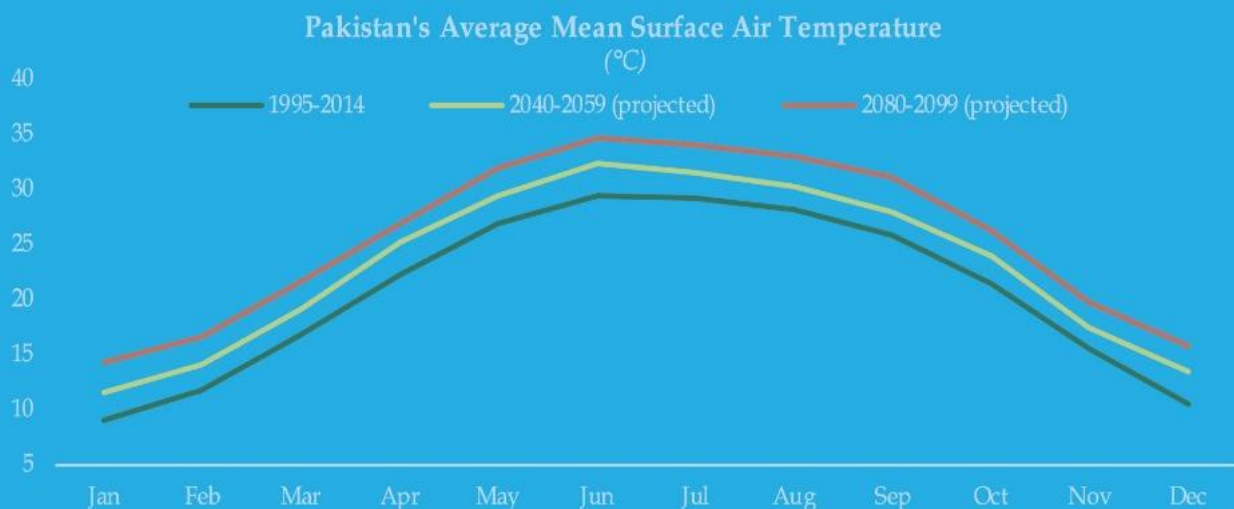




# 6

## Climate Change and its Impact on Pakistan's Economy

*Climate change poses an immediate and systemic risk to Pakistan's economy. Despite contributing very little to global greenhouse gas emissions, Pakistan is among the most climate-vulnerable countries. Climate change is already exerting significant pressure on Pakistan's economy and is expected to intensify in the coming years. It is driving substantial losses to both agriculture and industry, while creating challenges for maintaining price stability. Whilst Pakistan contributes only 1 percent to total global GHG emissions, the country's emissions intensity is high, pointing towards an inefficient, carbon-intensive production process. Considering Pakistan's climate vulnerabilities as well as large and steadily growing population and aspiration for sustained economic growth, these realities necessitate large investments in both mitigation and adaptation. Against these challenges, Pakistan's preparedness to address climate change is weak. The country's climate action is constrained by weaknesses in policy and institutional environment; technical capacity and human capital deficits; and limited social readiness – all of which warrant urgent attention. There is also an urgent need to mobilise domestic resources for climate finance, particularly in light of persistently high financing gaps for mitigation and adaptation needs amid limited international climate inflow, and misaligned global priorities.*





# 6 Climate Change and its Impact on Pakistan's Economy

## 6.1 Introduction

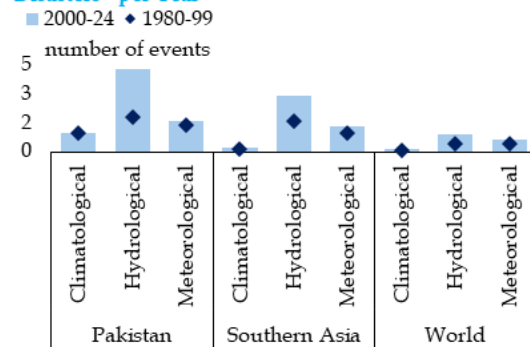
Climate change is no longer a distant risk.<sup>1</sup> It is a real, systemic global risk with profound impact on lives and livelihoods, reshaping economic structure, GDP growth, productivity, and financing decisions across the globe. Moreover, scientific evidence is clear that climate change is also contributing to the breach of other planetary boundaries, triggering tangible risks of irreversible and abrupt environmental damages (**Appendix 6A**).<sup>2</sup> There is also strong evidence that unless necessary and timely action is taken by the global community, the intensity of climate change will inevitably increase, leading to further economic damages and social disparities amid growing ecological imbalances.

Evidence of the impact of climate change around the world continues to accumulate. Between 1995 and 2024, more than 9,700 global climatic events have led to direct economic losses of around US\$ 4.5 trillion (in real terms), affecting 5.7 billion people, and causing more than 832 thousand fatalities worldwide (Germanwatch, 2025). The impact of global climate change is pronounced in Pakistan, which is the 15<sup>th</sup> most affected country from climatic events between 1995-2024 (Germanwatch, 2025). Climatic disasters in Pakistan have been higher than both global and regional averages in 2000-24 as well as in the preceding two decades (**Figure 6.1**).

Moreover, signs of continued climate stress in Pakistan are increasingly being manifested through higher temperatures, erratic rainfall, rising sea levels, and rapid glacial retreat (**Figure 6.2a-d**). Damages from climatic events can escalate non-linearly as climate issues reinforce each other, such as intense rains after a heatwave coinciding with glacial melt (IMF, 2025a).

The biggest underlying driver of global climate change is the emission of greenhouse gases (GHG), chief among which are carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) emissions. In absolute terms, global GHG emissions are driven by advanced economies (AEs), leading emerging markets and developing economies (EMDEs) along with some major producers of global fossil fuels (**Figure 6.3**).

**Average Frequency of Selected Climate Disasters\* per Year** Figure 6.1



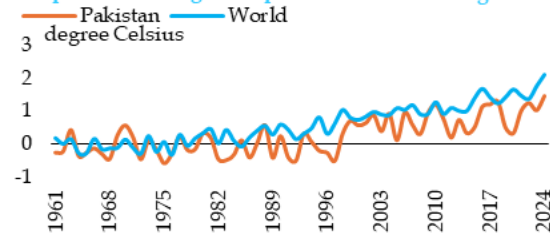
\*Climatological: GLOF, drought, forest fire etc.;  
Hydrological: floods, avalanches(wet), landslides(wet) etc.; Meteorological: heatwave, storm, cyclones etc.  
Source: EM-DAT

<sup>1</sup> Climate change refers to long-term shifts in temperature (i.e. global warming) and weather patterns that can occur naturally but is now primarily driven by human activities. Source: UN (n.d.a)

<sup>2</sup> Planetary boundaries refer to the limits to nine environmental, biophysical dimensions of earth within which it must remain for humanity to survive and thrive. This chapter mainly focuses on climate change, which is only one of the 7 (out of 9) planetary boundaries crossed. The breaching of planetary boundaries; how it impacts Pakistan, and how Pakistan contributes to their breach is discussed briefly in **Appendix 6A**.

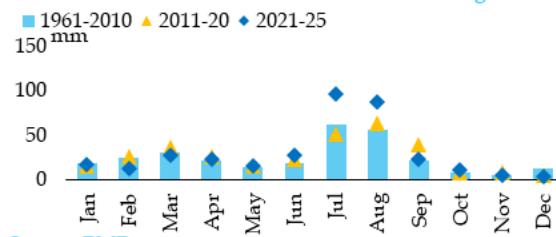
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Temperature Change Compared to 1951-80\*



Source: CID, IMF

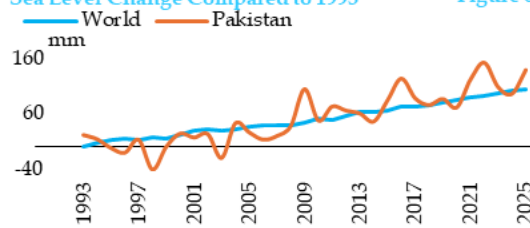
Figure 6.2a Rainfall in Pakistan



Source: PMD

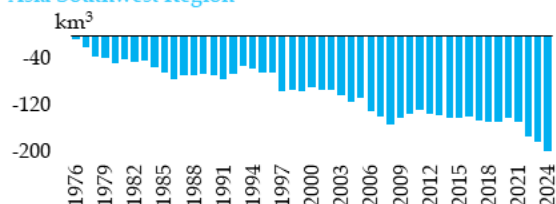
Figure 6.2b

Sea Level Change Compared to 1993\*\*



\*1951-1980 avg. temperature is the baseline as per NASA.  
 \*\*1993 marks the start of sea level satellite record  
 Source: WB

Figure 6.2c Cumulative Change in Selected Glaciers of Asia Southwest Region\*\*\*

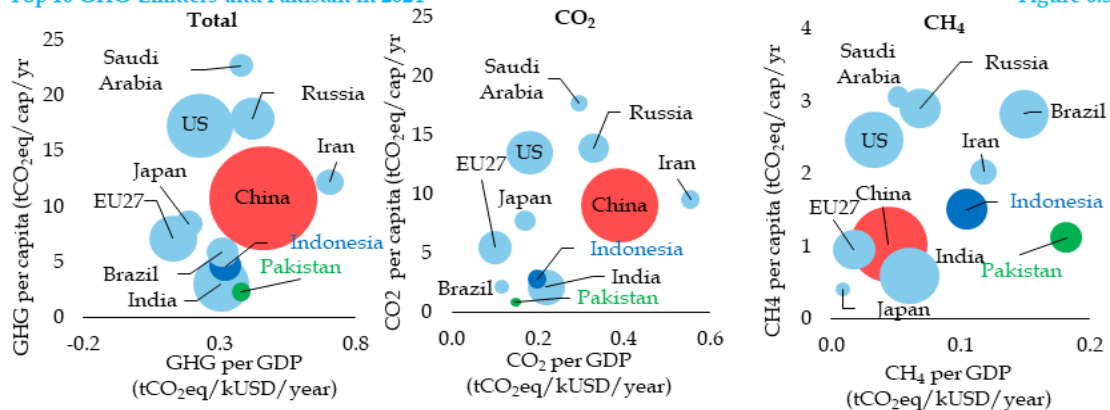


\*\*\* Majorly Pakistan and some parts of occupied Kashmir and China  
 Source: WGMS

The top ten GHG emitting economies together contribute about 70 percent of total global GHG emissions.<sup>3</sup> In contrast, Pakistan contributes only 1 percent to total global GHG emissions.<sup>4</sup> Similarly, Pakistan's per-capita emissions remain notably low, ranking 147<sup>th</sup> in the world.

However, Pakistan's emission intensity – measured as GHG emission per unit of GDP – is relatively high, despite modest improvement over time (Figure 6.3 & 6.4). Pakistan ranks 20<sup>th</sup> in global GHG emission as against 45<sup>th</sup> rank in terms of nominal

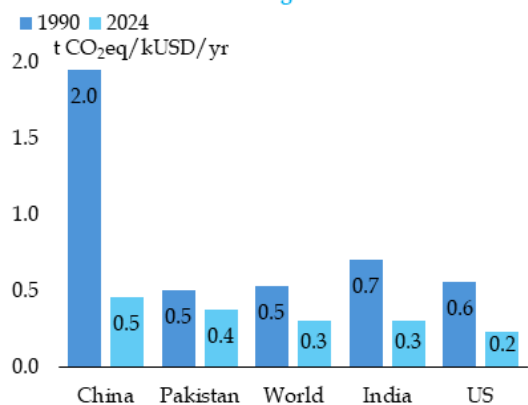
Top 10 GHG Emitters and Pakistan in 2024



Note: Size of the bubble indicates emissions in absolute terms.  
 Source: EDGAR

<sup>3</sup> Nearly 54 percent of total global GHG are contributed by the top 4 emitting economies in 2024. Source: EDGAR (n.d.)  
<sup>4</sup> EDGAR (n.d.).

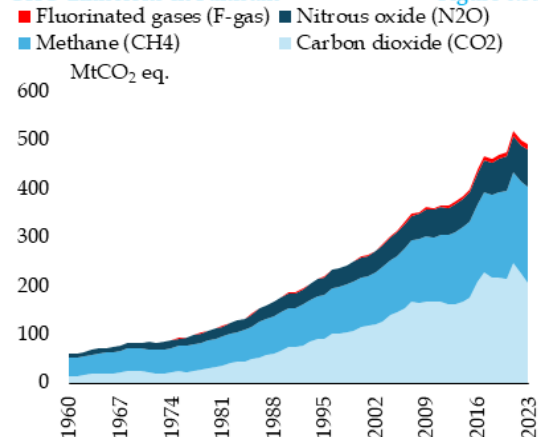
**Emission Intensity (GHG/GDP) - Selected Countries and Global Average** Figure 6.4



Source: EDGAR

GDP.<sup>5</sup> Since the 1960s, total emissions have increased significantly, with the energy and agriculture sectors as the major contributors (Figure 6.5a & b). Pakistan's high emission intensity puts the country at the risk of materially increasing its emissions, if its economy continues to follow the traditional development

**GHG Emissions in Pakistan** Figure 6.5a



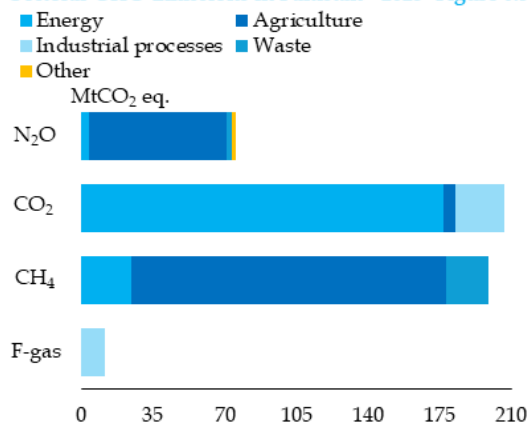
Source: WRI

pathways.

