiency and collections. The government has recognized this and initiated a comprehensive power sector reform package, supported through the World Bank's Program for

74 Million tons of oil equivalent.
75 The reference to circularity captures the fact that the arrears keep getting passed from one energy sector entity to the next. In the power sector the deficits cascade from the distribution sector to the central power purchaser, and then to the power producers and fuel suppliers.
76 IMF, Fossil Fuel Subsidies Database (Washington, DC: International Monetary Fund, 2022), https://www.imf.org/en/Topics/climate-change/energy-subsidies. Note that this figure includes only "explicit subsidies." The IMF also provides an estimate for "implicit subsidies" that takes account of the underpricing of externalities. Total energy subsidies, including both explicit and implicit, are estimated at 11.9 percent for 2020. For further details about the IMF's research, see Ian Parry, Simon Black, and Nate Vernon, *Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies* (Washington, DC: International Monetary Fund, 2021), https://www.imf.org/en/Publications/WP/Issues/2021/09/23/Still-Not-Getting-Energy-Prices-Right-A-Global-and-Country-Update-of-Fossil-Fuel-Subsidies-466004.
77 At the end of FY2022, Pakistan's total circular debt was PKR 2,253 billion in the electricity sector and PKR 1,500 billion in the gas sector. The exchange rate: 1 US$ = 200 PKR.
78 In the gas sector these issues are often collectively referred to as "unaccounted-for gas." Although the portion due to leakages is hard to estimate, this is a further source of avoidable GHG emissions in the country.

Affordable and Clean Energy (PACE). For the first time, the reform program covers all aspects of the sector, focusing strongly on reducing current and future power costs, reducing reliance on imported fossil fuel, scaling up RE, addressing inefficiencies within the electricity distribution companies (DISCOs), and lowering subsidies in the sector by better targeting them to those most in need. Similar reforms—including increases in residential tariffs—are required in the gas sector.

Pakistan has huge solar and power potential but so far this has been largely neglected due to vested interests and misplaced concerns about "surplus capacity". These concerns, frequently voiced over the last few years, do not take account of system operation and commercial realities. Of the 43 GW of installed capacity, 40.5 GW is classed as "dependable", and yet the "peak capability"[79] of the National Transmission and Dispatch Company (NTDC) system is just under 28 GW, against a peak summertime demand of over 30 GW.[80] This, along with the inability and unwillingness of the government to operate all the available capacity due to high fuel prices, combined with the commercial losses involved in supplying non-paying consumer segments, is the reason for the widespread scheduled power cuts during 2022. As a result, the power system has a supply deficit, exacerbated by the currently high prices for imported fuels, requiring the urgent development of additional RE capacity. According to a World Bank study, utilizing just 0.071 percent of the country's available area for solar photovoltaics (PVs) would meet Pakistan's current total electricity demand.[81] The wind resource is also considerable, especially in Balochistan and Sindh. The 2019 ARE Policy[82] outlined a target to achieve 20 percent of power capacity from non-hydro RE sources by 2025, and 30 percent by 2030. The Indicative Generation Capacity Expansion Plan 2021–2030[83] (IGCEP), approved in September 2021, includes hydropower in a broader definition of RE, with a target to reach 60 percent of electricity generation by 2030. This would require a significant build-out of 13.6 GW of additional solar and wind capacity based on current projections, but this has yet to begin. Critical to achieving the objectives of the 2019 ARE Policy and the 2021 National Electricity Policy (NEP)[84] are the introduction of competitive bidding for new power generation projects and ending the old practice of direct contracting and cost-plus tariffs that have led to high power costs and an over-reliance on fossil fuels. However, despite assurances that the first rounds of competitive bidding are imminent, there has been no action since the procedure was formalized by the National Electric Power Regulatory Authority (NEPRA) in 2017.[85] Instead, a number of new fossil-fuel plants have been commissioned under a cost-plus tariff regime during this period. As a result, Pakistan has become more exposed to rising fossil-fuel prices and has not been able to capitalize on the low prices for solar and wind energy seen in other countries such as India, South Africa, and Uzbekistan.

The energy intensity of GDP is relatively high in Pakistan compared to other countries in the region, and there is substantial potential for improvement in demand-side efficiency. Pakistan's energy intensity—the amount of energy needed to produce US$1 of GDP and a measure of energy efficiency—was 4.6 megajoules (million joules, MJ) per dollar in 2018, compared to 4.4 MJ/$ in India, 2.6 MJ/$ in Türkiye, 2.5 MJ/$ in Bangladesh, and just 1.8 MJ/$ in Sri Lanka. Moreover, the rate of energy efficiency improvement was only 1.2 percent over 2000–2018 (declining in more recent years), which is well short of the SDG7 global target of 2.6 percent.

79 The total "dependable capacity" consists of all the available capacity on the NTDC network assuming that all plants are generating at full output, with no fuel or hydrological constraints, but taking account of plant deratings due to age and inefficiencies. In practice this is virtually impossible to achieve, even if the current fuel cost and CD issues were addressed, due to the seasonal and daily availability schedules for large hydropower, scheduled and unscheduled maintenance, fuel shortages at individual plants, and the variability of solar and wind. "Peak capability" takes account of these constraints, and will vary throughout the year.

80 NEPRA. 2022. *State of Industry Report 2022*. Available at: https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf

81 World Bank, "Solar Photovoltaic Power Potential by Country," World Bank Understanding Poverty website, July 23, 2020, https://www.worldbank.org/en/topic/energy/publication/solar-photovoltaic-power-potential-by-country.

82 Mohammed Bilal Khan, "Alternative Energy Policy 2019 at a Glance," *The Nation* (March 18, 2020), https://nation.com.pk/2020/03/18/alternative-energy-policy-2019-at-a-glance.

83 Syed Safeer Hussain, "Submission of Revised Indicative Generation Capacity Expansion Plan (IGCEP) 2021–30)," National Electric Power Regulatory Authority (NEPRA), Managing Director's Letter to National Transmission & Despatch Co. Ltd (NTDC), September 24, 2021, Republic of Pakistan, https://nepra.org.pk/licensing/Licences/LAT-01%20IGCEP%2024-09-2021%2037702-29.pdf.

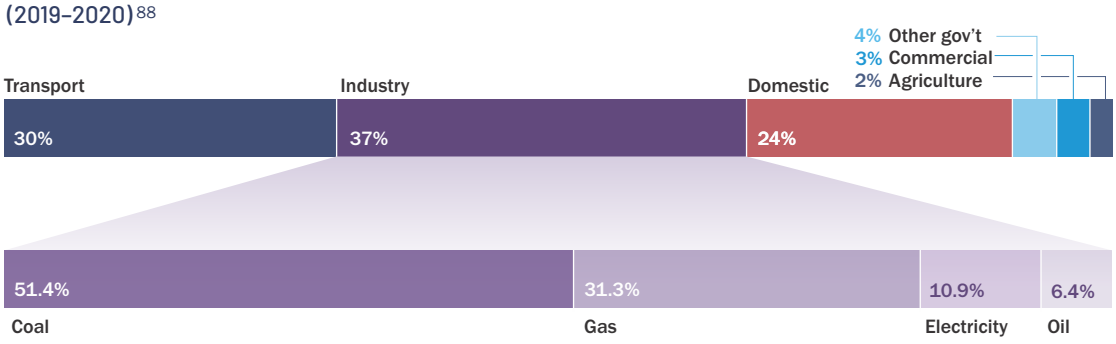
84 Government of Pakistan, Ministry of Energy, *National Electricity Policy 2021* (Government of Pakistan, 2021), http://www.mowp.gov.pk/userfiles1/file/National%20Electricity%20Policy%202021.pdf.

85 NEPRA, "Notification (S.R.O 306(1)/2017 dated 02-05-2017) Regarding NEPRA Competitive Bidding Tariff (Approval Procedure) Regulations, 2017," memorandum from the director of NEPRA (Government of Pakistan, 2017), https://nepra.org.pk/Legislation/3Reg/3.7%20NEPRA%20Competitive%20Bidding%20Tariff%20(Approval%20Procedure)%20Regulations,%202008/NCBT-01%2003-05-2017%206072.pdf.

High energy intensity, combined with rapidly growing energy consumption, adversely affects energy security by further adding to the country's dependence on imported fuel for meeting its energy needs, and by increasing peak demand requirements in the electricity and gas sectors. For example, a large and growing source of electricity demand, especially during summer peak periods, is cooling. Increased usage of air conditioning, combined with poor levels of building energy efficiency and rising temperatures, will place huge pressures on the electricity network and could increase annual cooling related GHG emissions from 23 million MtCO2e in 2020 to over 50 million MtCO2e by 2030.[86] Furthermore, there are over 175 million electric fans in Pakistan, most of which are inefficient models that consume over twice as much electricity as highly efficient fans with direct current (DC) motors that can be manufactured domestically.[87]

Reducing industry's use of coal would have significant benefits for Pakistan's balance of payments and GHG emissions. The industrial sector has the highest share of energy use. Combined with its heavy reliance on coal, the sector makes a disproportionate contribution to air pollution and GHG emissions. In 2020, industry represented 37 percent of total energy consumption and 73 percent of coal consumption (mostly imported). Electricity generation represents a smaller share of total coal consumption, albeit one that has grown rapidly in recent years due to a number of new coal-fired power plants. Industrial coal consumption is dominated by the brick kiln and cement industries, leading to both energy use and process emissions, with air pollution impacts. These industries are economically significant contributors to GDP and employment and have important linkages to other sectors. But since much of the coal consumption in the industrial sector uses imported coal, there would be wider economic benefits to implementing efficiency and decarbonization measures, in addition to the significant environmental benefits.

Figure 4.2: Energy Consumption by Sector (above) and by Fuel Type in the Industrial Sector (below) (2019–2020)[88]



Transport sector emissions are rapidly increasing because of the increased use of private transport modes in cities and the expansion of freight traffic. Freight represents around 32 percent of transport emissions but is expected to grow rapidly. In 2020 the sector handled an estimated 188 billion-ton kilometers (BTKM) of inland freight. By 2050, demand for logistics services could grow to 5–6 times its 2022 level. Roads, the backbone of Pakistan's transport sector, currently carry 94 percent of freight traffic. Rail has only a 5 percent share, down from over 86 percent in the 1950s, and 23 percent in 1997.[89] With long transport distances and the country's significant demand for bulk commodities and containers well suited to the mode, rail service could offer a viable alternative to road traffic. Not only would this decrease transport emissions but it would also increase the nation's competitiveness by lowering transport costs, cutting road maintenance costs, and reducing the incidence of road accidents.

86 Green Cooling Initiative Country Data, last accessed September 5, 2022, https://www.green-cooling-initiative.org.
87 World Bank. 2022. *Supporting the Manufacture in Pakistan of High-Quality DC Fans.* https://openknowledge.worldbank.org/handle/10986/38109
88 Energy Yearbook 2020.
89 R.E. Looney, "The Growth and Decline of Pakistan's Rail System," *International Journal of Transport Economics 25, no. 3* (October 1998): 353–378, https://www.jstor.org/stable/42747994.

While the majority of Pakistanis have some access to electricity, universal access to modern and reliable energy is a long way from being achieved due to persistent issues with supply and disparities between population groups. Based on household survey data recently commissioned by the World Bank,[90] over 97 percent of households have access to electricity, out of which 89 percent have access to the grid, 8 percent are using off-grid solutions and only 2.4 percent have no access to electricity. However, electricity access in Sindh is just under 93 percent, and 68 percent of the population nationwide receive electricity for 16 hours or less per day, with this figure rising to 76 percent in rural areas. Almost 17 percent of households experience poor quality power availability, including unstable voltage issues. Access to modern energy for cooking is considerably lower, as nationwide only 39 percent have access to a piped gas network, 11 percent of households use liquid petroleum gas (LPG) while the rest use wood, charcoal or crop residue. In rural areas 24 percent of households cook over an open fire, which generates indoor air pollution and results in health issues. Analysis by the World Bank shows that a combination of grid extension, mini-grids, and off-grid solar would be required to achieve Pakistan's target of universal electricity access by 2030.[91] However, the private sector would need to lead the deployment of mini-grids and off-grid solar to ensure long-term sustainability. For households with grid access, power availability and quality need to be improved, which links back to the underlying issue of inefficiencies and poor performance within the DISCOs.