Historically, growth in per capita income and human development in countries around the world has been achieved on the back of high energy consumption and high GHG emissions.<sup>6</sup> However, rising income levels along with population growth continue to be the biggest drivers of global CO<sub>2</sub> emissions in energy sector,<sup>7</sup> despite improvements in the energy intensity of GDP and carbon intensity of energy (Figure 6.6a). The same is true for Pakistan, where growth in population and income, alongside relatively high carbon intensity of energy, are driving the growth in CO<sub>2</sub> emissions of energy sector (Figure 6.6b).<sup>8</sup>

As things stand presently, global climate action remains inadequate across all indicators required to achieve the 2030 target to contain global warming to 1.5 °C

**Sectoral GHG Emissions in Pakistan - 2023** Figure 6.5b



Source: WRI

<sup>5</sup> Both numbers are for 2023. Source: EDGAR (n.d.); WB (n.d.)

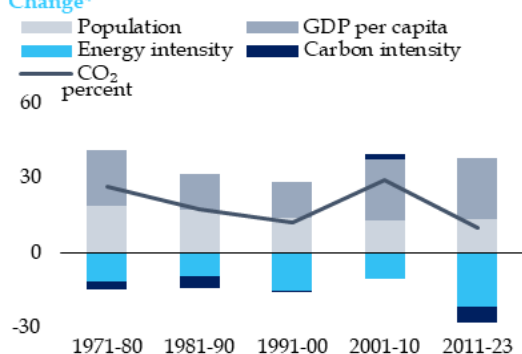
<sup>6</sup> Guliyev, H., & Seyfullayev, I. (2025); Li et al. (2022)

<sup>7</sup> Energy sector contributes about two-third of global CO<sub>2</sub> emissions.

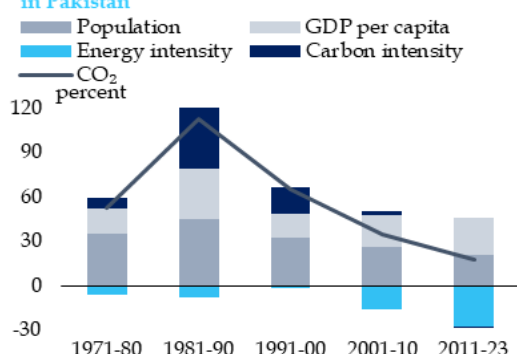
<sup>8</sup> Pakistan's carbon intensity of industrial energy consumption is nearly 38 percent greater than that of North America, and 50 percent more than the European Union (EU). Source: WB (2023a)

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Global Drivers of Global CO2 Emission Change\* Figure 6.6a



Drivers of CO2 Emission Change\* in Pakistan Figure 6.6b



\* Contribution to energy related CO<sub>2</sub> emissions based on Kaya identity: CO<sub>2</sub> emissions = population x GDP per capita x energy intensity (total energy supply (TES)/GDP) x carbon intensity (CO<sub>2</sub>/TES). Source: IEA

(Schumer et al., 2025).<sup>9</sup> The last ten years were the warmest on record; in fact, in 2024 temperatures reached 1.55 °C above the pre-industrial level (1850-1900 AD).<sup>10,11</sup> The situation is grave for Pakistan as it faces warming at a considerably higher rate than world average (GoP, 2025a).

In light of the foregoing discussion, Pakistan faces a particularly challenging position. On the one hand, it is one of the most climate-vulnerable countries despite contributing very little to global GHG emissions. On the other hand, it needs to develop its economy and increase GDP growth, while decreasing emission intensity. This is indeed a daunting challenge, considering that decoupling of

GDP growth – from CO<sub>2</sub> emission and resource depletion – is a transition that even AEs with all their financial resources, strong institutions and technological progress have only begun recently.<sup>12</sup>

Notwithstanding these challenges, Pakistan has shown strong commitment to climate action through the formulation and progressive enhancement of Nationally Determined Contributions (NDCs). Under the Paris Agreement, Pakistan has pledged to cut 50 percent of GHG emissions by 2035 compared to Business as Usual (BAU) scenario.<sup>13</sup> To this end, the country has taken several initiatives, such as ten billion tree tsunami, mangrove conservation and restoration drives (GoP, 2025b). Pakistan

<sup>9</sup> Climate action includes mitigation (practices to reduce GHG emissions or enhance carbon sinks to absorb GHG emissions) and adaptation (adjustment of existing system to reduce vulnerability to the current and future impacts of climate change). Source: IPCC (2022); EU (n.d.)

<sup>10</sup> UN (n.d.b)

<sup>11</sup> Under the Paris Agreement, countries committed to reduce GHG emissions to keep long-term global warming well below 2 °C while pursuing efforts to limit it to 1.5 °C, as the impact is much lower at 1.5 °C. Source: UNFCCC (2015)

<sup>12</sup> Berahab, R. (2017)

<sup>13</sup> Under BAU, emissions are projected to rise from 405 MtCO<sub>2</sub>e in 2015 to 2,559 MtCO<sub>2</sub>e by 2035. Of the pledged fifty percent reduction, seventeen percent will be achieved unconditionally through domestic resources, whereas the remaining thirty-three percent is subject to provision of grant based or concessional international finance, technology transfer, and capacity building. Source: GoP (2024a).

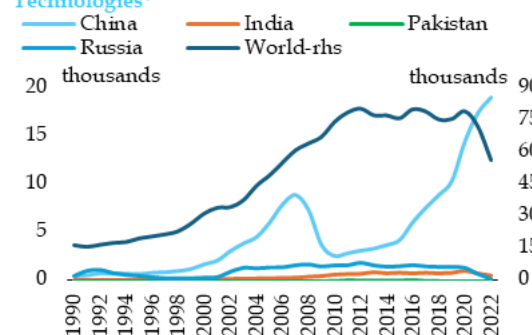
has also emerged as a global leader in rooftop solar, expanding its capacity by nearly twenty times between 2022 and 2024 (Schumer et al., 2025). At the same time, the country has rolled out an electric vehicle policy alongside energy efficiency measures across various sectors, such as building infrastructure and consumer appliances. Moreover, to support the efforts towards building resilience to climate vulnerabilities and natural disasters, Pakistan has also secured financing under the IMF's resilience and sustainability facility (RSF).

Undertaking actions like these for climate mitigation and adaptation is not only crucial for combating climate risks faced by

the country but also for maintaining economic competitiveness.<sup>14</sup> The latter is particularly true in light of rising global investors' interest in environmental, social and governance (ESG) assets amid increasing concern for environment,<sup>15</sup> and shifting trade and investment preferences.<sup>16</sup> In addition, the upward trend in green patents globally presents an opportunity for Pakistan to leapfrog carbon intensive pathways and instead directly adopt green technologies (Figure 6.7).<sup>17</sup>

Against this backdrop, the rest of this chapter is organised as follows. Section 6.2 sheds light on the already realised and expected impact of climate change on Pakistan's economy as well as economic policymaking, where the key finding is that climate change has evolved from long-term concern to pressing macroeconomic risk. This is followed by Section 6.3 that discusses the challenges related to climate action, including limited institutional and technical capacities, which reflect Pakistan's low level of preparedness to face climate shocks. Section 6.4 highlights the need to mobilise domestic resources for climate finance considering consistently low international inflows. Section 6.5 offers concluding remarks with broad recommendations.

Patents for Environment-related Technologies\* Figure 6.7



\*Technologies relevant to environmental management, climate change mitigation, climate change adaptation and ocean sustainability  
Source: OECD

<sup>14</sup> Climate mitigation and adaptation enhance competitiveness by reducing climate-related losses, supporting green innovation, and leveraging policies like carbon border adjustment mechanism (CBAM) and emission trading.

<sup>15</sup> ESG assets are on its way to become 25 percent of global assets under management by 2030 (Bloomberg, 2024). This is amid growing commitment by corporate shareholders towards profits, people and planet as against yesteryears' sole focus on shareholder value maximisation. For instance, in 2019 Business Roundtable (BRT), a 50-year-old association of American CEOs, shocked corporate governance theorists with a commitment to deliver value to all corporate stakeholders, including communities, instead of only serving shareholders. BRT also support reduction in GHG emission (BRT, n.d.).

<sup>16</sup> For details, see Section 6.2 and Box 6.2

<sup>17</sup> The share of SDGs related patents increased from about 25 percent in 2015 to 31.4 percent in 2023. Within this, patents specifically linked to climate action (SDG 13) and affordable and clean energy (SDG 7) grew faster than most other SDGs between 2000 and 2023, highlighting accelerated innovation in green technologies. (WIPO, 2024)

## 6.2 Impact of Climate Change on Pakistan's Economy<sup>18</sup>

Climate change poses multi-sectoral and multifaceted threats to Pakistan's economy. The directly exposed sectors, most notably agriculture, energy, infrastructure, and tourism, experience the most immediate and visible impacts,<sup>19</sup> with their repercussions extending into industry and services sectors. They also have negative socio-economic consequences that undermine the progress towards sustainable development goals (SDGs).<sup>20</sup>

Climate disasters have already inflicted economic losses amounting to US\$ 29.3 billion on Pakistan's economy during 1992-2021 (IMF, 2025), whereas the 2022 floods alone caused damages of around US\$ 28 billion (MoPD&SI, 2022).<sup>21</sup> SBP staff estimates also show that in terms of direct impact, floods had significant and negative effect on GDP, albeit it was partially compensated owing to post-diluvial improvements in agricultural output and post-disaster rehabilitation and recovery. Nevertheless, the floods also had an indirect (negative) impact on GDP through increases in input prices (**Box 6.1**).

In the long term, World Bank (2022) estimates show Pakistan's GDP is projected to fall by 4.5–6.5 percent by 2050 due to climate change in the optimistic scenario, and by as much as 7–9 percent in the pessimistic scenario, where agriculture and industry are the most exposed sectors.<sup>22</sup> Without timely climate action, the output of both these sectors is estimated to drop by up to 17 percent, by 2050.

Moreover, in addition to physical and operational level impacts, there are significant transitional risks that impact various sectors of the economy.<sup>23</sup> In view of these risks, this section maps out broad contours of climate change impacts and its risks across agriculture and industrial sectors, along with risks to inflation, external account, and fiscal position.

### Impact on Agriculture

Pakistan's agriculture sector is among the country's most climate vulnerable and hardest-hit sectors, being highly sensitive to climate variability and extreme weather events. Given the sector's importance, even modest climate shocks translate into huge economic losses and threaten food

<sup>18</sup> In consideration of limited empirical estimates of future climate-related losses in Pakistan, some sub-sections of Section 6.2 are based on global literature review in the context of Pakistan's economy. Forecasting of its economic impacts is challenging since frequency and magnitude of climatic events are uncertain (Batten, 2018).

<sup>19</sup> IPCC (2023)

<sup>20</sup> IMF (2025a); UN-Habitat (2023).

<sup>21</sup> Both numbers are adjusted for 2021 inflation.

<sup>22</sup> The risks of these declines are compared to BAU without further climate impacts and a counterfactual steady GDP growth of 4 percent by 2050. Pessimistic scenario assumes the likelihood of simultaneous and multiple climate events, which may compound the direct and indirect risks.

<sup>23</sup> Examples of physical impact include flood related damage to crop and industrial facilities, whereas examples of operational impact, includes heatwaves affecting agricultural and labour productivity. Transitional impacts stem from policy pressure, carbon pricing, shifting consumer demand requiring decarbonisation via new materials/processes. Source: BoE (2018)

security.<sup>24</sup> In fact, agriculture sector was the hardest hit in the 2010, 2022, and 2025 floods with damages estimated at US\$ 5.0, 13.0, and 1.5 billion, respectively (NDMA, 2025; MoPD&SI, 2025).

**Crop production:** Crop production is highly sensitive to fluctuations in temperature, rainfall patterns, water availability, and extreme events – such as floods, droughts, and heatwaves (ADB, 2017). For example, in 2010, floods submerged 2.3 million hectares of *Kharif* crops, destroyed around 2 million bales of cotton (ADB & WB, 2010). In 2022 floods, crops accounted for around eighty percent of total agriculture damage, with livestock contributing 17 percent. Around 1.8 million hectares of agricultural land was damaged (MoPD&SI, 2022). Similarly, during 2025 floods, agriculture sector was the most affected, with 2.2 million acres of crop land inundated.

Furthermore, estimates suggest that a 0.5 – 2.0 °C rise in temperature will reduce overall agricultural productivity by around 8 – 10 percent by 2040 (Dehlavi et al., 2015), while overall crop yields may decline by 47 percent by 2050 (UNDP, 2024). Yield reductions due to climate change are estimated to be widespread across all major crops (**Table 6.1**). Similarly, a 3–5 °C rise can reduce cotton and sugarcane yields by up to 6 and 16 percent per year, respectively (Akbar & Gheewala, 2020).

Change in Yield\*

Table 6.1

Major Crops	Pakistan vs World	percent		
		Next Decades (2020-39)	Mid-Century (2040-2059)	End of Century (2080-2099)
Maize	Pakistan	-6.2	-10.2	-10.4
	World	-3.6	-7.3	-11.2
Rice	Pakistan	-13	-22.5	-29.7
	World	-1	-1.1	-2.2
Wheat	Pakistan	-0.6	-2.1	-6.2
	World	-3.5	-7.5	-12.9

\*Projected annual change due to climate change (moderate emission scenario) compared to a scenario without climate change

Source: UNDP (n.d.)

**Water stress:** Agriculture output losses are compounded by growing water stress,<sup>25</sup> as the sector is the largest consumer of water, using about 96 percent of freshwater withdrawals (WB, n.d.). With more than 82 percent of arable land depending on river-fed irrigation,<sup>26</sup> rising temperature and increasing weather variability exacerbate these issues. This adds to growing demand for scarcer water resources and puts the food system at further risk (ADB, 2012).

Moreover, accelerated glacier melting has not only caused floods, damaging the crops directly but also depleted water resources. As these glaciers deplete, flows may decrease by around 30-40 percent in the next 50 years (ADB, 2017). At the same time, rainfall patterns have become erratic; prolonged dry spells during the winter season and above normal monsoon rains, often resulting in floods, have hampered crop productivity and caused substantial losses to agriculture sector (SBP, 2025; SBP,

<sup>24</sup> The sector contributes 23.3 percent to Pakistan's GDP, sustains over one-third of the labour force with majority being women, and directly and indirectly contributes around 70 percent of the country's exports. Source: PBS (2025a); PBS (2025b); FAO (n.d.a)

<sup>25</sup> Total renewable water resources per capita have fallen from 4,858.3 m<sup>3</sup>/inhab/year in 1964 to 1,012.72, m<sup>3</sup>/inhab/year in 2022, well below the water stress threshold of 1,700 cubic meter. Source: FAO (n.d.b)

<sup>26</sup> Source: FAO (n.d.a)

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2023a). These climatic pressures on water resources are compounding the challenges posed by inefficient water management that has led to greater water scarcity, and low use efficiency (Figure 6.8) amid depletion of ground water at an alarming rate (PIDE, 2022).

**Livestock:** Climate change directly affects livestock sector in terms of loss of livestock, its reproduction and health. For instance, the 2010 and 2022 floods in Pakistan caused about 1.5 million and 0.8 million livestock fatalities, respectively (MoPD&SI, 2022; ADB & WB, 2010). In addition, climate change can affect livestock indirectly via feed and fodder (Gauly et al., 2013). Excessive heat stress not only harms the health, fertility, and productivity of farm animals but also causes an immediate reduction in milk yield of dairy animals (Rahman et al., 2019).

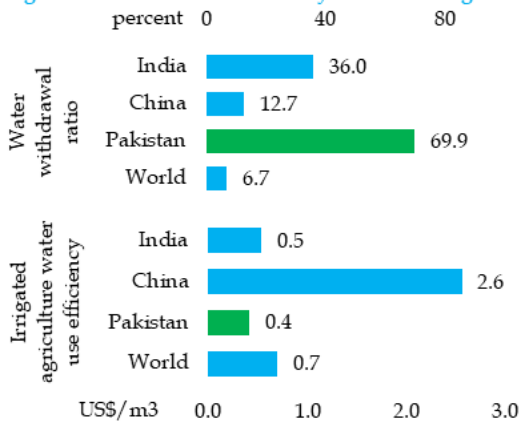
Moreover, water scarcity impacts feed production, leading to livestock weight loss

and higher mortality during prolonged dry periods (Chandio et al., 2023).<sup>27</sup> In the absence of climate action, livestock losses in Pakistan are estimated to be 18 percent of GDP by 2030 (UNDP, 2024). In addition to these physical impacts, the livestock sector also faces a major transitional impact considering that it is characterised by relatively high methane intensity of livestock products (Figure 6.9).

**Impact on Industry**

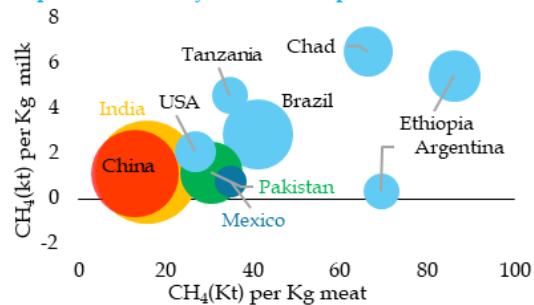
While the impact of climate change on agriculture remains central, it has cascading impacts across industrial sectors, including manufacturing, energy and others. These impacts range from physical damage to supply chain breakdowns and reduced productivity. For example, the recent floods in Pakistan affected industrial activities both due to reduced raw materials availability and supply chain disruptions, with estimated industrial losses at US\$ 0.3 billion in 2010 and US\$ 3.8

Agriculture Water Use Efficiency in 2022 Figure 6.8



Source FAO

Methane Emissions from Livestock in 2023 - Top 10 Countries by Livestock Population Figure 6.9



\*Total methane emissions by livestock per kg of meat and milk produced by cattle, goat, sheep, & buffalo  
 Note: size of bubble represents number of animals (cattle, goat, sheep, & buffalo)  
 Source: FAO

<sup>27</sup> For instance, droughts during 1999-2002 in Sindh and Balochistan killed two million livestock (WB & ADB, 2021), whereas livestock output declined by 48 percent in the worst affected districts by droughts during 2015-2017 (WB, 2022).

billion in 2022 (SBP, 2023a; MoPD&SI, 2022; ADB & WB, 2010).

**Manufacturing:** In terms of physical damage, the impact of climate change events on crops and livestock have spillover effects on wheat and rice milling, food processing, textile and other agro-based manufacturing industries. These industries face shortage of inputs and raw materials due to loss of agriculture output.

Similarly, within manufacturing, textile and clothing sub-sectors are at risk from climate change across their production cycle (Table 6.2). Textile industry also faces a major transitional impact, considering that it is one of the largest contributors to global GHG emissions, higher than aviation and shipping sectors (UNCTAD, 2025; Filho et al., 2022). As a result, there is a demand for sustainable and green production cycle to reduce the impact on climate change through different regulations. Adapting these measures imposes an additional cost on the industry.

**Energy:** As one of the most climate exposed sectors and one of the main drivers of climate change, energy sector faces a variety of climate risks. Energy infrastructures – generation and distribution systems – are vulnerable to extreme weather conditions and natural disasters (Mikellidou et al., 2018; Goncalves et al., 2024).

In Pakistan, the country's 11,500 MW of hydel power capacity,<sup>28</sup> which was 28.0 percent of total grid as of FY25, is

<sup>28</sup> NEPRA (2025).

<sup>29</sup> MoF (2024).

**Climate Impacts on Textile Sector** Table 6.2

Climatic event	Impact channel	Impact
Temperature, precipitation, extreme weather	Raw material supply	Yield reduction, quality decline, price volatility
Water availability, energy supply, extreme weather	Production operations	Operational disruptions, increased costs, resource scarcity
Extreme weather, sea level rise	Supply chain logistics	Infrastructure damage, transport delays, higher shipping costs
Climate migration, job displacement	Labour stability	Workforce Disruptions, Social Challenges in Production Hubs

Source: Sustainability directory

vulnerable to climatic conditions due to increased variability of rain, glacial melting, and drought amid rising temperatures. At the same time, with thermal power grid capacity at 56.3 percent, energy sector also faces a transitional risk, becoming more evident as the country adds decentralised solar to the overall energy mix. Moreover, extreme temperature results in tripping of T&D lines, while high power demand in extreme heat also results in power-breakdown (IGC, 2025a; Mahmood et al., 2013; Mohsin et al., 2024).

#### Impact on Labour Productivity

Labour productivity in Pakistan across all sectors, including agriculture and manufacturing, is estimated to decline by 7 percent and 10 percent due to climate change under moderate and high emission scenarios, respectively.<sup>29</sup> UNDP's Human Climate Horizon (HCH) estimates show that Pakistan is at risk of losing

significantly higher number of labour hours per worker in a year compared to global average in both low-risk sectors and high-risk sectors over the next three decades.<sup>30</sup> These losses are projected to increase further, if the necessary climate action is not undertaken (Figure 6.10).

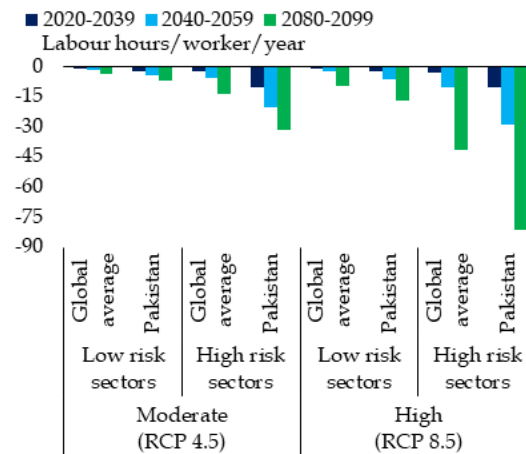
This is because high temperature and heat stress affect labour productivity across the globe due to occupational safety and health hazard (ILO, 2020). Such is the case in Pakistan as well. A recent survey of textile workers in Karachi showed that extreme heat stress at working places is resulting in health issues and reducing labour productivity (Germanwatch, 2025).

### Impact on External Account

Climate change impacts the external account through various channels (IMF, 2025b). The negative impact of climate change on Pakistan's industry and agriculture spillover onto exports through reduced output and labour productivity. For instance, in FY25, damages to domestic cotton crop due to heatwaves and erratic rainfall necessitated higher cotton imports (SBP, 2025). Earlier in FY23, food and textile exports were affected by the floods, while damage to food crops resulted in higher import of pulses, sugar and cotton. These episodes exemplify the empirical findings of Khan et al. (2019) who found a negative relationship between climate change and Pakistan's agriculture exports over the period 1975-2017.

On the whole, developing countries like Pakistan are at the risk of worsening trade

Impact of Climate Change on Labour Hours of Pakistan Figure 6.10



Representative Concentration Pathways (RCPs) are scenarios that include time series of emissions and concentrations of the full suite of GHGs, aerosols and chemically active gases, as well as land use/land cover. Each RCP ends in numbers (e.g., 4.5, 8.5) that provides only one of many possible scenarios that would lead to the specific radiative forcing characteristics (IPCC Fifth Assessment Report).

Source: HCH, UNDP

balance due to both direct and indirect effects of climate change. The former impacts production, infrastructure and transport routes. The latter results from changes in resource endowments, such as land and water availability, and efficiency of factors of production (Dellink et al. (2017).

In addition to these physical and operational risks, trade balance may also be affected by transitional risks (IMF, 2021). For instance, EU's climate neutral regulations and European Green Deal may put Pakistan's textile exports at a risk going forward, if the necessary actions are not taken (Box 6.2). Addressing such risks will not only require compliance with the

<sup>30</sup> High-risk sectors are agriculture, mining, construction and manufacturing, while all others are classified as low-risk sectors for the labour hours estimation. Source: UNDP (n.d.)

evolving environmental standards but also necessitates changes to Pakistan's own import policy to reduce imported emissions that feed into exports (CDPR, 2024).

Similar to exports, foreign direct investment (FDI) is negatively affected in economies and industries that are more vulnerable to climate risks.<sup>31</sup> The risks and uncertainty associated with climatic events can worsen foreign investors' confidence leading to likely reduction in FDI and portfolio investment (IMF, 2025b).

### Impact on Price Stability and Monetary Policy

Climate shocks impact price stability through different channels. The impacts are expected to be visible both in the short and medium term, whereas weak mitigation actions also increase the risk of inflationary pressures. For instance, supply side shocks arising from floods, extreme temperatures or drought can affect crop production leading to volatility in food prices (IMF, 2025b). Similarly, damage to transport infrastructure, trade disruptions and policy spillovers may also have differential impacts on prices (UNDP, 2024). Moreover, inflation can also be affected by climate policies, such as carbon pricing, that can cause structural shifts to price patterns across the economy (Debelle, 2019; McKibbin et al., 2020).

Literature suggests that rising temperature has an adverse effect on headline inflation in both low- and high-income countries

(Kotz et al., 2023). Within the components of inflation, food inflation is impacted the most in both advanced and emerging economies. This is due to climatic variations in short-term, particularly due to rising temperatures (Faccia et al., 2021). Food inflation is also impacted by negative effects of temperature on crop yield; Abbas et al. (2022) found a negative relationship of temperature and rainfall with wheat production in Pakistan during the period 1979–2020 leading to increase in food inflation.

Similarly, floods also increase inflationary pressures in the short-term (Parker, 2018). For instance, in the 2010 floods, food inflation rose due to supply-chain disruptions, which along with higher government borrowing for post-flood expenditures reduced monetary policy effectiveness to contain monetary expansion and inflation (SBP, 2010). Though short-lived, the impact of the 2022 flood was devastating for inflation in the first few months (Hussain et al., 2025). SBP staff estimates also show that floods have had a positive and immediate contribution to the NCPI inflation, whereas temperature shocks are likely to increase inflation in the long run (**Box 6.1**).