4.3.2 Key Policy and Investment Recommendations

This policy package for accelerating a just transition to sustainable energy and transport consists of five higher-level policy recommendations and several suggested priority actions.

Policy Recommendation #9: Transition away from fossil fuels.

Pakistan urgently needs to accelerate the commissioning of RE capacity in the power sector to reduce the overall cost of generation and improve energy security. In the near term, considering the country's generous endowment of hydropower, solar and wind resources, the power sector is a natural candidate for displacing fossil fuels. The latest approved version of the IGCEP (2021-2030), which is supported by the World Bank's own analysis, shows that RE is now the least-cost generation option, even before consideration of the associated energy security and environmental externalities.[92] It calls for the addition of 17 GW of solar and wind capacity, plus 22 GW of hydropower capacity, by 2030. The transition to RE needs to begin immediately because it is technically and financially viable in all respects, especially with recent advances in batteries and other forms of storage, and demand response,[93] Aside from already committed plants, the IGCEP does not plan for any additional fossil fuel capacity. The government should explicitly rule out such projects in the future, building on the existing moratorium on imported coal projects and reflecting the underlying analysis and conclusions of the IGCEP. There may also be justification for early retirement of existing fossil fuel capacity, especially older plants operating at low efficiency, and this may be a good candidate for climate finance support.

There are three intermediate steps that are critical to accelerating this transition: (i) the immediate initiation of competitive bidding, starting with 2 GW by the middle of 2023 followed by annual rounds of procurement to meet the IGCEP targets;[94] (ii) the acceleration of plans for additional solar and wind capacity at identified sites near to existing thermal plants and substations, and through parallel development of strategically located RE parks,[95] and (iii) yearly updating of the IGCEP to quickly

90 The data and analysis are being finalized for publication.
91 This finding is based on a separate study that is being finalized for publication.
92 World Bank, Variable Renewable Energy Integration and Planning Study (Washington, DC: World Bank Group, 2020), https://openknowledge.worldbank.org/handle/10986/34586.
93 According to the hourly modeling carried out under the above study (using the same model now used to develop the IGCEP), reaching 30 percent of installed power sector capacity from solar and wind does not require any dedicated storage, so long as hydropower and other sources of generation can be operated more flexibly, and with much-needed investments in forecasting and communications. Going beyond 30 percent, however, would likely require additional storage, at which point Pakistan could take advantage of global innovations and cost reductions.
94 World Bank, Variable Renewable Energy Competitive Bidding Study (Washington, DC: World Bank Group, 2022), https://openknowledge.worldbank.org/handle/10986/37405.
95 World Bank, Variable Renewable Energy Locational Study (Washington, DC: World Bank Group, 2021), https://openknowledge.worldbank.org/handle/10986/35113.

respond to demand growth as a result of increased electrification and delays in other projects (see Policy Recommendation #11). Investment in new RE capacity should be led by the private sector, especially through FDI, under a competitive bidding regime, with public financing targeted toward larger, "strategic", hydropower projects and shared infrastructure for RE parks.[96] Pakistan should also explore opportunities outside the power sector for production of alternative fuels such as biomethane and green hydrogen.

Policy Recommendation #10: Improve supply-side efficiency.

Pakistan must see through politically difficult supply-side efficiency improvements, including tariff and subsidy reforms, the introduction of private sector participation in the DISCO sector, and the start of a competitive wholesale power market. These actions are critical to reducing the country's circular debt, improving service levels, and introducing market discipline in planning and in sector operations. Key to this will be ensuring that tariffs accurately reflect the true costs of supply, directing electricity and gas subsidies to the poorest consumers, and improving the operational efficiency of the DISCOs and gas supply companies. Improving operational efficiency should include efforts to introduce private sector participation in the management of the DISCOs and a renewed push to modernize metering, billing and the energy sector's transmission and distribution infrastructure.

The introduction of a competitive wholesale power market would help to reduce the possibilities for suboptimal planning and dispatch decisions by making the relative economics of different generators more explicit. This would favor lower-cost power generation which, as noted, implies non-fossil fuel generation. Large investments to improve the responsiveness and stability of the electricity transmission network will also be needed to cope with the expansion of RE and with potential climate change impacts. Alongside agencies such as the NTDC, the domestic and foreign private sectors could play an important role in this, by investing in new transmission lines and capitalizing on third-party access and wheeling arrangements (such as the use of a DISCO's distribution system to transport electrical power) under competitive wholesale market conditions.

Policy Recommendation #11: Place greater emphasis on enhancing demand-side efficiency.

Considering the high energy intensity of Pakistan's economy and the low rate of improvement over the past couple of decades, the government should embark on an urgent, wide-ranging demand-side efficiency program, aiming at immediate cost savings for consumers. Energy efficiency and conservation (EE&C) has been neglected in Pakistan for many decades, with serious consequences. Yet this could be reversed if an ambitious, comprehensive EE&C policy[97] were implemented through a well-resourced, professionally staffed National Energy Efficiency & Conservation Authority (NEECA), supported by provincial agencies where they exist. To achieve this, it is important to target a few quick wins, such as setting minimum performance standards for mass-market appliances and improving the energy efficiency of existing and new buildings in the commercial and residential sectors.[98] Considering the country's dwindling natural gas reserves, its increasing reliance on imported liquefied natural gas (LNG), and the heavy use of gas in the commercial and residential sectors, Pakistan needs to consider opportunities for shifting to electricity where economically and technically feasible, such as for space and water heating. Finally, there is huge potential for launching replacement or exchange programs for inefficient end-use appliances, such as incandescent lightbulbs and fans. Building on models developed in other countries, Pakistan should explore opportunities for developing the energy service companies (ESCOs) market to mobilize private sector investment. There may also be a need to establish publicly owned but commercially operated super-

96 Given the land intensive nature of solar and wind and the inevitable displacement caused by hydroelectric projects it will be essential to pursue a systematic, reliable, locally informed policy to ensure adequate protection of local land rights, appropriate compensation, resettlement, and rehabilitation, and strict rationalization and checks on the quantum and type of land acquired for public projects.

97 A draft Energy Efficiency & Conservation Policy has been prepared by NEECA but has not yet been approved.

98 The payback period of replacing an incandescent light bulb with an LED is only one month while that of a compact fluorescent light (CFL) bulb is seven months. Replacing the existing stock of inefficient lighting with LEDs alone could save Pakistan 5,500 gigawatt-hours (GWh) annually.

ESCOs to design targeted, self-financing programs through a shared savings model, or by tapping carbon finance.

Policy Recommendation #12: Decarbonize the industrial and transport sectors.

Given that the industrial sector is the largest consumer of fossil fuels, with only partial scope for electrification or fuel switching, the government needs to give specific attention to this sector and incentivize decarbonization and efficiency improvements through regulations, fiscal incentives, and improved access to financing. This will require a number of decisive actions: (i) incentivizing the uptake of carbon-efficient, energy-efficient, and water-efficient technologies and production processes, with the short-term priority being the replacement of old, inefficient motors and boilers; (ii) promoting electrification and fuel efficiency improvements, including through waste heat recovery and through fuel switching to sustainable sources such as bioenergy and green hydrogen; (iii) piloting and adopting innovative technologies for undertaking hard-to-abate industrial processes such as cement production that are unlikely to be replaced any time soon; and (iv) improving water usage and wastewater treatment. Pakistan should aim for the early adoption of decarbonization solutions that are already cost-effective and should seek concessional climate financing to pilot technologies and processes where there is a cost premium, relying on private sector investment for mass adoption of technologies once costs fall. ESCOs could play an important role by implementing energy efficiency and decarbonization measures and receiving regular payments in return, based on the achieved energy savings.

There is a need to more widely adopt programs such as the Partnership for Cleaner Textiles, which is being implemented in partnership with IFC. The rationale behind this is to, support global brands and their local suppliers to achieve (i) long-term competitiveness and (ii) their corporate sustainability targets by identifying and employing cleaner production techniques. Close, continuous collaboration between government and industry is essential for this. Experience from other countries suggests that buy-in is critical and that the likelihood of adopting energy efficiency policy is enhanced if industries and their associations are involved from the beginning in articulating efficiency plans and in investment financing negotiations and arrangements. The adoption of circular-economy practices—for example, under the Collect and Recycle program (CORE), especially on the waste-sorting/waste-recycling side[99] —would also heavily depend on such collaboration and needs to be sustained through continuous stakeholder engagement.

Decarbonizing transport in Pakistan and ensuring that it supports broader development objectives will require massive investment in mass-transit systems and rail, in addition to green urban mobility. An important opportunity in the freight segment, both in terms of development and decarbonization, would be the revival and transformation of Pakistan Railway (PR). PR currently carries only 5 percent of freight, and the 11 BTKM it carries is lower than the 1960s peak of 14.2 BTKM. The recent PR Revival Plan sets an extremely ambitious target of increasing rail's freight share to 15 percent by 2025 and 20 percent by 2030, which would mean carrying 39 BTKM by 2025 and 69 BTKM by 2030. A more realistically attainable scenario would be for rail to aim at a 20 percent share by 2050 (that is, a carrying capacity of 195 BTKM), which could reduce freight emissions by 10 percent —amounting to about 6.2 Mt CO2e a year. Doing so would require not just investment but the transformation of a system that is currently institutionally run into a competitive, customer-focused service fully integrated with, and embedded in, a larger multimodal network.

Most investment needs could be met by a planned US$8 billion initiative to upgrade the main North-South Rail Line (ML-1) through China–Pakistan Economic Corridor (CPEC) financing. Complementary targeted investments will be needed to improve rail connectivity with and within the ports. The most important of these is the 50-km-long Karachi Port to Pipri Corridor, which is already under planning. These investments will need to be accompanied by reforms that create the appropriate enabling environment. The first step would be to operationalize concessions awarded in 2013 to operate freight

99 In Pakistan, an alliance between the country's leading industry players and global brands has been formed, called CORE (Collect and Recycle) to help increase waste collection rates.

trains on PR tracks. The next step would be to separate the policy and commercial roles between the Ministry of Railways and PR, and to complete the setting up of a commercially oriented ecosystem by implementing existing plans to (i) create an independent and autonomous Railway Safety and Regulatory Authority, (ii) strengthen the newly formed Railways Freight Business Company, and (iii) enhance PR's capacity to prepare, procure, evaluate and manage PPP transactions, including updating the underlying framework, such as the Track Access Policy.

Trucking will continue to be the primary mode of freight transportation. For the trucking industry to absorb and benefit from new technologies—including e-logistics platforms can to optimize vehicle utilization—a bankable formal industry is a necessity. E-logistics platforms operating in Pakistan have shown promise. For freight, they could mitigate GHG emissions through the efficient utilization of vehicles and reduce food losses (caused by inadequate logistics) and their related landfill emissions. Second, for passengers and small businesses, the e-logistic platforms could improve mobility by complementing the public transport system, and also reduce fuel consumption through vehicle pooling services. Governance and regulatory shifts that reward formal tax-paying, rule-compliant actors will help such a transition.

Policy Recommendation #13: Ensure "just" transitions.

To achieve an equitable and sustainable transition of Pakistan's energy sector, the government will need to do three things: (i) have a clear understanding of those who might stand to lose politically and financially, and avoid disproportionately favoring some interest groups over others, (ii) protect the poor and vulnerable through targeted retraining and financial support; and (iii) achieve universal access to modern energy by 2030. Although there are compelling reasons for the federal and provincial governments to embrace the energy transition, the pace of change could be slowed by resistance from vested interests among fossil-fuel importers and producers, and from those who may lose their livelihoods as a result of new investment patterns, sectoral changes, demand shifts, facility closures, or supply-side efficiency measures.