The climate shocks also pose challenges for central banks in achieving monetary policy mandate (NGFS, 2023). For example, volatility in food prices drives inflation expectation (Abbas et al., 2015) and risks central bank's inflation projections. This was the case in FY23 when the then

<sup>31</sup> In EMDEs and other countries, there is a strong negative association between climate vulnerability and FDI inflows. However, the climate preparedness level moderates the negative impact on FDI (An et al., 2022; Gopalan et al., 2023; Shear, 2023)

unfolding impact of the 2022 floods in Pakistan alongside exchange rate and other supply shocks resulted in increased inflation volatility and contributed to revisions in SBP's inflation projection (SBP, 2023b).

Moreover, higher climate risks and loss of assets can weaken businesses' repayment capacity and banks' balance sheets, and limit lending, reducing the effectiveness of monetary policy.<sup>32</sup> These risks require central banks to be vigilant. However, constraints to data availability, required expertise to forecast climatic events, and identification and quantification of the transmission of physical impacts are major challenges to calibrating appropriate monetary policy response; hence affecting price stability (IMF, 2021; NGFS, 2023).

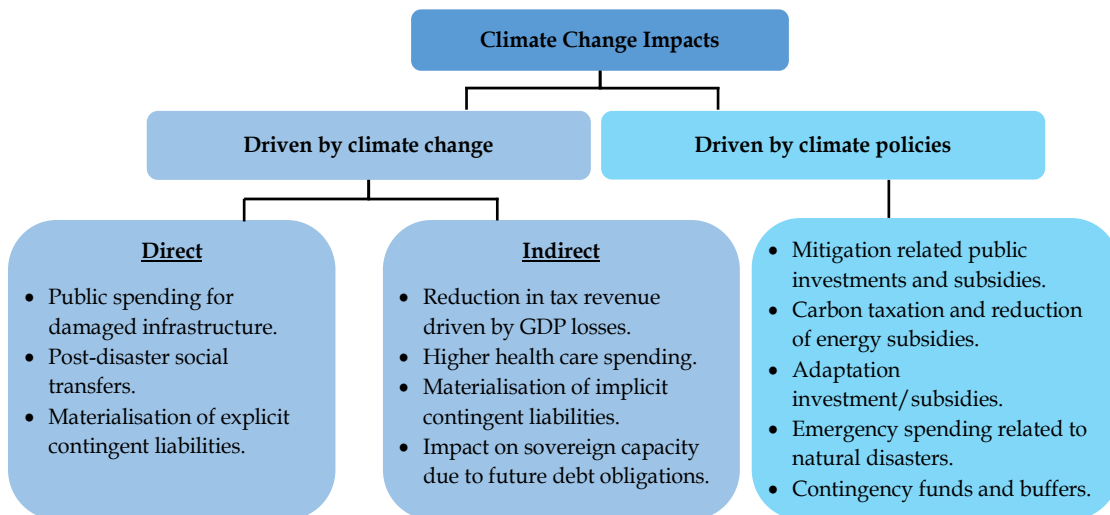
**Fiscal Impact**

Climate change has a significant effect on public finance with non-discretionary measures driven by direct and indirect impacts (IMF, 2025b). These include various types of public spending including rebuilding damaged infrastructure, and increased spending on healthcare and social safety. At the same time, GDP losses lead to reduced revenues, and materialisation of government guarantees that squeezes fiscal space further. These have repercussions for future debt obligations and sovereign risk (Figure 6.11).

In Pakistan, the fiscal cost of recent floods in Pakistan is a case in point. Pressure on fiscal accounts increased due to expenditures for rescue, relief and rehabilitation needs. Due to limited fiscal space and external financing, a substantial part of budgeted development spending

Impact of Climate Change on Public Finances

Figure 6.11



Source: IMF (2025b)

<sup>32</sup> Boneva et al (2022); Oguntuase (2020).

was reallocated for flood-related activities in FY11 (MoF, 2011; SBP, 2011). For the 2022 floods, recovery and reconstruction needs were projected to be 1.6 times the budgeted developmental expenditure for FY23, adding to fiscal pressures (MoPD&SI, 2022). The government also had to provide subsidies of Rs 44 billion to flood-affected areas and emergency cash assistance of Rs 70 billion, which was disbursed to flood-affected families through BISP (SBP, 2023a). Subsequently, the federal government also allocated Rs 164 billion in FY24 budget for flood related expenditures,<sup>33</sup> which added a fiscal burden of 0.2 percent of the then budgeted FY24 GDP.

In addition, there are transitional impacts of climate change on the fiscal position to meet the needs of climate mitigation and adaptation. For example, the recent risk assessments by the MoF highlight two alternative scenarios for Pakistan's climate outlook (MoF, 2025).<sup>34</sup> Under the optimistic climate action scenario, the government needs to invest 20 percent of US\$ 58.8 billion, required to mitigate GHG emissions by 2030, which will have additional fiscal burden. These additional costs will need to be met through the imposition of carbon taxes and reduction in fossil fuel subsidies (IMF, 2025b; Bachner et al., 2019).

### Impact on Urban Economy

Climate change and urban economies have a mutually reinforcing relationship. At the one end, rapid urbanisation is one of the leading causes of climate change with about 70 percent of global GHG emissions principally driven by energy demand, industrial processes, and extensive transport systems that are mainly concentrated in urban centres (Sharma, 2025). At the other end, climate-related hazards put urban economies at the risk of a variety of macroeconomic and socio-economic risks, such as damage to public and industrial infrastructure, productivity losses, increased mortality, illnesses, and scarcity of food and water (IIED, 2009).<sup>35</sup>

In terms of impact on climate change, Pakistan's major cities are also major emitters amid rapid urbanisation and increasing population density in urban areas. For instance, Karachi alone is estimated to produce around 9 percent of the country's total GHG emissions,<sup>36</sup> with nearly 38 percent stemming from manufacturing industries, followed by waste disposal/wastewater (18.3 percent), residential (18 percent), and transport (13.8 percent) segments. GHG inventories of all major cities of the country are not publicly available but anecdotal evidence suggests that the combined contribution of major cities is significant. This, coupled with the

<sup>33</sup> Out of the total, Rs 18 billion were allocated for disaster response costs, Rs 96 billion for subsidies related to disrupted economic activity, and Rs 50 billion for social protection. Source: MoF (2025).

<sup>34</sup> The first scenario is optimistic, which assumes that international support to meet conditional mitigation pledges is received and the world is able to achieve RCP 2.6 target; the second one assumes that governments do not invest in climate change, leading to RCP 8.5 scenario.

<sup>35</sup> Fifty-eight percent of cities report urban flooding, 54 percent cite extreme heat as climate related urban hazards, while around two-third of cities expect hazards to become more intense and frequent. Source: CDP, 2024

<sup>36</sup> Pakistan's GHG emission inventory is estimated to be around 489.87 mmt-CO<sub>2</sub>e (GoP, 2024), whereas Karachi's is estimated to be 43.5 mmt-CO<sub>2</sub>e. Source: UNDP, 2025

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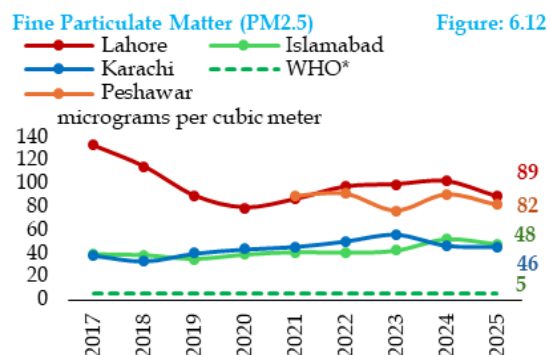
fact that a one percent increase in urbanisation increases carbon emission by 0.84 percent in long run in Pakistan (Ali et al., 2019), suggests that the transitional impact of climate change on urban economies will be significant.

At the same time, however, climate change is also reshaping the country's major cities in at least four major ways. First, urban air quality in Pakistan's major cities has been consistently poor and, in many cases among the worst globally, making Pakistan the most polluted country in 2025.<sup>37</sup> This is driven largely by rapid urbanisation, motorisation and seasonal burning of agricultural residues. High concentrations of particulate matter and other pollutants in cities like Lahore, Karachi, Islamabad and Peshawar regularly exceed acceptable standards, posing serious risks to human health and increasing health expenditure (Figure 6.12).

Second, Pakistan's urban population is growing at approximately 2.4 percent per year compared to global average of 1.4 percent. Owing to ill-planned urban infrastructure amid growing population pressure, concrete and asphalt are replacing vegetation in urban areas. This is leading to faster warming than surrounding rural areas and exacerbating urban flooding amid erratic rainfall patterns (Jabeen et al., 2010). These trends reflect the urban heat island effect where dense construction and reduced green cover trap heat in cities and impacting lives and livelihood (IGC, 2025b).

This worsens the impact of heatwaves, which is one of leading causes of climate related mortality globally (Countdown, 2023). In Karachi, for example, the severe 2015 heatwave caused more than 1,200 deaths (MoCC, 2015). This underscores how climatic events, infrastructural design and social vulnerabilities combine to produce fatal outcomes, where vulnerable groups, such as outdoor workers, the elderly and the urban poor, bear the heaviest impacts. As a result, heatwaves reduce overall economic productivity (Anwar et al., 2022), which is also affected by higher costs of cooling.

Third, extreme heat also alters atmospheric moisture content that triggers short but intense cloudbursts and flash flooding. In Pakistan, the largest sprawling megacities – Karachi and Lahore – have seen more frequent and severe floods. This, together with weak urban planning and insufficient drainage infrastructure, overburdened



\* WHO recommended air quality guideline level.  
Note: PM2.5 is primary indicator of air quality. They are micro inhalable air pollutants from sources like combustion and dust, that enter the bloodstream causing serious cardiovascular and respiratory illnesses.  
Source: IQAir

<sup>37</sup> Pakistan was ranked as the most polluted country in 2025 with PM2.5 concentration of 67.3 µg/m<sup>3</sup>, where Faisalabad, Rahim Yar Khan, Lahore, and Sukkur were among the top 10 most polluted cities in the world. Source: IQAir (2025)

sewage systems, especially in low-lying neighbourhoods, leading to widespread flooding in residential and commercial zones. These recurring floods cause significant damage to infrastructure, impact commerce, disrupt daily life and livelihood and strain essential amenities (Ejaz et al., 2024).

Fourth, climate variability and urbanisation are also placing additional stress on urban water resources. Extreme droughts and increasingly erratic rainfall patterns combined with inefficient water management have intensified Pakistan's looming water crisis. Additionally, runoff from heavy rain washes pollutants from commercial and industrial sites into reservoirs and rivers, degrading water quality, which has serious consequences for agriculture. Meanwhile, excessive groundwater pumping is lowering water tables and drawing down aquifers, making Pakistan a water scarce country according to all water scarcity indicators (Ashraf,

2018).

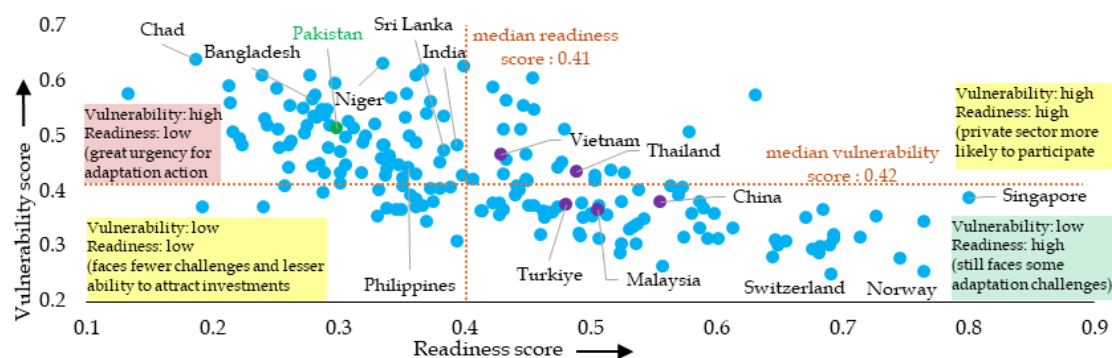
### 6.3 Challenges to Pakistan's Climate Action

The foregoing discussion shows that it is critical for Pakistan to undertake climate action. This is a formidable task considering Pakistan's low level of climate readiness despite high climate vulnerability (**Figure 6.13**).

In addition, the localised nature of the impact of climate events and climate adaptation complicates the design and implementation of climate policy. This is because the current state of local government and local participation in Pakistan is not commensurate with the importance of climate action. Both local government, and local participation in Pakistan are weak (Warraich, 2025). In contrast, whilst mitigation may be pursued through some large public sector projects and initiatives,<sup>38</sup> most of adaptation and

Climate Change Vulnerability and Readiness Index - 2023

Figure 6.13



Note: The dotted line represents median; the readiness index measures the ability to leverage investment and convert them into climate adaptation outcomes; scores range from 0 to 1, with higher values indicating better readiness and higher vulnerability. Purple markers represent notable regional peers in terms of readiness.

Source: ND-GAIN

<sup>38</sup> Mitigation projects are typically amenable to centralised and capital-intensive intervention such as utility-scale renewable projects, large-scale afforestation & carbon sequestration, and urban mass transit etc.

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disaster management are inherently local in nature, tailored to diverse geographies, climate zones and community-level vulnerabilities.<sup>39</sup>

Moreover, both mitigation and adaptation eventually impact individuals and businesses through physical disruptions, operational adjustments, and financial costs. While public policy and institutions enable and support private climate actions through information systems, regulation, coordination, and financing, the economic burden of climate action ultimately rests on citizens – either in the form of taxes or out-of-pocket expenditures.<sup>40</sup>

In this context, three overarching challenges to effective climate action relate to policy and institutional capacity; technical capacity and human capital; and social readiness. Cross-country comparison suggests that these factors, together with

resource availability (discussed in **Section 6.4**), enhance readiness towards climate action (**Figure 6.14**). Strengthening these facets are both necessary and urgent to prepare Pakistan for the impact of climate change and reduce vulnerabilities.

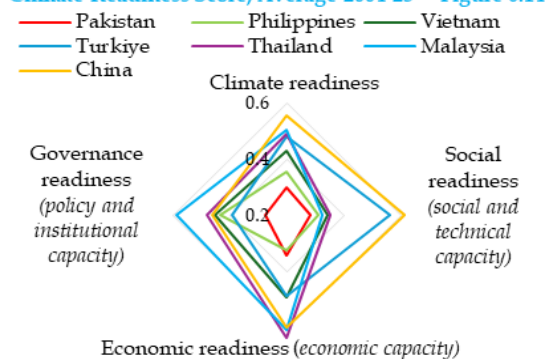
**Policy and Institutional Environment**

Pakistan's climate policy and institutional framework has expanded rapidly over the last decade, producing comprehensive policies and creating dedicated institutions for climate action. However, its effective implementation is constrained by persistent gaps in mandate alignment, coordination, and execution capacity (**Appendix 6B**).

**Policy implementation:** In terms of policy implementation, there are four major gaps that need to be addressed (Umar et al., 2023). First, there is inconsistent recognition of climate challenges and uneven prioritisation of actions across provinces. This is evidenced by delayed formulation and ineffective implementation of climate policies. Moreover, national frameworks, such as the National Adaptation Plan (NAP), offer broad priorities without regional specificity (UN, 2025).

Second, both the National Climate Change Policy (NCCP) 2021, and most provincial climate policy documents do not explicitly mention timelines for actions. Some policy measures allude to short- and medium-

**Climate Readiness Score, Average 2004-23** **Figure 6.14**



Note: Parentheses indicates the broader capacities that each readiness category measures; scores ranges from 0 to 1, with 1 being the most favourable

Source: ND-GAIN

<sup>39</sup> Adaptation solution varies by region – for example, drought management is needed in Balochistan, while groundwater recharge or rainwater harvesting to counter sea intrusion is the needed adaptation in Lower Indus Delta.  
<sup>40</sup> Much adaptation is undertaken by private actors: families elevating homes, farmers changing crops, and businesses investing in low-carbon technologies. Likewise, the private sector bears most transition costs through green investments and carbon taxes.

term measures, albeit without clear execution timelines. For instance, the mitigation targets included in the NDCs are neither time-bound, nor supported by detailed activity roadmaps, weakening prospects of successful implementation. This lack of well-defined milestones, along with inadequate sectoral prioritisation, is not commensurate with Pakistan's climate vulnerabilities and commitments (Masud & Khan, 2023).<sup>41</sup>

Third, there is limited scientific grounding and risk-based assessments. For instance, adaptation and mitigation measures are not guided by robust risk modelling or sector-specific climate impact analysis (UN, 2025). Lastly, climate policy and climate action have not been effectively integrated with other macroeconomic and sectoral policies, including alignment with the fiscal framework (**Box 6.3**) (Masud and Khan, 2023). For instance, whilst climate policy has prioritised renewable energy (RE) expansion through decentralised solar power, several regulatory, governance, and financing challenges create investment and operational barriers towards further RE adoption amidst a lack of grid and transmission readiness (**Box 6.4**).

**Institutional framework:** In terms of overall design Pakistan's climate institutional architecture is in line with global best practices. In 2017, the Pakistan

Climate Change Act (CCA) was passed, creating a legislative backing for climate governance framework. Under the CCA two main bodies were to be created: the Pakistan Climate Change Council (PCCC) and Pakistan Climate Change Authority (PCCA). Envisioned as a whole-of-government coordination and oversight forum, the PCCC is the apex body on climate action chaired by the Prime Minister and brings together key federal and provincial ministers and bodies. The PCCA was envisioned as a dedicated technical platform to formulate and execute programmes and coordinate implementation mechanisms.

Overall, the setting up of this structure was an important step. This is because climate action requires apex-level political leadership,<sup>42</sup> complemented by an independent expert climate body for technical oversight and professional bureaucracy for effective implementation (Elliott et al., 2021).

However, there are three major institutional challenges that have and continue to weigh on climate policy implementation in Pakistan (IMF, 2025a). First, the actual setting up of the PCCC and PCCA were delayed. The PCCC was established in 2022 – i.e. five years after the CCA was passed. Similarly, the setting up of the PCCA was notified in May 2024,

<sup>41</sup> NCCP 2021 is the revised version of the earlier NCCP-2012. NCCP 2012 was formulated with a major focus on climate resilient development and adaptation in view of Pakistan's high vulnerability to adverse climatic events. The 2021 revision came after the Paris Agreement 2015, when Pakistan accepted a voluntary reduction in emissions. Hence the updated NCCP 2021 focused equally on mitigation, adaptation and identification of sectoral policy measures. Source: MoCC, 2021

<sup>42</sup> Other countries are also addressing this question. China's National Energy Commission, with "super ministry" status, can influence other ministries and reports directly to state council; Zambia's climate change technical committee is placed under their MoF; while Ethiopia's EPA comes directly under the PM office, etc. Source: GSDRC, 2017

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following an order from the Supreme Court of Pakistan to the Federal Government (IMF, 2025a).

Second, both the PCCC and PCCA face the challenge of irregular meetings and operational delays. The meetings of the PCCC, for instance, have been few and irregular (Umar et al., 2023).<sup>43</sup> Similarly, despite its establishment, the PCCA remains largely non-functional due to operational delays, hurdles, and a lack of clarity on how both the Ministry of Climate Change and Environmental Coordination (MoCC&EC) and the PCCA will operate given their similar mandates (IMF, 2025a). The delay in the formation of the authority's rules poses a risk of duplication of technical functions, staffing, and workflow (MOCC&EC, 2025a; MOCC&EC, 2024a). Moreover, the MoCC&EC has inadequate resources, which constrain its programme execution capabilities (Umar et al., 2023).

Third, the unfinished devolution agenda is also contributing to institutional challenges.<sup>44</sup> For instance, although climate-sensitive – agriculture, water, environment, etc. – are largely devolved to provinces, until the NDC 3.0 in 2025, the federal entities continued to make international climate commitments, particularly through the NDCs, without systematic provincial ownership (Sheikh, 2025). This mismatch between

constitutional devolution and centralised policy ambition creates an implementation vacuum.

Moreover, provinces that are responsible for nearly 90 percent of required climate-related functions, lack formally mandated provincial NDCs or structured mechanisms to impact national climate goals (Naeem and Aslam, 2023). This institutional disconnect reflects not only the lack of centralised direction and action, but also the absence of a coordinated, whole-of-government response. As a result, regulatory oversight in climate sensitive areas remains weak (Sheikh, 2025).<sup>45</sup>

In the same vein, local governments – critical for ground-level adaptation, municipal services, and localised disaster response – remain under-empowered due to incomplete devolution (Warraich, 2025). Without fiscal authority and administrative autonomy, local bodies cannot initiate or sustain investments in climate-resilient infrastructure, nor can they ensure meaningful community participation (Umar et al., 2023).

#### **Technical Capacity and Human Capital**

Limited technical capacity and human capital are among major cross-cutting constraints to Pakistan's climate action. This impacts the public and private sectors alike across diverse sectors of the economy. These constraints manifest in a variety of

<sup>43</sup>As per CCA 2017, the climate change council is required to meet at least twice annually. However, council convened its first meeting only in 2022 (PID, 2022) with subsequent meetings remaining infrequent, indicating delayed operationalisation and irregular functioning.

<sup>44</sup>Decentralisation is crucial for sub-national buy-in for climate action (Khan & Hussain, 2025).

<sup>45</sup>The inadequate enforcement of land-use and floodplain zoning regulations in Swat exemplifies governance gap. As a result, hotel construction and human settlements arose in high-risk riverine areas, exacerbating human and economic losses during recent floods. Source: Habib et al., 2022; Samad et al., 2024.

ways, most important of which are discussed below.

**Risk assessment:** Timely risk assessment in Pakistan is constrained by technical limitations in climate observation and forecasting systems, including meteorology and hydrology (MoCC&EC, 2025a). For instance, insufficient supercomputing capacity affects the accuracy of climate forecast. In addition, there is also a need for significant improvement in local data input for global forecast systems, in the absence of which forecasts are coarse, restraining the usefulness of the system (Rehman, 2024). In addition to weak early warning systems, technical limitations also affect timely risk communication, reducing their effectiveness in disaster preparedness and response.

**GHG inventories:** Gaps in GHG measurement undermine the credibility and effectiveness of Pakistan's mitigation planning. Although Pakistan has compiled GHG inventories since 1994, there is a lack of an institutionalised and regularly updated system for GHG inventory preparation mechanism. Moreover, a weak data collection framework and limited GHG emission modelling capacity is one of major limitations to effective mitigation. In particular, the absence of district-level and sectoral emission-factors does not just affect the precision of Pakistan's GHG inventory, but also the regional and sectoral mitigation plan and financing of projects thereof.<sup>46</sup>

**Knowledge and training:** There is a lack of

an integrated approach to capacity building that spans technical, institutional, and knowledge systems in both public and private sectors. For example, agriculture extension departments often lack training in climate resilient farming.<sup>47</sup> Similarly, there is a limited pool of professionals in GHG inventory management in both public and private sectors, whereas there is a shortage of skills in climate sensitive areas, such as hydrology and meteorology, affecting the accuracy of weather forecast (MoCC&EC, 2025a).

Underlying these challenges is a broader deficit in climate education, research capacity, and human capital development. Climate change education, which is the cornerstone of long-term capacity building, is perceived as insufficient for a wide array of reasons, including insufficient funding and limited resources (Figure 6.15). The majority of firms report capacity-building activities as inadequate, citing insufficient funding, lack of skilled staff and limited technology and access to resources (MoCC&EC, 2025a). Human capital development also remains nascent as universities in Pakistan have a limited role in climate related R&D and technology advancements (Jaffery, 2025).

### Social Readiness

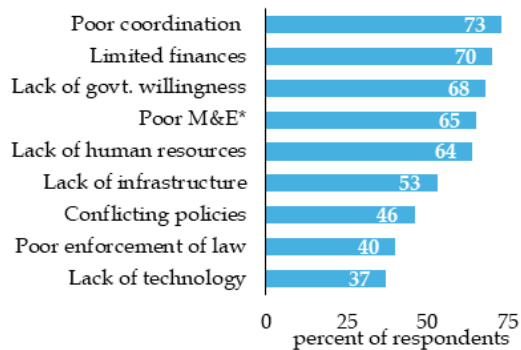
Research on social aspects of climate action is clear in the view that purely technical solutions will fall short if key social challenges are left unaddressed (Shaikh, 2024). This is because climate action causes substantial changes to how individuals and businesses operate. Indeed, the success of

<sup>46</sup> MoCC&EC (2025); Khan, & Hussain (2025); UN (2015)

<sup>47</sup> WB (2017); MoCC&EC (2025); UN (2015)

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Organisational Perception of Constraints to Climate Education Figure 6.15



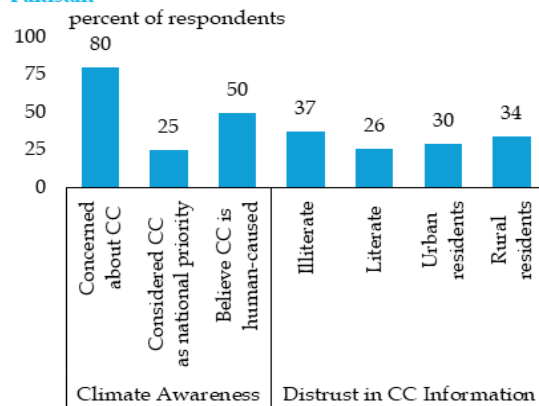
\*M&E: Monitoring and evaluation  
 Note: Based on survey of 175+ organisations  
 Source: MoCC&EC (2025)

climate action depends much on how well the public demands or accepts the required change. Public disregard of climate change as a national agenda and weak public trust amid challenges to political consensus are key social constraints in Pakistan. The country's already low educational attainment also undermines effective implementation of climate policy.

**Climate change awareness:** Basic climate change awareness seems to be high in Pakistan. A 2023 survey suggests that around 80 percent of Pakistanis are concerned with climate impacts. However, when asked to rank climate change as a national priority, only 25 percent placed it among the top three issues (Figure 6.16). This suggests that Pakistanis do not consider climate change as a pressing challenge that requires urgent action.