This means that the efforts to promote accelerated decarbonization in Pakistan will need to carefully consider the potential winners and losers and devise strategies to overcome political resistance and ensure that livelihoods are protected through retraining, fiscal transfers, and other measures. For example, introducing private participation in the DISCOs will require a parallel strategy to address the concerns of employees whose jobs may be threatened as a result of a shift to automated or pre-paid metering and other efficiency measures introduced by new management.

Separately, it will be essential for Pakistan to address the identified gaps in access to energy, with a particular focus on rural households and on the promotion of clean cooking solutions. Delivering universal electrification and access to clean cooking and heating by 2030 (SDG7 goal) is critical, with delivery likely to fall to the provincial governments. The total investment required to achieve universal access to electricity by 2030 is estimated at US$13.75 billion, out of which US$5.92 billion will be required just for Sindh and Balochistan. In Balochistan, the least-cost electrification options for at least 50 percent of the unelectrified population are solar-based mini-grids and stand-alone solar home systems. In addition to closing the remaining gaps in achieving universal electrification and improving the availability and quality of supply, Pakistan needs to give greater focus to clean cooking and heating solutions in rural areas, especially where there is unsustainable use of traditional biomass resources.

5.

THE MACRO-FISCAL AND DISTRIBUTIONAL IMPACTS OF CLIMATE AND DEVELOPMENT POLICY ACTIONS

5. THE MACRO-FISCAL AND DISTRIBUTIONAL IMPACTS OF CLIMATE AND DEVELOPMENT POLICY ACTIONS

This chapter evaluates the macro-fiscal, financial, and distributional implications of key policy actions to build climate resilience, accelerate inclusive and sustainable development, and pivot the economy into a low-carbon pathway. Three policy packages are analyzed with the support of macro-economic models: (i) needed shifts in the country's energy mix to alleviate chronic fiscal stress from overreliance on imported fossil fuels, to ensure equitable development, and to reduce levels of air pollution; (ii) carbon taxes with revenue recycling and feebates to hard-to-decarbonize sectors in order to improve the tax base and incentivize a shift away from fossil-fuel-based development; and (iii) actions to improve human capital for greater resilience in the face of climate-change-related risks and higher labor productivity and rising incomes. Also discussed in this chapter are needed investments in adaptive social protection systems and the adoption of additional green instruments.

The economy-wide, macro-fiscal and distributional implications of some of the recommended policy actions discussed in Chapter 4 are not directly addressed in the modeling performed in this chapter because of the limitations of the models and the unavailability of inputs data for some sectors, including agriculture, livestock, and land use. Both limitations can be addressed and are envisioned as key follow-up actions to the report. These include, in particular, the transformation of the agri-food system, the management of the irrigation system, and the restoration of degraded ecosystems. The successful implementation of policies such as carbon taxation could help free up significant resources for urgent investments in these sectors.

The macro models employed in this chapter are the same as those used in Chapter 2 and described in Annex 2. The results that are presented focus on the E3ME model because this model better captures the medium-run, cross-sectoral interactions, and transmission mechanisms at play. All policy simulations assume a baseline that models a BAU macro scenario in which the economy grows at approximately 4 percent per year out to 2050.

5.1 Policy Packages

5.1.1 Policy Package 1: The Government's IGCEP 2021–2030

Policy Package 1 outlines two policy scenarios. The first is based on the implementation of the IGCEP (2021–2030), which will substantially increase the share of RE in the electricity generation mix by 2030. The second scenario proposes a substantial increase in electrification so that electricity as a percentage of final energy consumption reaches 28 percent by 2030 from 20 percent in 2020,[100] while retaining the same percentage contribution of RE as assumed under the first scenario.

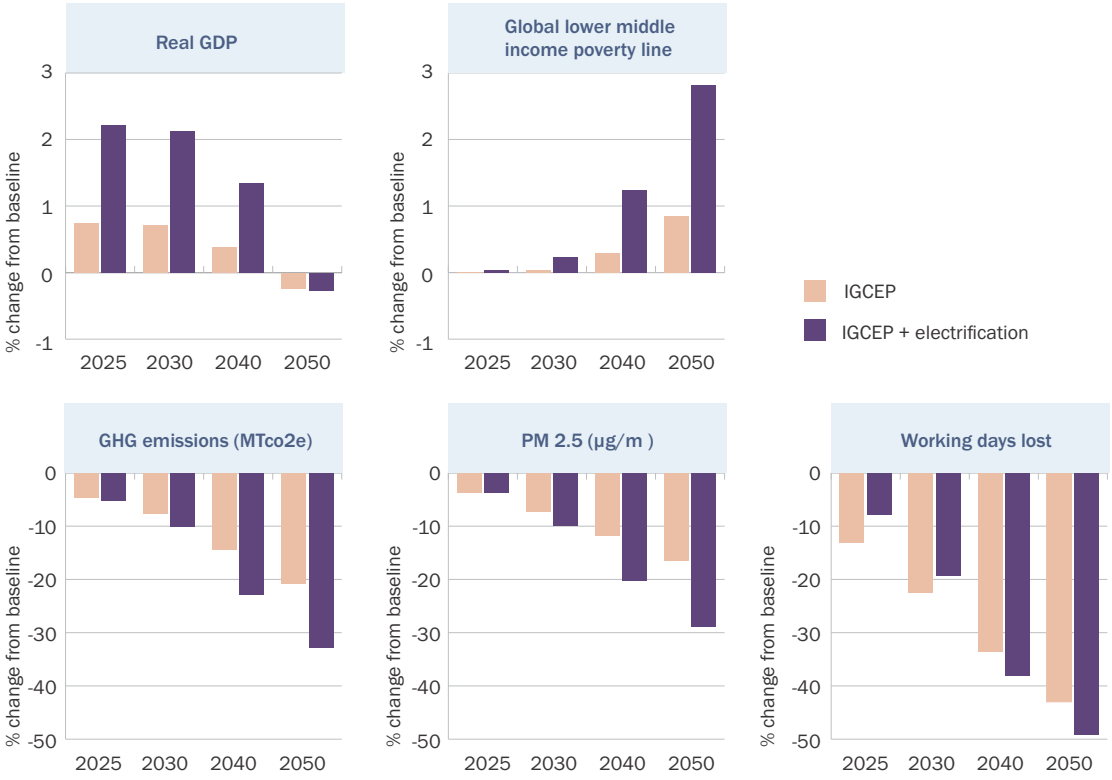
The implementation of the IGCEP will lead to a moderate boost in GDP and substantially reduce GHG emissions and PM2.5, with a small negative impact on poverty. Figure 5.1 shows the impact of the IGCEP alone (orange bars) on selected indicators. The expansion in RE generation capacity will boost GDP by 0.8 percent by 2025 before it falls slightly relative to the BAU level by 2050. Emissions fall by 20 percent relative to BAU by 2050 while PM2.5 declines by 16 percent. The initial boost to the economy is driven by higher investment but there is mild inflationary pressure in the latter decades from upward pressure on electricity tariffs to pay off the investment costs. In line with this, changes in

100 Note that the figure of 20 percent is higher than that quoted in Section 4.3.1, where a figure of 17 percent is quoted based on the Pakistan Energy Yearbook 2000. The difference is because the modeling in this section made use of energy demand data from the International Energy Agency (IEA), with traditional biomass excluded.

the poverty rate stay relatively low because of the stimulus effect. Poverty rate, eventually rises to about 1 percent compared to the BAU, but only close to 2050, as household electricity bills rise. This can of course be offset through targeted transfers to poor and vulnerable households.

If the more ambitious plan of fuel switching to electricity is also implemented in the same timeframe as the IGCEP—captured by the blue bars in Figure 5.1—the initial boost to GDP will be higher and emissions and PM2.5 level will fall more sharply, but poverty could rise, unless targeted transfers are implemented. Under this policy run, GDP growth rises slightly above 2 percent until 2030, and 1.3 percent thereafter until 2040, driven mostly by additional investment. By 2050, GDP growth falls slightly below the BAU. There is a further decline of 11 percent in CO2 emissions, with a total decline of 32 percent relative to baseline by 2050 if both policies are implemented. There is a corresponding decline in PM2.5 level, which totals almost 30 percent relative to BAU. The NPV of the needed investment in this case is an additional US$49.8 billion.

Figure 5.1: Impact of the IGCEP and the IGCEP + Electrification



This investment would further reduce reliance on imported fossil fuels, enhancing energy security and macro-fiscal stability. However, the upward pressure on prices starting in 2040 is also larger, rising to 8 percent relative to BAU, and reflects the increase in energy tariffs needed to finance a share of the policy-induced expansion of capacity, as well as the additional costs of electrification to end-users that get passed on in consumer prices for a period of time. Higher electricity tariffs and product prices will reduce real income and drive the poverty response, with a slight increase in the poverty rate after 2040 until the investment is paid off. As noted in Chapter 4, the current subsidy to the sector is significant and the electricity subsidy is poorly targeted. The repurposing of this subsidy to protect households at the bottom of the distribution would eliminate any negative impact on poverty.

5.1.2 Policy Package 2: Carbon Taxes, Revenue Recycling, and Feebates

A carbon tax could, from several perspectives, be beneficial to Pakistan's development. As discussed in Chapter 4, Pakistan imports nearly one-third of its energy in the form of oil, coal, and re-gasified liquefied natural gas (RLNG) at enormous cost, which contributes significantly to the country's chronic fiscal stress. The introduction of a carbon tax would provide a clear signal to both firms and households to start adopting efficiency measures and shift consumption and investment away from fossil fuels to RE sources. The resulting reduction in emissions would yield several co-benefits, of which a reduction in pollution is the most important. As discussed in chapter 2, Pakistan is among the countries with the highest levels of air pollution, with large attendant health impacts. Lower levels of pollution would improve health outcomes, with associated gains in labor productivity and household income from fewer lost days of work, lower healthcare costs, and lower costs of production.

A carbon tax would also broaden the tax base by bringing currently untaxed producers who operate in the informal economy–estimated to be between 35 and 50 percent–into the tax net at a low administrative cost. The use of traditional tax instruments is more challenging in such contexts. A broad-based carbon tax would circumvent this and could be relatively easy to implement, administratively and politically, if it is introduced gradually, with adequate revenue recycling to protect the poor and to sustain an expansion of shared prosperity.

The introduction of a carbon tax is under consideration within the government. A key guiding principle of the NDC (2021) is to explore market- and nonmarket-based approaches to diversifying funding sources for commissioning capital-intensive projects. To this end, the National Committee on the Establishment of Carbon Markets (NCEC) was established in 2018, with equal representation from the federal ministries, the provincial governments, and the private sector.

The modeling considers the gradual introduction of a carbon tax starting in 2025, with full revenue recycling. Two tax levels are considered, described in Table 5.1. This use of tax revenues is indicative. Some of the revenues generated could, in principle, be freed from feebates and used instead for debt repayment, resilience-building investments, or the financing of core development needs. A gradual ramp-up of the tax not only avoids a large impact on prices but allows the economy time to adjust to new incentives and to take advantage of new technologies as they become available.

Table 5.1: Carbon Taxes

Policy	Abbreviation	Model implementation
1. Low Carbon Tax + Revenue Recycling	Low CT + RR	Rate of US$1–5/tCO2 in 2025, gradually increasing to US$20/tCO2 by 2050. Revenues from taxes are recycled as (a) rebates to hard-to-decarbonize industries, and (b) transfers to the poorest 50 percent of households
2. High Carbon Tax + Revenue Recycling	High CT + RR	Rate of US$2–10/tCO2 in 2025 gradually increasing to US$40/tCO2 by 2050. Revenues from taxes are recycled as (a) rebates to hard-to-decarbonize industries, and (b) transfers to the poorest 50 percent of households

Figure 5.2 shows the impact of a carbon tax with revenue recycling, with and without the concurrent implementation of the IGCEP. Since the government has committed to the IGCEP, it is important to see the impact of these policies not just in isolation but also as additive to the IGCEP. The effects will differ because the marginal effectiveness of additional policies on emissions could decrease if they are implemented simultaneously with the IGCEP. In other words, it will, understandably, become increasingly difficult to reduce emissions further as the decarbonization agenda gets under way.

It was found that the implementation of a carbon tax alone has only a small positive impact on GDP. This is mainly caused by an increase in aggregate demand, driven by the recycling of revenues to the bottom 50 percent of households and feebates. Aggregate demand rises because of two factors: Households substitute away from fossil fuel-intensive products and use the transfer to purchase a broader set of goods and services; and secondly, firms make additional investments in renewables. The carbon tax, regardless of the level, is predicted to have a more beneficial marginal effect on GDP if the IGCEP is already in place. This is because the costly substitution and adjustment effects of the carbon tax are already captured by the IGCEP. Hence, what dominates are the positive recycling effects. In the absence of IGCEP, carbon taxes have the largest impact on emissions. By 2050, a low carbon tax could reduce emissions by 20 percent. With a high carbon tax, the impacts are stronger, with emissions declining by as much as 40 percent relative to BAU. Since carbon taxes are applied to all fossil-fuel uses (petroleum, coal, oil, and gas), they increase the price of fossil fuels relative to renewables, which results in higher demand for renewables and reduced emissions.

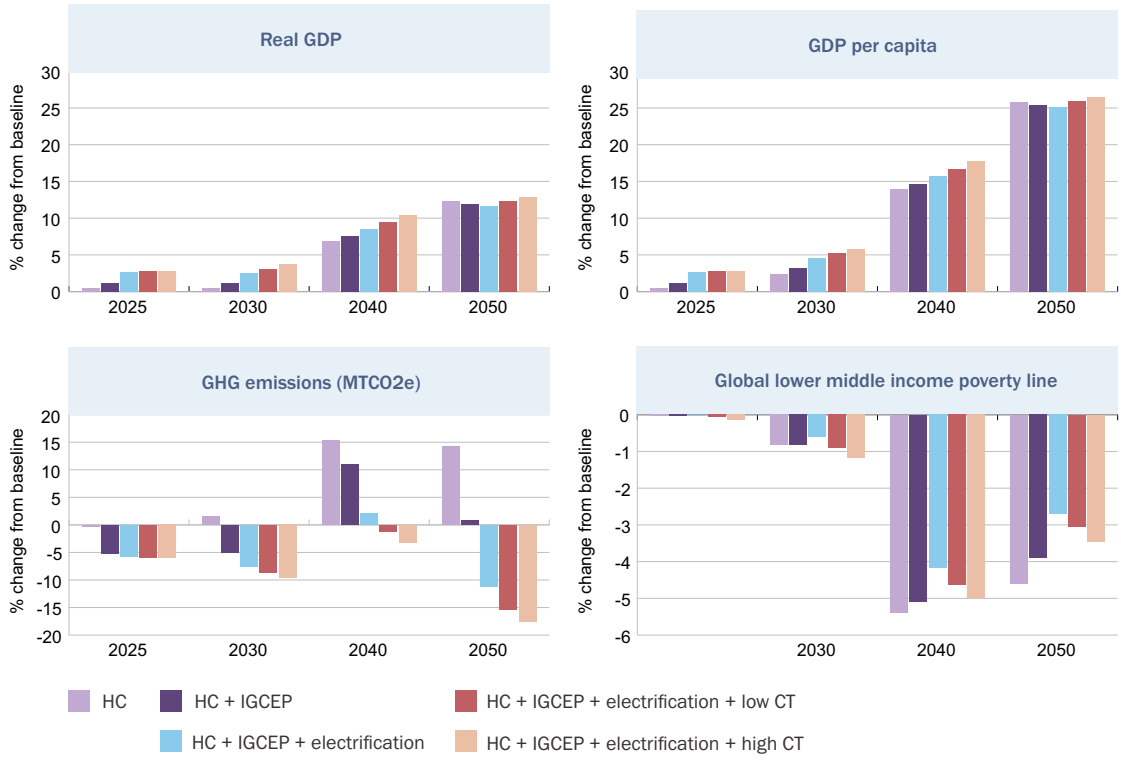
If carbon taxes are implemented concurrently with the IGCEP or IGCEP plus electrification, there is a significant boost to GDP through the decade of the 2040s. However, in 2050, this effect is projected to wear off as some of the investment costs are paid off through higher final consumers bills. There is a dampening in the fall in poverty relative to the projected baseline, indicating that larger transfers at the bottom of the distribution will be needed. As indicated above, the current subsidy to energy, agriculture and water sectors is significant but poorly targeted. This could be used to augment transfers and fully protect households at the bottom of the distribution, eliminating any negative impact on poverty. The analysis makes it clear, however, that it will be important to pay careful attention to ensuring that these policies have substantial economy-wide benefits, address climate mitigation goals, and are implemented in a manner that fully protects the poor from transition-related costs.

Figure 5.2: Impacts of Carbon Taxes without the IGCEP, with the IGCEP, and with the IGCEP and Electrification

5.1.3 Policy Package 3: Investments in Human Capital Development

Achieving equitable development and climate resilience in Pakistan is hard to envision without very substantial efforts to improve human capital. In the policy package simulated here, the focus is twofold: (a) accelerating the decline in the total fertility rate (TFR) toward replacement fertility; and (b) addressing child stunting by expanding access to safe water and sanitation (WASH), as per SDG 6, to all households that currently lack access. Under the modeled scenario, the TFR drops to 2.0 by 2035 and is then constant at 2.0 until 2050. Under BAU, total fertility drops to 3.0 between 2030 and 2040, and to 2.0 by 2050.

Figure 5.3: Impacts of Human Capital (HC) Development and with Other Policies



The combined policy package triggers a strong boost to GDP with a 15-year lag as healthier and better educated children enter the labor market and female labor market participation also rises due the to decline in the fertility rate. As shown in Figure 5.3, GDP rises 7 percentage points by 2040, and more than 12 percentage points by 2050. Due to the accelerated decline the TFR, GDP per capita also shows a large increase starting in 2040, with a 15 percent increase by 2040 and a 25 percent increase by 2050. The policy is also equity-enhancing. By 2050, the commensurate decline in poverty is sustained between 2.6 percent and 4.7 percent.

5.1.4 Investments in Adaptive Social Protection Policies

Social protection (SP) can help build the resilience of poor and vulnerable households to prepare for, cope with, and adapt to climate shocks. It does so by (i) reducing poverty and vulnerability and increasing coping capacity ahead of shocks, (ii) providing a steppingstone toward climate-resilient livelihoods, and (iii) supporting inclusive disaster preparedness, and disaster response and recovery. Pakistan's existing SP system can be strengthened and mobilized for more efficient delivery of relief and recovery building on lessons learned from the response to the 2022 floods. Ex-ante SP instruments could also be used to incentivize proactive protective behaviors and activities. Based on

the recent flood relief process, it is evident that the current National Socio-Economic Registry (NSER) is not able to support most informal sector Pakistani households who fall outside existing risk-sharing and risk-mitigation mechanisms and are not eligible for existing safety net programs targeted to the very poor, nor covered by social insurance, including formal pensions. Many are likely to incur significant losses due to climate-related disasters and could be driven into poverty. By integrating the principles of an adaptive SP system, swift support could be provided to such vulnerable groups. A comprehensive strategy to combine social assistance and insurance schemes, including microinsurance, health care coverage, and savings products for the poor and those in the informal sector, is essential. In addition, Pakistan needs to leverage the SP system to promote medium- to long-term incentives for households to prioritize human capital accumulation, in particular education, including skills for working in green sectors. This will require high-level government commitment and inter-governmental coordination between the federal and provincial levels.

5.2 Financing a Resilient and Inclusive Development Pathway

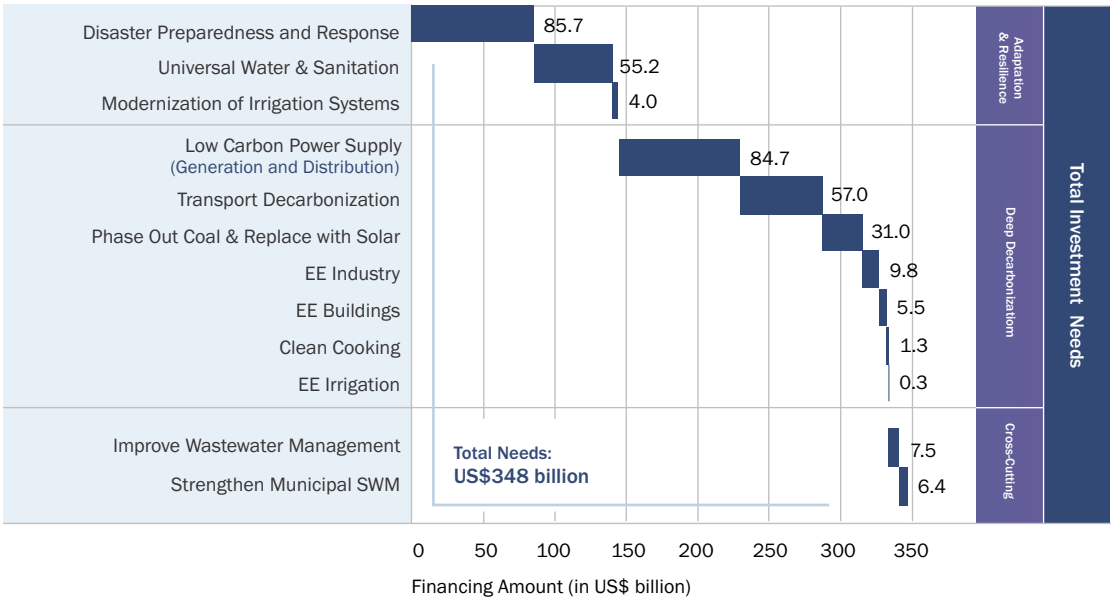
The total investment needs for a comprehensive response to Pakistan's climate and development challenges between 2023 and 2030 amount to around US$348 billion (or 10.7 percent of cumulative GDP for the same period) (see Figure 5.4).[101] This consists of US$ 152 billion for adaptation and resilience and US$196 billion for deep decarbonization (*see more details in Annex 6: Methodology for Estimating Total Climate and Development Financing Needs*). This figure is enormous in comparison with the historic average annual development budget at the federal and provincial levels and currently available finance, which was roughly US$11 billion per year between 2011/2012 and 2014/2015.[102] However, this estimate is likely an underestimation due to the unavailability of data on the investment needs of key transformations, such as a sustainable agri-food system, flood risk management plan, shock-responsive social protection system, and climate-resilient rural connectivity.

These estimates suggest a significant climate and development gap, for which a number of tangible solutions can be proposed to start bridging it. An illustrative assessment based on a retrospective review of the level of funding in recent years suggests that the financing composition currently available over the next decade can be estimated to be around US$39 billion from public finance (including MDB financing) and US$9 billion from public-private partnerships for infrastructure projects. This clearly will not be enough to address the priority transitions identified above.

As Pakistan calls for additional international financing, the government is encouraged to explore the repurposing of subsidies in the energy, agriculture and water sectors and improving tax and tariff collection. This can be done while protecting the poorest and most vulnerable through well targeted programs and transfers. Specifically, Pakistan could maintain its commitment to energy decarbonization and accelerate a comprehensive reform in the energy sector, including piloting the implementation of carbon pricing instruments.[103] If fully implemented the combined revenue of these measures could amount to around US$10 billion a year.

101 Using the best available data and a review of the literature, Figure 5.4 presents total indicative climate financing needs (not incremental costs) and potential resources for up to 2030. These estimates are tentative, but they do illustrate the order of magnitude of the financial need.
102 This is based on the latest CPEIR in 2017; more recent data are not available.
103 This will require a careful evaluation of international best practices.