Other surveys and studies also point in the same direction. For instance, the understanding that climate change is caused by humans is not widely pervasive in society. A 2025 nationally representative survey shows that 70 percent of

Climate Change (CC) Awareness in Pakistan Figure 6.16



Source: Baron et al. (2023)

respondents attributed climate change to natural cycles or factors beyond human control (GP, 2025). Such views can foster a sense of helplessness, reducing support for climate action. Li et al. (2023a) also find that households' and businesses' willingness to pay for climate action in Pakistan is limited due to low level of education.

**Public trust:** Climate actions, whether taken by the public sector or private sector, require households and businesses to believe that sacrifices today will pay off in the future and that authorities will manage resources fairly. This rests on public awareness, education, and the level of trust in climate information (Li et al., 2023b).

Research suggests that public trust in climate action in Pakistan is low, which is prevalent across different sections of society (Figure 6.16). Moreover, there is a general lack of trust in green products and their benefits, discouraging business entry in this segment (Jianguo & Solangi, 2023; Baron et al., 2023). Weak public trust in climate governance, emanating from

infrequent reporting on current climate projects and financial opacity, impairs the government's capacity to take climate action, such as raising new green taxes or enforcing emission control (CFP, n.d.; Sherani, n.d.)

Public trust is also affected by low community engagement. Research suggests that public sector's climate action in Pakistan has often been top-down, with insufficient input from the affected communities in the design and implementation of adaptation measures (MoCC&EC, 2024a). Moreover, climate journalism is limited to event-driven coverage, amid a lack of prioritisation and training that hinders community engagement on climate change (Ahmed, 2024). Lack of media focus leads to low public scrutiny of climate projects, engendering mistrust.

**Political consensus:** Building societal consensus for climate action in Pakistan is constrained by the country's political economy. Elite capture in Pakistan has contributed to restricting systemic changes in environmental institutions and reducing compliance with the regulations and behavioural changes by polluters (WB, 2019). Moreover, an abrupt shift towards greener policies could face pushbacks, if they are not managed in an inclusive way. Against this backdrop, environmental and climate advocacy groups in Pakistan, though growing, struggle to counter the influence of powerful industrial lobbies

due to limited resources and political influence (Shaikh, 2024).

#### 6.4 Challenges to Climate Financing<sup>48</sup>

Finance is critical to the success of climate action given its vast and diverse scale. In terms of mitigation, global climate finance, mainly sponsored by developed economies, is important to meet the targeted reduction in global GHG emissions. This is because the bulk of pledged emission reductions by most developing countries, including Pakistan, are conditional to the provision of international grants, stemming from the 'principle of common but differentiated responsibilities' (UNFCCC, 2015).

In terms of adaptation, countries must essentially finance domestic adaptation needs on their own since adaptation is inherently local. There have been some recent demands by countries and multilateral development banks (MDBs) for increasing global financing to meet adaptation needs, especially of developing economies (UNDP, 2024). However, unlike mitigation, adaptation efforts cannot be conditional to global financial flows, since when it comes to adaptation and disaster risk management each country is essentially on its own. Against this backdrop, the state of global and domestic climate financing landscape is a major challenge to Pakistan's climate action.

<sup>48</sup> Data related to climate finance – financial needs and flows by type, objectives, sectors and countries – is discontinuous. Data reported by different institutions also often do not match. Notwithstanding these limitations, there is sufficient evidence to believe that the key insights discussed accurately reflect the current state of climate finance in Pakistan and around the world.

*The State of Pakistan's Economy, Half Year Report 2025-26***Global Climate Finance Landscape**

The fundamental issue in global climate finance is the persistent gap between global financing needs and current global priorities – a challenge that Pakistan and several other EMDEs have in common. Global climate financing needs to limit global warming to 1.5 °C are estimated to be US\$ 8.6 trillion per year until 2030.<sup>49</sup> However, global climate financial flows remain substantially lower than both financing needs and global spending on other priorities, including the Covid-19 (Figure 6.17). This reflects low prioritisation of climate change as a major crisis, and insufficient political will.

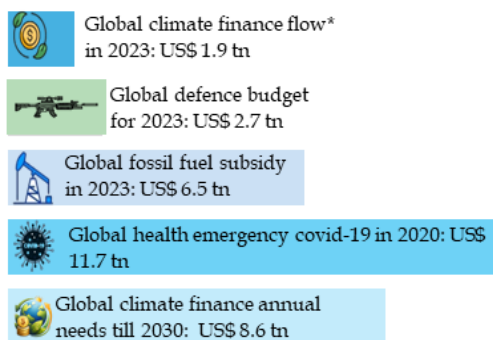
Moreover, the recent withdrawal of the US from the Paris Agreement risks increasing the gap between global financing needs and actual flows (Salik, 2025).<sup>50</sup> This is

because withdrawal by any major country risks setting a damaging precedent for withdrawals of pledges by other countries. It also raises sovereign risk perception for private investors in EMDEs. Institutional analyses show that predictable concessional global finance is important for mobilising large scale domestic and international private finance (OECD, 2023).

The large global financial gap presents a challenge to global agenda of climate change and enhances climate risks. The economic cost of climate inaction could amount to US\$ 266 billion by 2050 from 1.5°C of warming and it is estimated to reach US\$ 1,062 billion by 2100 (Climate policy initiative (CPI), 2025). For countries like Pakistan, this has two major implications. First, like other developing economies, Pakistan may not be able to achieve its conditional GHG emission reduction commitments, which are nearly two-thirds of its total commitments. Second, if global warming breaches the 1.5 °C mark, Pakistan's financing needs for adaptation and disaster risk management may be much higher than what's currently projected.

**Global Climate Finance Flows to Pakistan**

Pakistan's climate financing needs are estimated to be US\$ 331 billion between 2024 and 2030, equivalent to around 10 percent of cumulative GDP for these years

**Global Climate Finance in Context****Figure 6.17**

\*Latest publicly available data is for 2023; however, early data releases estimate the 2024 number to be around US\$ 2 trillion.

Sources: CPI; WB; IMF

<sup>49</sup> CPI (2025) reports global climate finance needs (required to limit global warming to 1.5 °C) at US\$ 8.6 trillion per annum; others such as OECD, IEA and ISO estimate that number to be US\$ 5.4 trillion to US\$ 11.7 trillion per annum. Average estimates are around US\$ 8-9 trillion (OECD, n.d; IEA, 2023; ISO n.d).

<sup>50</sup> As of January 2026, the United States has officially withdrawn from the Paris Agreement for the second time. Previously, the USA withdrew in 2020 but rejoined in 2021. The US withdrawal may hamper global climate aid as the US contributed around 8 percent of total global climate finance in 2024 alone. (Gabbatiss, 2025)

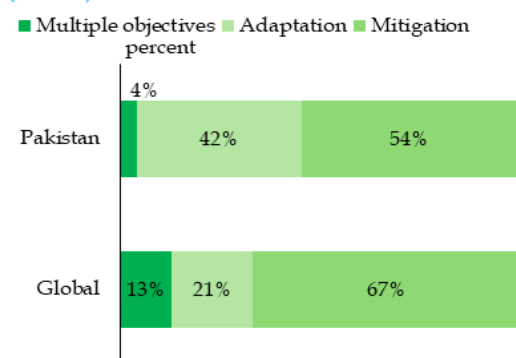
or US\$ 47 billion per year (CPI, 2024).<sup>51</sup> The financing needs reflect the country's high climate vulnerability and very little contribution to global GHG emissions. The country's financing need for adaptation is 42 percent of total financing needs, compared to 21 percent globally (Figure 6.18a), whereas financing needs for water and disaster risk management (DRM) are also higher than global average (Figure 6.18b).

However, global climate finance flows to Pakistan are far below the country's financing needs. In absolute terms, average annual climate finance inflows have been estimated at US\$ 1.4 – 2 billion over the past decade, peaking at approximately US\$ 4 billion in 2021. These inflows remain insufficient to fund Pakistan's conditional

NDC commitments. Moreover, global climate finance flows to Pakistan also remain significantly lower in per-capita terms, compared to that received by peer economies, including Bangladesh, the Philippines, Kenya and India (Akhtar & Khawaja, 2025). There are three main and somewhat interrelated reasons behind these financing gaps, which are briefly discussed below.

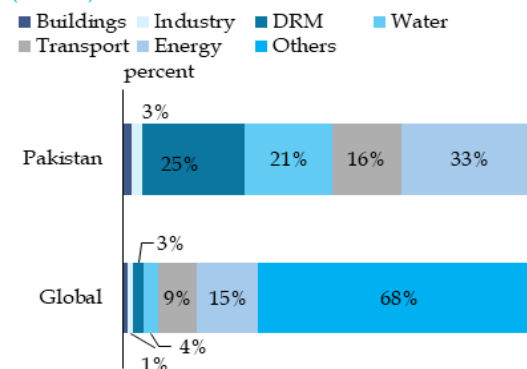
**Bankability:** Most non-grant international climate financing as well as domestic private sector financing are typically channelled to bankable projects (UKID, 2023).<sup>52</sup> For climate projects, bankability is somewhat more challenging given the long-gestation and complex nature of

Climate Finance Needs - by Objective (2024-30) Figure 6.18a



Source: CPI

Climate Finance Needs - by Sector (2024-30) Figure 6.18b



Source: CPI

<sup>51</sup> GoP's estimates of needed climate finance range from US\$ 200-348 billion for climate resilient development by 2030 and NDC implementation. Moreover, the GoP's latest Pakistan Climate Prosperity Plan for multi-phased investment and technology access, focusing on the convergence of development, climate and nature, has identified an investment need of US\$ 1.6 trillion by 2050. Source: GoP, 2024; MOCC&EC, 2024b; MoF, 2026.

<sup>52</sup> Climate financing opportunities that are bankable refers to the use of debts or equity in projects that offer a minimum market-based financial returns, if not above-market; where risks are mitigated while revenue streams and cash flows are predictable. Bankability hinges on a variety of factors including sovereign risk; credit risk; exchange rate risk; and political risk, and macroeconomic stability. Moreover, countries with mature financial markets, and stronger institutions, fiduciary standards and regulatory frameworks are better placed to prepare bankable projects.

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Multilateral Climate Finance by Objectives and Financing Type (till 2024)

Table 6.3

million US\$

<i>Adaptation</i>								
	Concessional loan	Grant	Guarantee	Equity	Approved	Disbursed	Disbursement percentage	Vulnerability*
China	0	7	0	0	7	5	75	0.38
Malaysia	0	10	0	0	10	3	30	0.37
India	0	58	0	0	58	31	52	0.49
Pakistan	0	163	0	25	188	57	30	0.52
Bangladesh	58	260	0	0	318	172	54	0.57
Total Global	825	7,622	40	543	9,030	4472	50	-
<i>Mitigation</i>								
	Concessional loan	Grant	Guarantee	Equity	Approved	Disbursed	Disbursement percentage	Vulnerability*
Malaysia	0	22	0	0	22	21	92	0.38
Pakistan	37	42	9	0	88	27	31	0.37
Bangladesh	291	63	0	0	355	25	7	0.49
China	0	395	0	0	395	261	66	0.52
India	805	310	0	333	1,447	823	57	0.57
Total Global	8,585	8,732	318	621	18,256	8,781	48	-
<i>Multiple Focus</i>								
	Concessional loan	Grant	Guarantee	Equity	Approved	Disbursed	Disbursement percentage	Vulnerability*
Malaysia	0	14	0	0	14	2	13	0.38
Pakistan	0	15	0	15	30	2	8	0.37
Bangladesh	0	47	0	0	47	35	75	0.49
China	100	79	0	0	179	104	58	0.52
India	200	91	0	25	315	28	9	0.57
Total Global	3,283	5,859	40	570	9,752	2,564	26	-

\*Higher vulnerability score indicates higher climate exposure and vice versa

Source: SBP Staff calculations based on CFU data and ND-GAIN

climate projects.<sup>53</sup> The emphasis on bankability has had a two-pronged impact on global climate finance flows to Pakistan.

First, when it comes to global climate finance mitigation projects are considered more bankable than adaptation projects (IMF, 2025c), whereas Pakistan's financing needs for mitigation are lower than global average (**Figure 6.18a**). Second, the bankability of climate projects in the

country is affected by recurring episodes of macroeconomic instability, exchange rate volatility, elevated sovereign risks and political uncertainty, amid underdeveloped financial markets and weak institutional and regulatory environment (Pereira, 2025).<sup>54,55</sup>

These factors reflect in global climate finance flows to Pakistan. Whilst globally, mitigation has seen more approvals and

<sup>53</sup> Climate projects require relatively long and cumbersome preparatory and logistical work to start and take longer to yield returns compared to traditional projects.

<sup>54</sup> This is mainly because of the public good nature of adaptation projects, such as storm-resilient roads, a flood embankment or a weather station does not generate direct cash flow. Consequently, most of adaptation finance remains dependent on strained domestic public budgets. Source: IMF, 2025c; OECD, 2025.

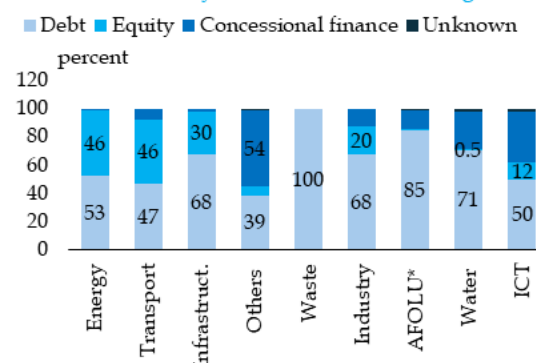
<sup>55</sup> In fact, under the Paris Agreement, adaptation is recognised as a development and equity issue seen from the perspective of humanitarian crisis prevention rather than climate policy Source: UN Paris Agreement 2015 Article 7.2.

disbursements, mostly through loans and equity (CPI, 2024),<sup>56</sup> Pakistan received more inflows for adaptation, which is mainly financed through grants (Table 6.3).