Figure 5.4: Indicative Estimation of Total Investment Needs for Climate-Resilient and Low-Carbon Development for up to 2030 [104]



A comprehensive climate financing strategy is therefore needed to support the achievement of this transformative climate transition. The key elements should include these four: (i) optimizing the utilization of domestic resources by removing the inefficiencies and inequities in their use; (ii) mobilizing additional domestic financing by widening the tax base and developing innovative financing mechanisms at the federal and provincial levels; (iii) creating an enabling policy and regulatory environment to bring in private investments; and (iv) strengthening the government's own capacity to access international climate finance. That said, it is also clear that it will be hard to fully close that gap in the short term, and hence further discipline will be needed to refine, prioritize, and sequence investment decisions.

(1) Optimizing the utilization of domestic resources

Better utilization of domestic resources could continue to play an important role in providing climate finance. This includes bolstering climate-related spending by mainstreaming climate risk considerations into development planning, sectoral policies, and programs. To do so, it is crucial that the design of each capital project consider the potential impacts of climate change on project implementation and sustainability, as well as opportunities to integrate low-carbon and energy-efficient standards where technically and financially feasible. Further, there is huge potential to revise the current spending of explicit subsidies on fossil fuels and agriculture-water to better target the poorest and the most vulnerable and strengthen their adaptive capacity over time.

(2) Mobilizing additional financial resources through revenue enhancement measures and innovative financing mechanisms

The introduction of innovative financing mechanisms will be crucial for narrowing or even closing the climate financing gap. This may include the introduction of carbon taxation, the implementation of green/blue bonds, and the promotion of PPPs.

104 The detailed methodology and assumptions for the climate finance stocktaking are provided in Annex 6. Please note that the sectoral needs are based on the best available data and analytics. Certain investment needs of critical sectors, such as climate-smart agriculture, integrated land management, which are identified as key priorities of the CCDR, are nevertheless unavailable. To avoid double counting, the total recovery and reconstruction needs for 2022 floods (US$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 US$10.7 billion a year based on MOCC analysis.

Practical experience has shown that green bonds are effective in generating revenue for high-cost, large-scale development programs. They seem well-adapted to the needs of key sectors, although further institutional and regulatory adjustments may be needed and are contingent upon the global financial environment as well as the country's macro-fiscal stability. The introduction of a high carbon tax with full revenue recycling (see Section 5.2) could theoretically generate revenue of US$28.6 billion between 2020-2030, with much of the fiscal revenue to be accumulated at a later stage of the implementation. A portion of total revenue could be leveraged to support adaptation and decarbonization efforts, while the rest would be transfers to the poorest and most vulnerable households.

The role of the private sector in addressing climate challenges is crucial, but it is constrained by a lack of resources and skills and the need to transition to sustainable practices. This is mainly due to a lack of green financing, especially investments in green infrastructure projects and human capital, as well as the absence of an enabling environment for private investment, as discussed in Chapter 3. The gaps are even more pronounced within the large SME sub-sector, which accounts for an estimated 90 percent of all businesses in Pakistan and employs roughly 80 percent of the non-agricultural labor force. Besides SMEs, a significant proportion of businesses in Pakistan operate in the informal sector, which accounts for 35–50 percent of undocumented economic activity. This not only keeps them outside the tax net but also makes it difficult to provide them with financial services. Private sector mostly invests in sustainable practices when the regulator demands compliance, there is market for environment friendly products, or the practices provide a premium; compliance requirements for suppliers mostly seen for exporters and at times voluntary ESG compliance to improve the image of the business although that is a less common factor.

(3) Strengthening the capacity to access international climate finance and bolster private sector investments

Enhancing institutional capacity for climate action implementation and transparency in monitoring and reporting are two urgent prerequisites for Pakistan to unlock access to international climate finance. While Pakistan can do much more to raise domestic resources, as discussed above, the investments needed to build climate resilience and accelerate a transition away from fossil fuels will be substantially out of reach for domestic capital, despite its significant development and climate benefits. Such investments typically require concessional international finance. Specifically, developing and implementing a nationwide GHG MRV and adaptation M&E system would allow the government to keep track in real time of the implementation progress being made toward its climate targets. Mainstreaming climate adaptation and mitigation considerations into the planning process and the public financial management system and process through climate risk screening and climate budgeting would further improve the transparency, efficiency, and impact of public spending on climate actions. To achieve these objectives, it is imperative that the government strengthen its institutional and technical capacities for climate-informed planning, climate action implementation, and stakeholder engagement. Importantly, this needs to be accomplished through a whole-of-economy approach across central and line ministries as well as provincial departments.

From a private sector perspective, institutional capacity at the regulatory, sectoral, and corporate levels needs to be strengthened to scale up green investment. Capital markets in Pakistan are shallow, the adoption of globally accepted environmental and social risk management (ESRM) systems is very low, and there is a lack of institutional capacity at the regulatory, sectoral, and corporate levels. To raise its competitiveness and attractiveness to potential PPP sponsors, the government should pay particular attention to strengthening its capacity for PPP management and improving its country risk rating, especially the rule-of-law indicators.[105] Additionally, the regulatory framework for FDI needs to be strengthened, including at the subnational level, and political risks addressed to attract green investments. Policy measures need to be adopted to scale up green investments in the financial sector, especially through (i) enhancing the existing Green Banking

105 William Mako, Ijaz Nabi, and Amna Mahmood, "Developments in Climate Finance and Implications for Pakistan," Insights for Change (Consortium for Development Policy Research (CDPR) August 2022), https://mcusercontent.com/bfb54020f918218452cd35b67/files/1c1035c0-0112-4a1b-1249477f36cacd0a/Development_in_Climate_Finance.pdf.

Guidelines and mandating their adoption to allow the banking sector to develop much-needed ESRM frameworks;[106] (ii) issuing green financing targets from the State Bank of Pakistan (SBP) to FIs; (iii) introducing commercially viable incentives for green financing for FIs to build capacity, pursue green finance and lend to investments that reduce GHG emissions; and (iv) requiring FIs to report on the GHG emissions impact of their financing. Green financing targets should be (i) designed to minimize potential misallocation of credit, accompanied by capacity building of relevant stakeholders, (ii) flexible enough to allow mid-course correction; and (iii) employed in a way that encourages sustainable operations for FIs.

5.3 The Aggregate Effects of Policy Packages on Emissions

Figures 5.5 depicts the aggregated emissions-reduction effects of different policy pathways. The trend lines use the modeled BAU, which predicts an increase in total GHG emissions from 524 million MtCO2e in 2020, to 890 million MtCO2e in 2030, and to 1,633 million MtCO2e in 2050. This represents an increase of 312 percent from 2020 levels, a lower projection than the emissions target for 2030 included in Pakistan's NDC (2021). The difference is mainly due to a lower modeled GDP growth rate. The modeled growth rate uses Pakistan's historical GDP growth trends and projections out to 2029, which are then extrapolated to 2050. This gives an average growth rate of about 4 percent per year. In contrast, the NDC assumes 9 percent GDP growth per year.

A climate-resilient, low-carbon and equitable development path would enable Pakistan to reach its unconditional NDC target for 2030 (15 percent below BAU) and beyond. The low-carbon transition of the energy sector through implementing the IGCEP, promoting electrification, and establishing a carbon tax (*Scenario 3*) could help Pakistan reduce its total emissions by 12 percent from BAU by 2030. Additionally, investing in SWM, completing the NBSs identified in the NDC, and achieving the MP (*Scenario 4*) could lead to a total emission reduction of 33 percent from BAU by 2030.

Achieving deeper decarbonization (*Scenario 5*) would require implementing more radical mitigation policies and technologies beyond 2030, especially those that bring in negative emissions (in the form of the capture and removal of carbon from the atmosphere). Analysis commissioned by the World Bank[107] shows that, with additional policies and investments, energy sector emissions could be constrained to peak by 2035, thereby falling from 256 MtCO2 in 2020 to 206 MtCO2 by 2050. This is against a backdrop of a 380 percent increase in economic output, resulting in a 160 percent increase in energy demand, and a 400 percent increase in industrial output over the same period. Achieving such an emissions trajectory in the energy sector would require i) a tripling of electricity's share of energy demand (to 48 percent by 2050) and rapid scale-up of RE, combined with an accelerated phase down of fossil fuels;[108] ii) 80 percent penetration of energy-efficient appliances; iii) 80 percent of buildings classified as “green” through EE&C retrofits and enforcement of high standards for new buildings; iv) massive adoption of efficient technologies and process changes in industry; and v) aggressive deployment of mass transit and EVs in the transport sector. By 2050, industrial emissions would represent 52 percent of total energy sector emissions, despite very significant decoupling of emissions from industrial growth. Bringing down industrial emissions further would require the deployment of carbon capture, utilization, and storage (CCUS) to target cement process emissions, which if deployed at a 50 percent penetration rate, could further reduce energy-sector GHGemissions by 29 MtCO2 to reach 177 MtCO2 by 2050. Implementation of such policies could put Pakistan on a path toward “net zero” emissions by 2070. Furthermore, expanding the forest cover to 15 percent of total land cover (or 16 billion trees) through the TBTTP (6 percent forest cover) could achieve a total sequestration of 800 million MtCO2e between 2020 and 2040, or 40 million MtCO2e annually.[109]

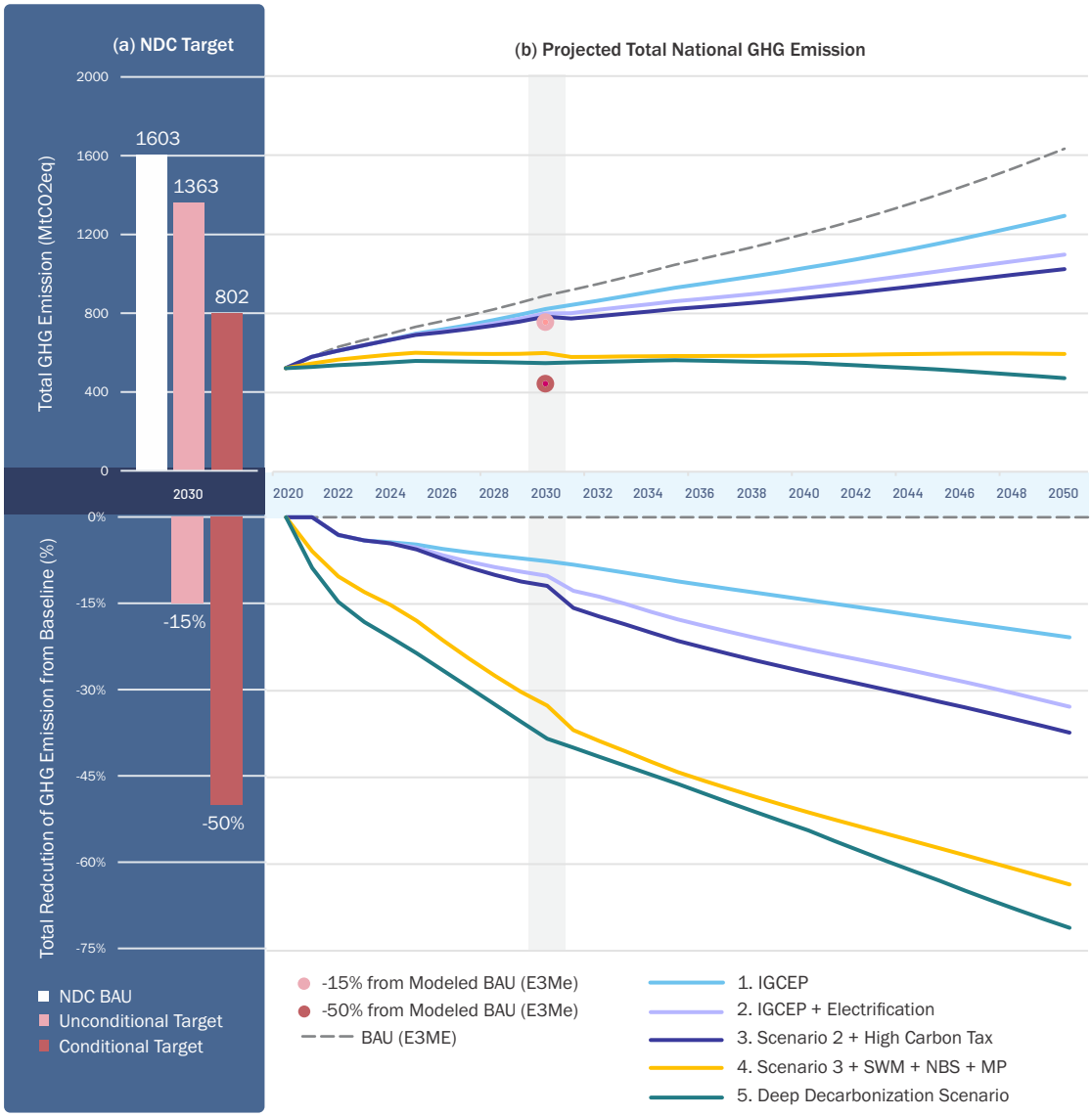
106 To promote green finance and global E&S practices in Pakistan through market-creation activities, IFC has been working with the SBP on capacity building through policy-level advisory work, and with FIs to demonstrate the business case for global finance (GF). In addition, in the past, IFC has worked with two of its client banks to showcase the potential for GF across multiple sectors in their existing portfolio.

107 The World Bank has commissioned “energy transition” studies for a number of countries in South Asia, and the Pakistan study is under implementation. Draft results were presented during a webinar organized on July 5, 2022 and can be accessed at https://my.atainsights.com/webinar/wb-the-energy-transition-in-pakistan-meeting-growing-energy-demand-sustainably

108 In addition to achieving 155GW of installed solar and wind capacity and 52GW of hydropower capacity by 2050, the government would have to institute a moratorium on all new coal plants (except those committed up to 2025), carry out early decommissioning of coal plants after 25 years of operation, and ensure no new thermal plants (coal, gas and oil) after 2030.

109 This is a rough estimation based on the carbon sequestration value provided in the NDC.

Figure 5.5 Aggregated GHG Emissions Impacts of Different Policy Scenarios for 2020–2050 (right panel)[110] in Comparison to the NDC (2021) Target for 2030 (left panel)



110 **IGCEP:** Rapid expansion of RE including wind, solar and hydropower, reaching a total of 63 percent production by 2030, per the IGCEP 2021-2030. **Electrification:** Electricity as a percentage of final energy consumption increases from 20 percent in 2020 to 28 percent by 2030. **Carbon Tax:** Rate of US$2–US$10/tCO_2 in 2025 gradually increasing to US$40/$tCO_2$ by 2050. Revenues from taxes are recycled as (a) rebates to hard-to-decarbonize industries, and (b) transfers to the poorest 50 percent of households. **SWM:** The high emissions abatement scenario assumes reducing dumping by 5 percent by 2025, 25 percent by 2030, and 50 percent by 2035. **NBS:** Implementation of the Billion Trees Afforestation Project and the TBTTP, which together will sequester CO_2 around 500 million $MtCO_2e$ by 2040 per the NDC. **MP:** In 2021, Pakistan signed the MP to curb its methane emissions by 30 percent, to about 99 $MtCO_2e$, by 2030. It is assumed that the government will maintain this same amount of methane emissions between 2030 and 2050.

6.

SUMMARY OF RECOMMENDATIONS

6. SUMMARY OF RECOMMENDATIONS

This CCDR aims to provide recommendations for how Pakistan could embark on a sustainable development path while, at the same time, rationally managing climate change-related physical, transitional, and financial risks. Each of the policy recommendations is underpinned by a handful of short-, medium-, and long-term policy actions that, if taken, would support the country in shifting to a climate-resilient development path. Many of these policies would also move the country toward low-carbon growth. The policy recommendations and specific policy actions all differ in their potential impacts on development and climate as well as in their implementation readiness. Additionally, Pakistan faces several other challenges, including internal resource constraints, capacity shortfalls, and governance and political economy issues. The CCDR attempts to provide a preliminary prioritization of each policy recommendation on these aspects, subject to further discussion and evaluation with key stakeholders. Table 6.1 presents the criteria that formed the foundation for evaluating the recommended policy actions. Moreover, the CCDR recognizes that, before each of these policy recommendations can be prepared and implemented, in-depth analysis of institutional and regulatory framework issues and of governance and political economy challenges, will be required.

Table 6.1: Criteria for Prioritizing and Sequencing the Recommended Policy Actions

	Criteria	Description
Development Impact	Human Capital	• Impact on poverty reduction • Potential for employment generation
	Economic Growth	• Relevance to growth as measured by contribution to GDP
	Natural Capital	• Conservation and restoration
Climate Impact	Mitigation	• Impact on emission reduction • Potential for lock-in
	Resilience	• Reduced vulnerability to climate risks • Enhanced adaptive capacity
Implementation Readiness	Enabling Architecture	• Adequacy of policy framework • Adequacy of institutional framework • Technology availability
	Financing	• Impact on fiscal burden • Attractiveness to private sector

Table 6.2 below provides the full list of policy recommendations and their underpinning policy actions. It also presents a snapshot of their overall performance in supporting development and climate outcomes. In each case, the number of shaded circles depicts the priority level of the policy package against the sub-criteria detailed in Table 6.1, while the red, yellow, and green circles offer a quick visual depiction of their impact on development, on climate, and on implementation readiness, respectively. Further, the CCDR attempts to categorize the urgency of each policy action by considering its capacity to provide an enabling environment and a technical foundation for other policy actions, as well as the current political economy. In general, it is recommended that *short-term (ST) policy actions* be initiated and/or implemented within the next two years leading up to 2024/2025; *medium-term (MT) policy actions* be initiated and/or implemented within the subsequent five years, or up to 2029/2030; and (iii) *long-term (LT) policy actions* be initiated and/or implemented post-2030. Please refer to the superscript after each policy action for the proposed timeline and level of urgency.

Table 6.2: Summary of Policy Recommendations in the CCDR

Timeline urgency: *** Short-Term = (2022/2023 to 2024/2025)
** Medium-Term = (2024/2025 to 2029/2030)
* Long-Term = (Beyond 2030)

Policy recommendation	Priority policy actions	Prioritization result
Policy Package A: Transforming the Agriculture-Food System		
1. Repurpose existing subsidies in agriculture and irrigation	• Gradually phase down the wheat support system *** • Gradually remove the subsidy to electric tubewells *** • Gradually phase down the natural gas subsidy for fertilizer production ** • Implement reforms in the sugar sector such as removing entry barriers like licensing restrictions on new sugar mills and removing import duties and export subsidies for sugar *** or ** • Repurpose released resources to support smallholder farmers to transition to CSA and RA practices **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
2. Support a sustained adoption of CSA and RA practices	• Implement reforms in the sugar sector: such as removing licensing restrictions on new sugar mills and removing import duties and export subsidies for sugar *** or ** • Repurpose released resources to support smallholder farmers to transition to CSA and RA • practices **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
3. Improve and modernize irrigation and drainage to provide climate-resilient, predictable, and flexible services in response to changing demand	• Invest in infrastructure to improve hydraulic control and flow measurement *** or ** • Improve water allocation practices and water measurement, billing, and collection, starting with the tariff on surface irrigation water (*abiana*) *** • Finalize and implement the updated national flood protection plan ** • Develop an irrigation water management system **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
4. Strengthen climate-smart livestock systems and prioritize ecosystems and landscape restoration	• Support smallholder farmers to improve their livestock productivity *** • Develop a national program and roadmap to restore priority ecosystem services *** • Strengthen economic incentives for action to conserve and restore ecosystems ** • Develop a decision support system to prioritize landscape restoration investments linked to socio-economic benefits ** • Develop a system of natural capital accounts ** • Build institutions and capacity on climate-smart livestock systems and landscape restoration *	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
Policy Package B: Building Resilient and Livable Cities		
5. Strengthen urban planning and management capabilities	• Modernize urban land management systems to incentivize urban densification *** or ** • Improve land regulation and land use planning *** or ** • Support the implementation of NBSs ** • Formulate a national urban resilience strategy and provincial-level as well as city-level adaptation plans ** • Invest in measures to achieve national clean air standards and reduce GHG emissions **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing

Policy recommendation	Priority policy actions	Prioritization result
6. Enhance green urban mobility	• Accelerate large-scale investment in mass-transit solutions *** or ** • Improve first- and last-mile connectivity *** • Introduce incentives to reduce traffic congestion *** • Invest in pedestrian mobility and encourage non-motorized transport *** • Set policy targets and a regulatory framework for sustainable fuel adoption *** • Establish measures to discourage private-vehicle mobility ** • Develop compact cities and limit sprawl ** • Support new greenfield infrastructure that reduces in travel distance ** • Encourage e-commerce and work-from-home arrangements to reduce urban travel ** • Replace all motorized shared modes with zero emissions versions ** • Transform 60 percent of the bus and transport fleet to zero emissions by 2030, and aim for 100 percent zero emissions vehicles by 2050 *	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
7. Promote climate-smart municipal services	• Strengthen regulations for SWM and transition to low-carbon solutions ** • Expand water treatment capacity ** • Rehabilitate existing water supply infrastructure **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
8. Create sustainable revenue streams for green and resilient urbanization	• Strengthen cost recovery for urban municipal services ** • Strengthen the legal and regulatory framework for PPPs ** • Develop a performance-based, climate-resilience-focused, grant-financing mechanism ** or *	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
Policy Package C: Accelerating a Just Transition in Energy and Transport		
9. Transition from fossil fuels	• Avoid further development of fossil fuel power plants, possibly use climate finance to support early retirement of existing plants *** • Immediately initiate of competitive bidding for RE, starting with 2 GW by the middle of 2023 followed by annual rounds of procurement to meet the IGCEP targets *** • Accelerate plans for additional solar and wind capacity at identified sites near existing thermal plants and substations, and through parallel development of strategically located RE parks ** • Annually update the IGCEP to quickly respond to changes in supply projections **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
10. Improve supply-side efficiency	• Implement reforms to ensure that tariffs better reflect costs, and re-target electricity and gas subsidies to the poorest consumers *** or ** • Introduce private sector participation in the management of the DISCOs, combined with a modernization drive *** or ** • Introduce a competitive wholesale power market *** • Invest in the electricity transmission network to improve its reliability and prepare for increased variability ** or *	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing

Policy recommendation	Priority policy actions	Prioritization result
11. Address demand-side efficiency	• Finalize and implement an ambitious EE&C policy through a strong and well-resourced NEECA and the related provincial EE&C agencies *** • Set minimum performance standards for mass-market appliances *** • Improve the energy efficiency of existing and new buildings in the commercial and industrial sectors ** • Shift to electricity where economically and technically feasible, such as space and water heating ** • Institute commercially driven replacement or exchange programs for inefficient lightbulbs, streetlights, and fans ** • Develop the market for ESCOs to mobilize private-sector investment **	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
12. Decarbonize the industrial and transport sectors	**Industrial Decarbonization** • Incentivize the uptake of carbon-, energy- and water-efficient technologies and production processes, with the nearest-term priority being the replacement of old, inefficient motors and boilers ** • Promote electrification and fuel efficiency improvements, including through waste heat recovery and fuel switching to sustainable sources such as bioenergy and green hydrogen ** • Pilot and adopt innovative technologies for hard-to-abate industrial processes such as cement production ** • Improve water usage and wastewater treatment ** **Transport Decarbonization** • Facilitate the revival of PR and swift implementation of the PR Strategic Plan *** • Consider private sector involvement in PR ** • Provide concessions to operate freight trains on PR tracks *** • Facilitate the modernization of the trucking sector *** • Establish and implement a new commercial strategy for PR ** • Implement railway economic corridors ** • Develop new rail links; upgrade and restore existing rail links; and extend new lines * • Support the consolidation of trucking flows using technology *	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
13. Ensure "just" transitions	• Develop a clear understanding of those who might stand to lose politically and financially and avoid disproportionately favoring some interest groups over others *** • Devise strategies for "just" transitions to overcome political resistance *** • Ensure protection of livelihoods through retraining and other measures *** and ** • Achieve universal access to modern energy by 2030, with a particular focus on rural households and on the uptake of off-grid electrification and clean-cooking solutions ***	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing
Policy Package D: Strengthening Human Capital for Sustained and Equitable Development and Climate Resilience		
14. Improve WASH and family-planning services	• Provide equitable and sustainable access to safely managed water and sanitation facilities for all households, as per SDG 6 target *** • Invest in family planning services to reduce the fertility rate by 2035 ***	Development: Human Capital, Growth, Natural Capital Climate: Resilience, Mitigation Readiness: Enabling Architecture, Financing