The bias for bankability in global climate finance and Pakistan's low bankability is also reflected in geographical allocation of global climate finance. With debt being the dominant instrument (Figure 6.19), global climate finance is lopsided towards AEs, and those EMDEs that have developed financial markets and bankable project pipelines (Kerr & Hu, 2025). For instance, North America, Western Europe, and East Asia attracted nearly 82 percent of total global finance flows in 2022. In contrast, flows to highly vulnerable regions, such as Sub-Saharan Africa and South Asia, were significantly lower, as most EMDEs face a cost of capital penalty that risks making climate projects unfeasible (Figure 6.20a & 6.20b) (CPI, 2024; IEA 2024).<sup>57</sup>

**Project Pipeline:** Pakistan's climate finance gap also stems from a limited capacity to develop project pipeline. Developing project pipelines is important to attract international public and private sector inflows since it gives a sense of direction and confidence to MDBs and market participants, and increases their

Climate Finance - by Sector and Instrument Figure 6.19



\*AFOLU stands for agriculture, forestry, other land use, and fisheries.

Source: CPI

commitments (Fraz, 2025; UKID, 2023; IMF, 2025c).

The country's weak project pipelines are due to a variety of factors. At the one end, as discussed in Section 6.3, integrated sectoral or provincial action plans do not exist, whereas the National Adaptation Plan also does not have detailed project prioritisation. At the other end, there is a need for evidence-based quantification of the cost of climate inaction to create buy-in for global grants and concessional financing (UKID, 2023).

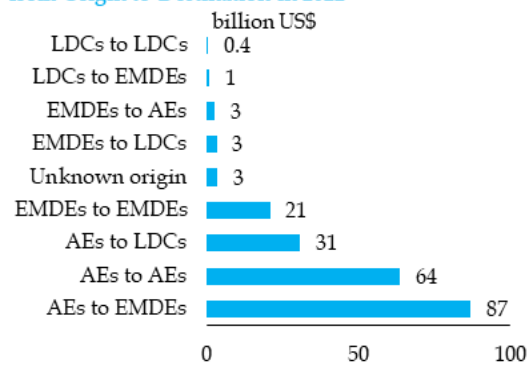
Lastly, MDBs also report that Pakistan's disbursement rates for climate finance are hindered by bureaucratic bottlenecks and shifting political priorities (Fraz, 2025). For example, World Bank's Pakistan Hydromet

<sup>56</sup> Climate finance data shows that debt overwhelmingly dominates sectors with mature markets and strong private participation, especially the main mitigation sectors. Energy sector projects were financed with the share of (market-rate) debt and equity at 53 percent and 46 percent respectively, reflecting their commercial viability and ability to mobilise private capital on a scale. Transport projects were financed with an almost equal share of (market-rate) debt (47 percent) and equity (46 percent), while only a small share (around 7 percent) came from concessional finance. Source: CPI, 2025.

<sup>57</sup> Cost of capital penalty (or capital risk premium) refers to the significantly higher financing costs for clean energy projects in EMDEs compared to advanced economies. For example, the cost of capital for a utility-scale solar PV plant in 2021 was between two to three times higher in key emerging economies than in AEs and China. Source: IEA, n.d.

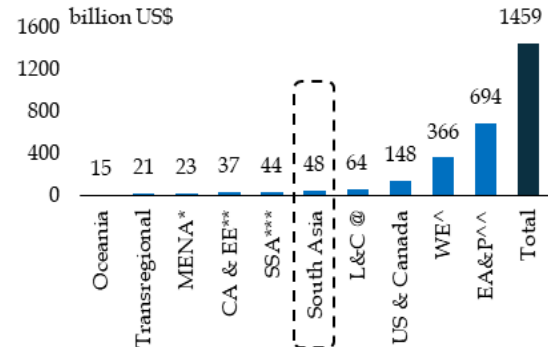
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International Climate Finance Flows from Origin to Destination in 2022 Figure 6.20a



AEs: Advanced economies; EMDEs: Emerging market and developing economies; LDCs: Least developed countries  
Source: CPI

Global Climate Finance - by Destination in 2022 Figure 6.20b



\* Middle East and North Africa; \*\* Central Asia and Eastern Europe; \*\*\* Sub-Saharan Africa; @ Latin & Caribbean; ^ Western Europe; ^^ East Asia & Pacific;  
Source: CPI

and Climate Services Project concluded in mid-2025 with critical components scrapped. According to the World Bank's completion report, weather radars, automatic weather stations and observatories were dropped due to procurement delays and institutional frictions (WB, 2025a). In addition, lack of technical data anchors, such as integrated MRV (Monitoring, Reporting, and Verification) system, makes it difficult for donors to track outcomes, leading to risk aversion among international lenders (GoP, 2024).

**Supporting Domestic Environment:** A supporting domestic environment is necessary to attract and absorb global climate finance, especially those from the private sector. In this context, three gaps particularly stand out.

First, limited pool of skilled climate finance professionals<sup>58</sup> affects the ability of provincial and local governments to develop competitive climate finance proposals (Fraz, 2025; MoCC&EC, 2025b). Sub-national governments also struggle with setting up monitoring and evaluation (M&E) systems for climate projects (MoCC&EC, 2025b). Project proposals are rejected if financiers are not satisfied with the M&E plan,<sup>59</sup> or if projects do not meet the typical international development assistance assessment criteria standards.<sup>60</sup>

Second, there is a need to fast-track the mainstreaming of corporate sector compliance with Environment, Social and Governance (ESG) framework, CBAM, and other related certifications. In this context, the SECP's notification for listed companies for phased adoption of sustainability-related (IFRS-S1) and climate-related (IFRS-

<sup>58</sup> This includes areas of blended-finance, fiscal guarantees or partial guarantees, and disclosure requirements.

<sup>59</sup> Green Climate Fund, 2018; Global Environment Facility Evaluation, 2006

<sup>60</sup> For example, OECD's Development Assistance Committee criteria use six core standards for evaluating international development and humanitarian aid: (a) Effectiveness; (b) Impact, (c) Efficiency, (d) Relevance, (e) Coherence, and (f) Sustainability. Source: OECD, 2019

S2) disclosure standards is a step in the right direction and are directly aligned with Pakistan Green Taxonomy, facilitating compliance for exports facing carbon-related regulations like the EU's CBAM (SECP, 2025). The IFRS-S2 is particularly important since it requires companies to disclose all their GHG emissions (ACCA, n.d.).

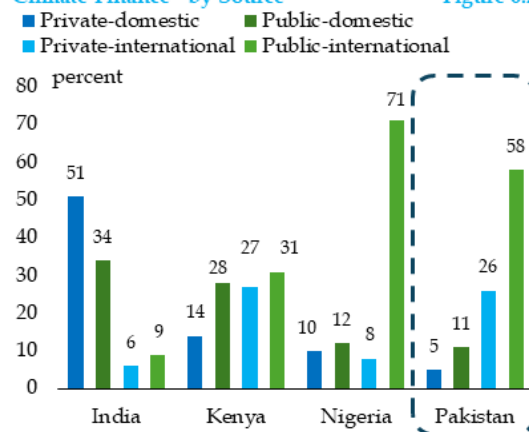
Globally, ESG is rapidly moving from niche to mainstream. ESG assets are expected to reach US\$ 40 trillion by 2030, or about 25 percent of total global assets under management (Bloomberg, 2024). In this context, it is important to support and incentivise corporate compliance with the ESG framework beyond listed companies and link all such companies to global investors to attract a growing pool of international ESG capital and green financing.

Third, there is a need to develop the currently nascent and underdeveloped carbon market in Pakistan, considering its potential to finance public and private sector investments in mitigation projects. To this end, the policy framework for carbon markets needs to be improved, alongside the creation of public platforms or a registry that provides visibility into carbon market transactions and other related information (TIP, 2025) (Box 6.5).

### Domestic Financing Landscape

Despite relatively lower global climate finance flows, Pakistan relies more on external financing due to limited domestic participation from both public and private

Climate Finance - by Source Figure 6.21



Source: UNCCA

sectors (Figure 6.21). Domestic public climate finance in Pakistan remains limited and contributed only 11 percent of total climate finance in the country between 2018-2021 (Akhtar & Khawaja, 2025). This reflects structural weaknesses in revenue generation and limited financing ability.

Moreover, unlike many advanced and several emerging economies where private capital is increasingly central to climate finance, Pakistan's private sector participation remains marginal with a 5 percent contribution in overall climate finance between 2018-21. Most domestic private finance is highly concentrated in a few large renewable energy projects supported by public guarantees.<sup>61</sup>

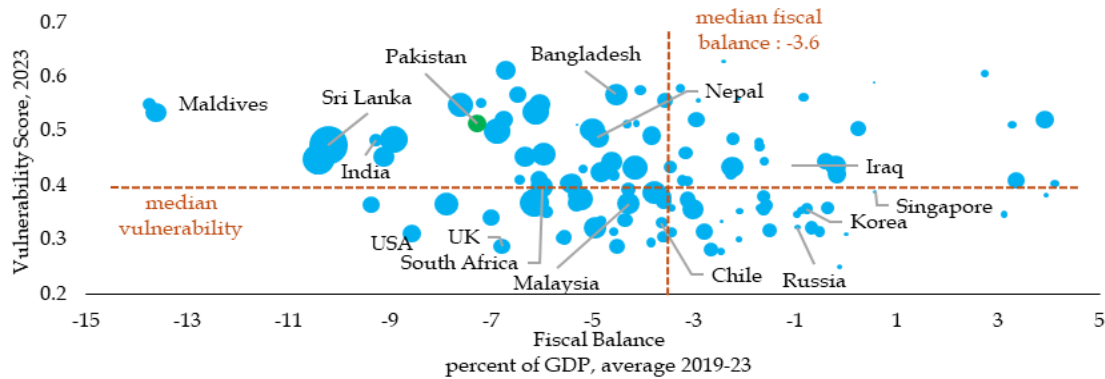
**Domestic public financing:** Pakistan's high fiscal constraint is a major challenge to its ability to address climate vulnerabilities. Pakistan is among the countries that have relatively high fiscal constraints and high climate vulnerability (Figure 6.22). As a result of insufficient fiscal space, spending

<sup>61</sup> UNFCCC, 2021; CPI, 2023; OECD, 2023

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Fiscal Space and Climate Vulnerability

Figure 6.22



Note: Higher vulnerability score indicates higher climate exposure and vice versa; size of bubbles represent the interest expense as a ratio of total expenditure.

Sources: ND-GAIN; WB

on climate adaptation and building resilience against climate-related disasters is crowded out (IMF, 2023).

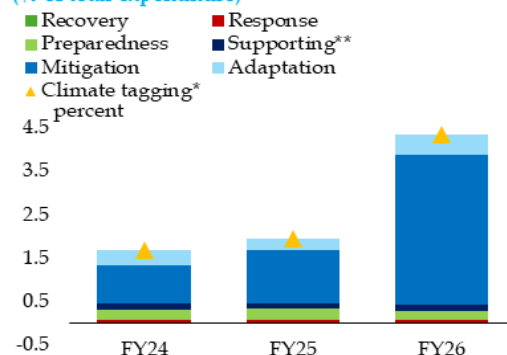
Although, as discussed in **Section 6.3 & Box 6.3**, climate budget tagging has begun recently,<sup>62</sup> domestic public finances are constrained by the fact that climate risks have not been systematically integrated into macroeconomic models, fiscal frameworks, and public investment planning in Pakistan. This is important because economic models need to be extended to include a wider range of social and economic impacts to incorporate climate vulnerability and allocate funds beforehand.<sup>63</sup> Furthermore, due to weak integration, post-disaster rehabilitation spending is reactive and financed through budget reallocations rather than prior provisions (UNDRR, 2022).

Moreover, as **Figure 6.23** shows, public spending on adaptation is significantly

low. This is not in line with the fact that, unlike mitigation spending, which to some degree is conditional on international support, the responsibility of adaptation primarily rests with the government. Lastly, there are different climate finance units in different ministries with overlapping responsibilities at the federal level, where provinces are operating in silos amid a lack of effective systematic

Federal Budget Climate Classification (% of total expenditure)

Figure 6.23



\* Includes disaster spending; \*\* Activities related to capacity building and awareness raising

Sources: MoF; WB (2022)

<sup>62</sup> Climate Budget Tagging (CBT) is a systematic process that identifies, classifies, weights and marks budget lines to facilitate the estimation of public spending on climate change mitigation and adaptation.

<sup>63</sup> IMF, 2022; Ghafoor et al., 2016

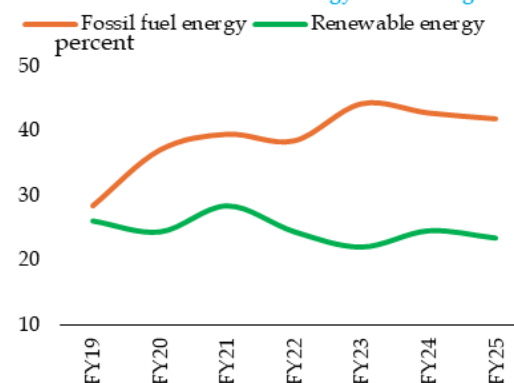
coordination among relevant ministries (UKID, 2023).