Policy recommendation	Priority policy actions	Prioritization result
15. Build a shock-responsive SP system	• Establish a policy framework for shock-responsive SP, including ex-ante actions to reduce risk *** • Ensure the dynamism of NSER as an integral element of strengthening the SP-delivery system *** • Expand coverage of the poor and vulnerable under SP programs and increase the benefit adequacy *** or **	**Development**: Human Capital, Growth, Natural Capital **Climate**: Resilience, Mitigation **Readiness**: Enabling Architecture, Financing
Policy Package E: Aligning Institutions, Policies, Incentives, and Financing to Scale Up Climate Actions		
16. Align institutions, policies, incentives, and financing	• Set up systematic metrics and measurement and reporting systems to monitor and report on the costs and benefits of climate actions *** • Introduce climate-risk screening and climate-informed public financial management at the federal and provincial levels *** • Develop and implement a climate and disaster resilience framework and financing strategy *** • Green the financial sector, including through financial regulation, taxonomies, reporting and disclosure standards, and the development of green financial tools and instruments *** • Finalize and implement the NAP and Provincial Action Plans to mainstream climate and broader environmental actions into development planning ** • Strengthen the institutional and regulatory framework on PPP management and for FDI **	**Development**: Human Capital, Growth, Natural Capital **Climate**: Resilience, Mitigation **Readiness**: Enabling Architecture, Financing

7. BIBLIOGRAPHY

Air Quality Life Index. *Country Spotlight: Pakistan*, 2022. https://aqli.epic.uchicago.edu/country-spotlight/pakistan/#:~:text=Pollution%20Ranking&text=Pakistan%20is%20today%20the%20world's,(WHO)%20guideline%20was%20met.

Algur, Kisan Dilip, Surendra Kumar Patel, and Shekhar Chauhan. "The impact of drought on the health and livelihoods of women and children in India: A systematic review." *Children and Youth Services Review* 122 (March 2021): 105909. Doi: https://doi.org/10.1016/j.childyouth.2020.105909.

Armstrong, Richard L., Karl Rittger, Mary J. Brodzik, Adina Racoviteanu, Andrew P. Barrett, Siri-Jodha Singh Khalsa, Bruce Raup, et al. "Runoff from glacier ice and seasonal snow in High Asia: separating melt water sources in river flow." *Regional Environmental Change* 19 (2019) :1249–1261. Doi: https://doi.org/10.1007/s10113-018-1429-0.

Babar, Maryam Salma, Saema Tazyeen, Hiba Khan, Christos Tsagkaris, Mohammad Yasir Essar, and Shoaib Ahmad. "Impact of climate change on health in Karachi, Pakistan." *The Journal of Climate Change and Health* 2 (May 2021): 100013. Doi: https://doi.org/10.1016/j.joclim.2021.100013.

Brollo, Fernanda, Emine Hanedar, and Sébastien Walker. *Pakistan: Spending Needs for Reaching Sustainable Development Goals (SDGs)*. IMF Working Paper WP/21/108. Washington, DC: International Monetary Fund, 2021. https://www.imf.org/en/Publications/WP/Issues/2021/04/29/Pakistan-Spending-Needs-for-Reaching-Sustainable-Development-Goals-SDGs-50285.

Buchner, Barbara, Baysa Naran, Pedro de Aragão Fernandes, Rajashree Padmanabhi, Paul Rosane, Matthew Solomon, Sean Stout, et al. *Global Landscape of Climate Finance 2021*. Climate Policy Initiative, 2021. Last accessed September 5, 2022. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2021.

Cruz, Jose Luis and Esteban Rossi-Hansberg. *The Economic Geography of Global Warming*. Becker Friedman Institute Working Paper no. 2021-130, 2021. https://bfi.uchicago.edu/insight/research-summary/the-economic-geography-of-global-warning.

Davies, Stephen and William Young. "Unlocking Economic Growth Under a Changing Climate: Agricultural Water Reforms in Pakistan." In *Water Resources of Pakistan: World Water Resources, vol. 9*. Edited by M.A. Watto, M. Mitchell, and S. Bashir. Cham, Switzerland: Springer, 2021. https://doi.org/10.1007/978-3-030-65679-9_7.

Food and Agriculture Organization. Rangelands of Pakistan. Current Status, Threats and Potential. Food and Agriculture Organization, 2016. https://www.fao.org/3/I5660E/i5660e.pdf.

Fernandez Milan, Blanca and Felix Creutzig. "Reducing urban heat wave risk in the 21st century." *Current Opinion in Environmental Sustainability* ISSN: 1877-3435 – 14 (June 2015): 221–231. Doi: http://dx.doi.org/10.14279/depositonce-5766.

German Watch. *Global Climate Risk Index 2021*. https://www.germanwatch.org/en/19777.

Global Burden of Disease (GBD) 2019 Risk Factors Collaborators. "Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019." *Global Health Metrics* 396, no. 10258 (October 2020): P1223–1249, last accessed September 5, 2022. Doi: https://doi.org/10.1016/S0140-6736(20)30752-2.

Global Change Impact Studies Centre. National Greenhouse Gas Inventory Information for Pakistan. 2018. Government of Pakistan. *Pakistan: Updated Nationally Determined Contributions 2021*. Government of Pakistan, 2021. https://unfccc.int/sites/default/files/NDC/2022-06/Pakistan%20Updated%20NDC%202021.pdf.

Government of Pakistan, Finance Division. *Pakistan Economic Survey 2020–21*. Government of Pakistan, 2021. https://www.finance.gov.pk/survey_2021.html.

Government of Pakistan, Finance Division. *Medium Term Budget Strategy Paper (2022/23–2024/25)*. Government of Pakistan, 2022. https://www.finance.gov.pk/budget/Budget_2022_23/MTBSP_2022_23___2024_25.pdf.

Government of Pakistan, Ministry of Climate Change. *National Economic and Environmental Development Study*. Government of Pakistan, 2011, https://unfccc.int/files/adaptation/application/pdf/pakistanneeds.pdf.

Government of Pakistan, Ministry of Climate Change. *Technical Report on Karachi Heat wave June 2015.* Government of Pakistan, 2015. https://ghhin.org/wp-content/uploads/heatwave.pdf.

Government of Pakistan, Ministry of Climate Change. *Pakistan's Second National Communication on Climate Change to United Nations Framework Convention on Climate Change (UNFCCC)*. Government of Pakistan, 2019. https://unfccc.int/documents/199292.

Government of Pakistan, Ministry of Climate Change. *Policies: National Electric Vehicle Policy*. 2019. http://www.mocc.gov.pk/Policies.

Government of Pakistan, Ministry of Climate Change. *Policies: Final Updated National Climate Change Policy*. 2021. http://www.mocc.gov.pk/Policies.

Government of Pakistan, Ministry of Energy. *National Electricity Policy 2021*. Government of Pakistan, 2021. http://www.mowp.gov.pk/userfiles1/file/National%20Electricity%20Policy%202021.pdf.

Hannah Ritchie and Max Roser. "CO_2 and Greenhouse Gas Emissions." *Our World in Data*. 2020. https://ourworldindata.org/greenhouse-gas-emissions.

Ian Parry, Simon Black, and Nate Vernon. *Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies*. Washington, DC: International Monetary Fund, 2021. https://www.imf.org/en/Publications/WP/Issues/2021/09/23/Still-Not-Getting-Energy-Prices-Right-A-Global-and-Country-Update-of-Fossil-Fuel-Subsidies-466004.

IMF. Fossil Fuel Subsidies Database. Washington, DC: International Monetary Fund, 2022. https://www.imf.org/en/Topics/climate-change/energy-subsidies.

India State-Level Disease Burden Initiative Air Pollution Collaborators. "Health and economic impact of air pollution in the states of India: the Global Burden of Disease Study 2019." *Lancet Planet Health* 5, no. 1 (January 2021): e25-e38. Doi: https://doi.org/10.1016/S2542-5196(20)30298-9.

Khan, Amir Nawaz and Ali, Amjad. Desertification Risk Reduction Approaches in Pakistan. Springer, 2014. https://link.springer.com/chapter/10.1007/978-4-431-55369-4_9.

Khan, Mohammed Bilal. "Alternative Energy Policy 2019 at a Glance." *The Nation*, March 18, 2020. https://nation.com.pk/2020/03/18/alternative-energy-policy-2019-at-a-glance.

Kirschbaum, Erik. "Copenhagen has taken bicycle commuting to a whole new level." *Los Angeles Times*, August 8, 2019. https://www.latimes.com/world-nation/story/2019-08-07/copenhagen-has-taken-bicycle-commuting-to-a-new-level.

Looney, R.E. "The Growth and Decline of Pakistan's Rail System." *International Journal of Transport Economics* 25, no. 3 (October 1998): 353–378. https://www.jstor.org/stable/42747994.

Lutz, A.F., W.W. Immerzeel, A.B. Shrestha, and M.F.P. Bierkens. "Consistent increase in High Asia's runoff due to increasing glacier melt and precipitation." *Nature Climate Change* 4 (2014): 587–592. Doi: https://doi.org/10.1038/nclimate2237.

Mako, William P., Ijaz Nabi, and Amna Mahmood. "Developments in Climate Finance and Implications for Pakistan." *Insights for Change*. Consortium for Development Policy Research (CDPR), August 2022. https://mcusercontent.com/bfb54020f918218452cd35b67/files/1c1035c0-0112-4a1b-1249-477f36cacd0a/Development_in_Climate_Finance.pdf.

Mako, William P., Ijaz Nabi, Amna Mahmood, and Shehryar Khan. *Recent developments in climate finance: Implications for Pakistan—Main Report*. Working Paper PAK-22034. International Growth Center (IGC) and the Consortium for Development Policy Research (CDPR), 2022. https://www.theigc.org/wp-content/uploads/2022/09/Mako-et-al-2022-Working-paper.pdf.

Malik, Aslam Amin, Pervaiz Amir, Shakeel Ahmad Ramay, Zuhair Munawar and Vaqar Ahmad. *National Economic and Environmental Development Study (NEEDS).* Ministry of Climate Change, Government of Pakistan, 2011. https://unfccc.int/files/adaptation/application/pdf/pakistanneeds.pdf.

Malik, Sadia Mariam, Haroon Awan, and Niazullah Khan. "Mapping vulnerability to climate change and its repercussions on human health in Pakistan." *Globalization and Health* 8, no. 31 (2012). Doi: https://doi.org/10.1186/1744-8603-8-31.

Mansuri, Ghazala, Mohammad Farhanullah Sami, Mohammad Ali, Bilal Javed, Priyanka Pandey, and Dung Thi Thu Doan. *When Water Becomes a Hazard: A Diagnostic Report on The State of Water Supply, Sanitation, and Poverty in Pakistan and Its Impact on Child Stunting.* Working paper. Washington DC: World Bank, 2018. https://openknowledge.worldbank.org/handle/10986/30799?show=full.

Mueller, V., C. Gray, and K. Kosec. "Heat stress increases long-term human migration in rural Pakistan." *Nature Clim Change* 4(2014): 182–185. Doi: https://doi.org/10.1038/nclimate2103.

Narain, Urvashi and Chris Sall. *Methodology for Valuing the Health Impacts of Air Pollution: Discussion of Challenges and Proposed Solutions.* Washington, DC: World Bank Group, 2016. https://openknowledge.worldbank.org/handle/10986/24440.

Organisation for Economic Co-operation and Development. *Mortality Risk Valuation in Environment, Health and Transport Policies.* Paris: OECD Publishing, 2012. Doi: https://doi.org/10.1787/9789264130807-en.

NEPRA. "Notification (S.R.O 306(1)/2017 dated 02-05-2017) Regarding NEPRA Competitive Bidding Tariff (Approval Procedure) Regulations, 2017." Memorandum from the director of NEPRA. Government of Pakistan, 2017. https://nepra.org.pk/Legislation/3Reg/3.7%20NEPRA%20Competitive%20Bidding%20Tariff%20(Approval%20Procedure)%20Regulations,%202008/NCBT-01%2003-05-2017%206072.pdf.

Pörtner, H.-O., D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, et al. eds. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*, IPCC Sixth Assessment Report, edited by H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, et al. Cambridge University Press (in press). https://www.ipcc.ch/report/ar6/wg2.

Qureshi, Asad Sarwar and Chris Perry. "Managing Water and Salt for Sustainable Agriculture in the Indus Basin of Pakistan." *Sustainability* 13, no. 9 (May 2021): 5303. Doi: https://doi.org/10.3390/su13095303.

Schelske, Oliver, Bernd Wilke, Anna Retsa, Gillian Rutherford-Liske, and Rogier de Jong. *Biodiversity and Ecosystems Services Index: measuring the value of nature.* Swiss Re Institute, September 24, 2020. Last accessed September 5, 2022. https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-biodiversity-and-ecosystems-services.html#.

Silpa, Lisa Yao, Perinaz Bhada-Tata and Frank Van Woerden. *What a Waste 2.0 —A Global Snapshot of Solid Waste Management to 2050.* Washington, DC: World Bank Group, 2018. https://openknowledge.worldbank.org/handle/10986/30317.

Syed Safeer Hussain. "Submission of Revised Indicative Generation Capacity Expansion Plan (IGCEP) 2021–30)." National Electric Power Regulatory Authority (NEPRA), Managing Director's Letter to National Transmission & Despatch Co. Ltd (NTDC). September 24, 2021, Republic of Pakistan. https://nepra.org.pk/licensing/Licences/LAT-01%20IGCEP%2024-09-2021%2037702-29.pdf.

United Nations Climate Change. *Nationally Determined Contributions Registry*. 2021. https://unfccc.int/NDCREG.

United Nations Development Programme. *Pakistan – Climate Public Expenditure and Institutional Review (CPEIR).* New York: UNDP, 2017.

WHO. "Health consequences of air pollution on populations." *WHO News* (website). November 15, 2019. Last accessed September 5, 2022. https://www.who.int/news/item/15-11-2019-what-are-health-consequences-of-air-pollution-onpopulations#:~:text=Exposure%20to%20high%20levels%20of,people%20who%20are%20already%20ill.

World Bank. *Revitalizing Pakistan's Fisheries: Options for Sustainable Development*. Washington, DC: World Bank Group, 2018. https://openknowledge.worldbank.org/handle/10986/30156.

World Bank. *Opportunities for a Clean and Green Pakistan: A Country Environmental Analysis*. Washington DC: World Bank Group, 2019. https://openknowledge.worldbank.org/handle/10986/32328.

World Bank. *Pakistan at 100: Shaping the Future.* Washington DC: World Bank Group, 2019. https://openknowledge.worldbank.org/handle/10986/31335.

World Bank. "Fertility rate, total (births per woman) – Pakistan." World Bank website, 2020. Last accessed September 5, 2022. https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=PK.

World Bank. "Foreign Direct Investment, Net Inflows (% of GDP) – Pakistan." World Bank website, 2020. https://data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS?locations=PK.

World Bank. *Forest area (% of land area) – Pakistan*. Washington DC: World Bank Group, 2020. Last accessed September 4, 2022. https://data.worldbank.org/indicator/AG.LND.FRST.ZS?end=2020&locations=PK&start=2000

World Bank. *Leveling the Playing Field: Pakistan Systematic Country Diagnostic*. Washington DC: World Bank Group, 2020. https://doi.org/10.1596/34549.

World Bank. "Rural Population (% of total population) – Pakistan." World Bank website, 2020. https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=PK.

World Bank. "Solar Photovoltaic Power Potential by Country." *World Bank Understanding Poverty* website, July 23, 2020. https://www.worldbank.org/en/topic/energy/publication/solar-photovoltaic-power-potential-by-country.

World Bank. *Variable Renewable Energy Integration and Planning Study*. Washington, DC: World Bank Group, 2020. https://openknowledge.worldbank.org/handle/10986/34586.

World Bank. *Overview of the Urban Immovable Property Tax in Pakistan and Revenue Simulations*. Draft. Washington DC: World Bank Group, 2021.

World Bank. *Pakistan Blue Carbon Rapid Assessment: Policy Recommendations for the Revision of Nationally Determined Contribution*. Washington, DC: World Bank Group, 2021. https://openknowledge.worldbank.org/handle/10986/35663.

World Bank. "Urban Population (% of total population) – Pakistan." World Bank website, 2021. https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=PK

World Bank. *Variable Renewable Energy Locational Study*. Washington, DC: World Bank Group, 2021. https://openknowledge.worldbank.org/handle/10986/35113.

World Bank. "Pakistan: Climate Projections." Climate Change Knowledge Portal. Last accessed June 10, 2022. https://climateknowledgeportal.worldbank.org/country/pakistan/climate-data-projections.

World Bank. *Pakistan Climate and Health Vulnerability Assessment*. Draft. Washington, DC: World Bank Group, 2022.

World Bank. *Pakistan Human Capital Review.* Draft. Washington, DC: World Bank Group, 2022.

World Bank. "Poverty headcount ratio at $3.20 a day (2011 PPP) (percentage of population)." World Bank Poverty and Inequality Platform. Washington, DC: World Bank Group, 2022. https://data.worldbank.org/indicator/SI.POV.LMIC.

World Bank. *Variable Renewable Energy Competitive Bidding Study*. Washington, DC: World Bank Group, 2022. https://openknowledge.worldbank.org/handle/10986/37405.

World Bank, *The Changing Wealth of Nations*, (Washington DC: World Bank Group, 2021), https://openknowledge.worldbank.org/handle/10986/36400.

World Bank. "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050." World Bank website. Last accessed September 5, 2022. https://datatopics.worldbank.org/what-a-waste.

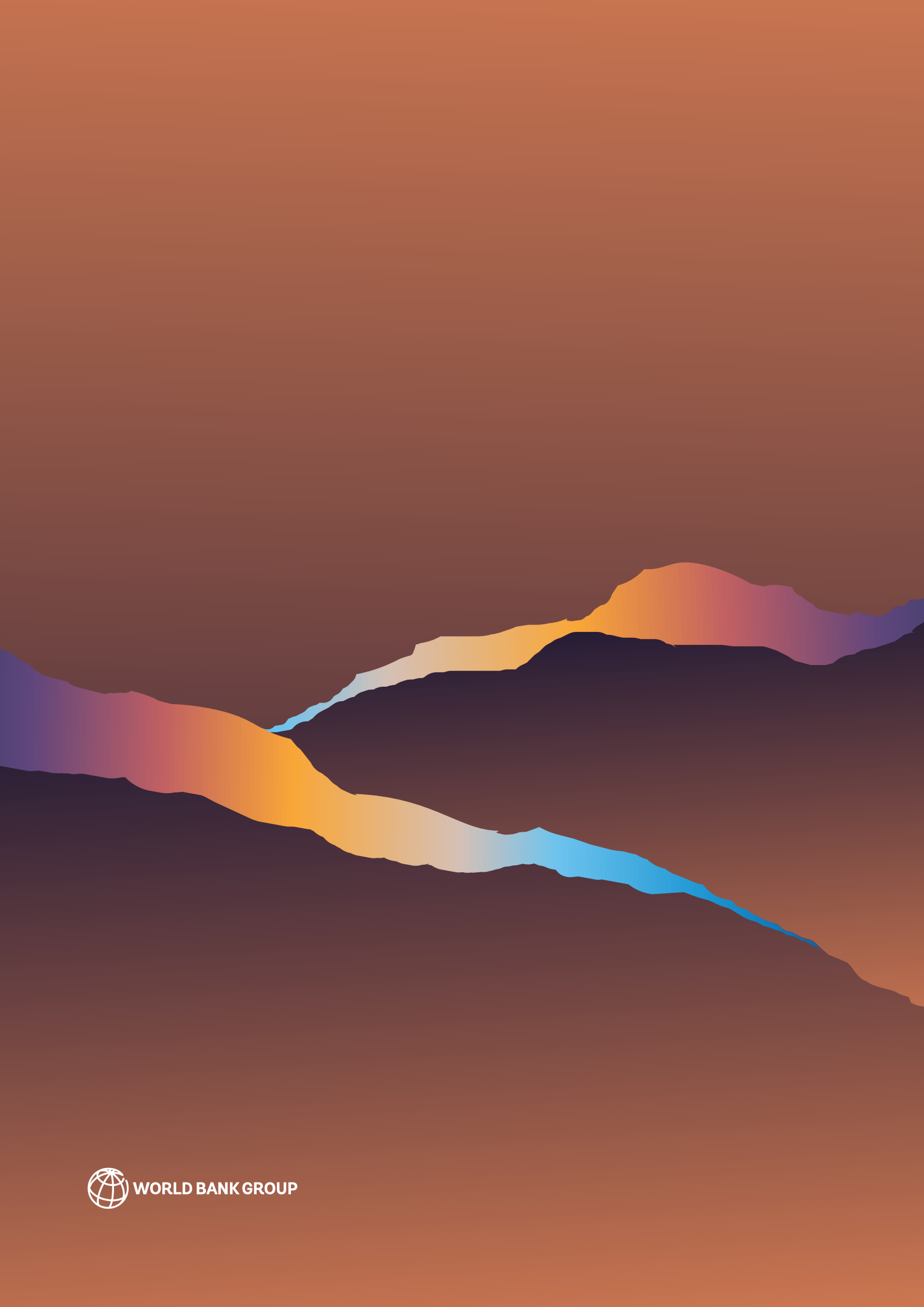
World Bank and Asian Development Bank. *Climate Risk Country Profile: Pakistan.* Washington, DC and Manila: The World Bank Group and the Asian Development Bank, 2021. https://openknowledge.worldbank.org/handle/10986/36372.

World Economic Forum. “Record-breaking heat wave strains 'limits of human survivability' in India and Pakistan.” WEF, May 9, 2022. Last accessed September 4, 2022. https://www.weforum.org/agenda/2022/05/record-breaking-heatwaves-limit-human-survivability-india-pakistan.

World Resources Institute. “Global Historical GHG Emissions.” CLIMATEWATCH. 2022. https://www.climatewatchdata.org/ghg-emissions?end_year=2018&regions=PAK&start_year=1990.

Young, William J., Arif Anwar, Tousif Bhatti, Edoardo Borgomeo, Stephen Davies, William R. Garthwaite III, E. Michael Gilmont, et al. *Pakistan: Getting More from Water*. Washington, DC: World Bank Group, 2021. https://openknowledge.worldbank.org/handle/10986/31160.

Zhang, Fan. *In the Dark: How Much Do Power Sector Distortions Cost South Asia?* South Asia Development Forum. Washington, DC: World Bank Group, 2019. https://openknowledge.worldbank.org/handle/10986/30923.



WORLD BANK GROUP