**Domestic private financing:** Domestic private climate finance in Pakistan remains low due to a combination of financial sector constraints, policy uncertainty and weak market infrastructure. This includes underdeveloped capital markets, carbon market, and green bond market. The country issued its first sovereign green Eurobond in 2021, marking an important step toward diversifying climate finance beyond concessional loans and grants. Whilst the issuance helped establish market precedent and signal policy intent, subsequent activity has been limited.<sup>64</sup>

Moreover, the banking sector, which dominates the country's financial landscape with nearly 77 percent of total financial assets (SBP, 2024), mainly lends to the government, whereas bank lending to private sector is mostly concentrated in short-term loans. These characteristics exhibit high risk aversion, making the sector unsuitable to finance long-term climate mitigation and adaptation projects with uncertain cash flows and illiquid collaterals (IMF, 2022). Moreover, the fixed investment loans extended to energy sector are primarily concentrated in thermal generation as opposed to renewable energy (Figure 6.24).

In recognition of these challenges, a number of policy initiatives have been taken. For instance, SBP's Green Banking Guidelines in October 2017 (SBP, 2017),

Fixed Investments Loans in Energy Sector\* Figure 6.24



\*Energy generation, transmission and distribution  
Source: SBP

encouraging banks and DFIs to integrate environmental risk management, facilitate green financing and reduce their environmental footprint. In 2022, SBP also issued Environmental and Social Risk Management manual as a supporting tool (SBP, 2022a). Building on this foundation, the government in collaboration with Ministry of Climate Change and SBP has recently released the Pakistan Green Taxonomy to define green economic activities and guide financial flows toward climate mitigation and adaptation (MoCC&EC, 2025b).

Notwithstanding these positive developments, several challenges persist. For instance, there are capacity gaps within financial institutions in climate risk assessment and reporting, while robust monitoring, verification and disclosure frameworks are still under development. These issues constrain the effective operationalisation of the taxonomy and reduce incentives to mainstream investment in sustainable activities (OECD,

<sup>64</sup> In May 2021, WAPDA launched its first green Eurobond (Indus Bond) for 10 years to raise US\$ 500 million at a competitive price. Since then, only two green bonds have been launched: Parwaz Green Action bond and Sovereign Green Sukuk in March 2025 and May 2025, respectively.

2026). Moreover, Pakistan's Green Banking Guidelines are voluntary, whereas several emerging market regulators including China, Bangladesh, Nepal and others have issued mandatory green credit or sustainability requirements for banks (Park and Kim, 2020).

### 6.5 Final Remarks

Several sobering realities emerge from the above analyses and discussions that warrant urgent and consistent action by individuals, businesses, and public sector officials. First, climate change is irreversible, and its impact on global and Pakistan's economy is real. In some ways, such as the recent floods, the impact has already made its presence felt. And if appropriate climate action is not taken, then climate change is estimated to have even more serious impact on lives and livelihoods, with negative macroeconomic and socioeconomic consequences. These risks that can escalate non-linearly – affecting both rural and urban areas – include damage to agricultural and industrial output with cascading effects on the services sector, price stability, external and fiscal accounts.

Second, although Pakistan contributes little to global GHG emissions, it is highly vulnerable to climate change. Despite that, Pakistan has low level of climate readiness. This means that Pakistan needs to invest substantially in adaptation to be able to deal with the expected impact of climate change. However, the country's relatively high emission intensity, its large and steadily growing population, and aspirations for GDP growth and

development also demands large investments in mitigation to avoid carbon-intensive lock-in and simultaneously reducing climate vulnerability.

The growing global capital flows in ESG investments and the increasing global trend in green technologies present an opportunity for Pakistan to directly leapfrog onto climate friendly modernisation and development. However, green growth and low emission development remain a daunting challenge, because even some of the world's advanced and resource rich economies have not been able to successfully achieve it. Recent evidence shows that global climate action remains insufficient as both developed and developing economies are on course to miss their emission reduction targets for 2030 to contain global warming to 1.5 °C.

Third, although Pakistan has shown a strong commitment to global climate action and has made notable progress in formulating a climate change policy framework, the country's climate preparedness is affected by a variety of unaddressed challenges. The implementation of climate policy is not effective due to several reasons including weak integration of climate change policy with other macroeconomic and sectoral policies; overlapping mandates and coordination across and between different tiers of government; weak local governments; and a lack of clear timelines for action.

Weak technical capacity and human capital constraints – such as a limited GHG

emissions database, shortage of skilled personnel for climate risk assessment and climate policy implementation, and deficit in climate education and research capacity – augment these challenges. In addition, there are social constraints at play. These include a public disregard for climate change as a national agenda and weak public trust in government policies and action, amid low political support for climate action. Addressing these social constraints are critical since climate actions require households and businesses to believe that sacrifices today will pay off in the future and that authorities will manage resources fairly.

Underlying these challenges is limited climate finance. Although Pakistan mainly relies on global climate inflows, the global climate finance flows to Pakistan are not commensurate with the country's financing needs for climate action. This is mainly owing to low bankability of projects, undeveloped project pipelines, and lack of a domestic supporting environment.

Domestic climate finance flows, which are especially critical for adaptation finance, are affected by limited public financing.

This is due to persistent fiscal constraints, a lack of systematic integration of climate risks into macroeconomic models and overlapping responsibilities. In addition, private financing is also low, constrained by the fact that majority of bank lending goes to the government, whereas private sector lending is in relatively short-term projects amid policy uncertainty and weak market infrastructure.

Fourth, climate action eventually burdens everyone: individuals, businesses, and the public sector. This is because climate action necessitates a change in ways and means of production, consumption pattern, and also how perhaps the society is organised. The latter is an important consideration, especially in the context that while mitigation may still be somewhat achieved through large public sector projects and initiatives, most of adaptation and disaster management are inherently local in nature. Integrated economy-wide planning is, therefore, urgently needed for a balanced climate action and for catering Pakistan's diverse geographies, climate zones, and communities.

#### Box 6.1: Estimating the Impact of Climatic Shocks on Economic Growth and Inflation in Pakistan

**Introduction:** Most studies use temperature to estimate the impact of climate change on economic growth, while others use rainfall or precipitation as other climate proxies. Bilal & Kanzig, 2026; Kahn et al., 2021; Dell, 2012 studied the impact of temperature on a panel of countries.

Their findings suggest that higher temperature variations compared to historical averages result in a reduction in economic growth. The impact may vary depending upon the magnitude of temperature variations. In the case of Pakistan, studies established a negative relationship between temperature and GDP growth and productivity in agriculture, manufacturing and services sectors (Akram & Hamid, 2015; Akram & Gulzar, 2013; Akram, 2015). The impact of precipitation on aggregate growth is mostly seen in developing countries (Damania et al., 2020), with the rise in rainy days and extreme rainfall reducing economic growth (Kotz et al., 2022).

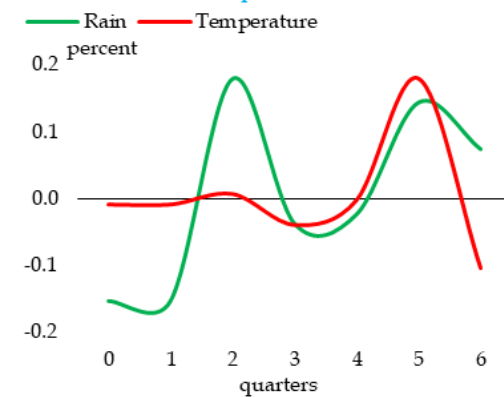
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Similarly, studies find impact of temperature on inflation mostly through food inflation (Hagos, 2018; Faccia et al., 2021; Li et al., 2023; Kotz et al., 2023). Moreover, rains resulting in floods impact inflation through reduced output, particularly of agriculture, supply disruptions due to infrastructural damage, and labour productivity. Rojasavachai et al., 2025; Kunawotor et al., 2021; Baten et al., 2020; Mitra et al., 2017 find that rainfall and floods have negative impact on food and headline inflation through various channels.

**Methodology:** To investigate the dynamic response of growth (RGDP) and inflation to climatic shocks, this Box estimates Impulse Responses (IRs) using Local Projections (LP) on quarterly data spanning from Q1-2016 to Q4-2025,<sup>65</sup> whereas, an extended sample size from Q1-2003 to Q4-2025 is used for inflation model.<sup>66</sup> Moreover, Historical Decomposition (HD) approach is also employed to estimate the period-wise contribution of climatic shocks.<sup>67</sup> National average rain and temperature data is used to capture the impact of climatic shocks on economic growth. In addition, real effective exchange rate (REER), policy rate (PR), fiscal balance to GDP ratio (FB\_Y) and wholesale price index (WPI) are incorporated in the model to control for the effects of external, monetary policy, fiscal policy and input prices.

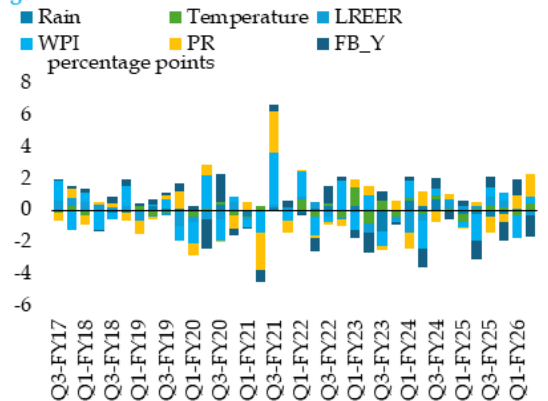
**Impact on economic growth:** Figure 6.1.1 shows that one standard deviation (SD) shock to rain (flood) has a negative and immediate effect on RGDP in the first quarter, which is partially compensated by some improvement in second quarter. Moreover, fluctuations in temperature are also used to capture the impact of climatic shocks. The findings suggest that the likely response of RGDP to 1 SD-shock to

**Response of Real GDP Growth to 1 SD Shock in Rain and Temperature** Figure 6.1.1



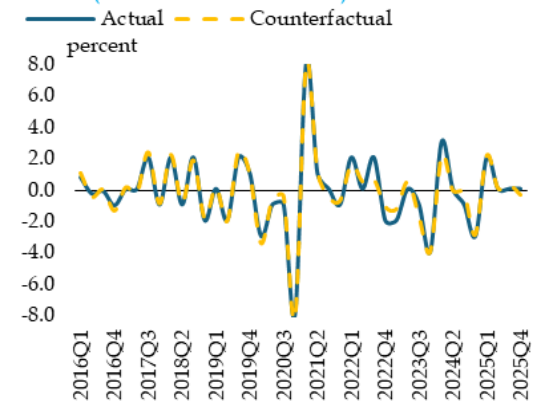
Source: SBP Staff estimates

**Historical Decomposition of Real GDP growth** Figure 6.1.2



Source: SBP Staff estimates

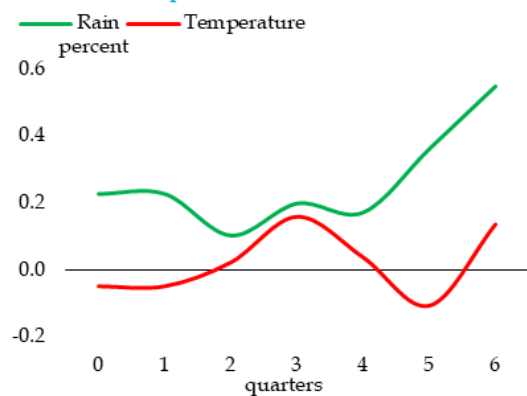
**Counterfactual Analysis of Real GDP Growth (without Climatic Shocks)** Figure 6.1.3



Source: SBP Staff estimates

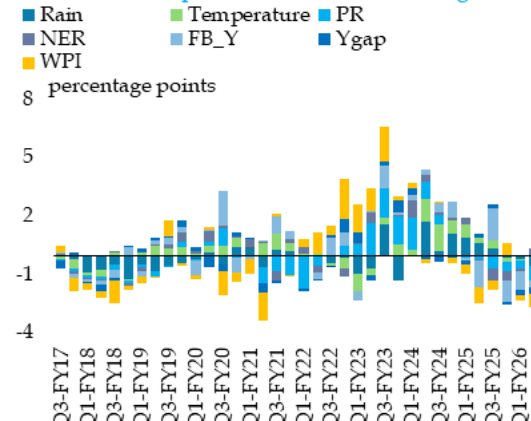
<sup>65</sup> The sample period used for estimation is restricted due to non-availability of quarterly data of real GDP.  
<sup>66</sup> LP is useful for its flexibility. LP estimations are based on separate equations; hence they more robust; flexible to non-linearity; and tackle model misspecification.  
<sup>67</sup> It may be noted that HD results are based on SVAR estimations.

**Response of CPI Inflation to 1 SD Shock in Rain and Temperature** Figure 6.1.4



Source: SBP Staff estimates

**Historical Decomposition of CPI Inflation** Figure 6.1.5



Source: SBP Staff estimates

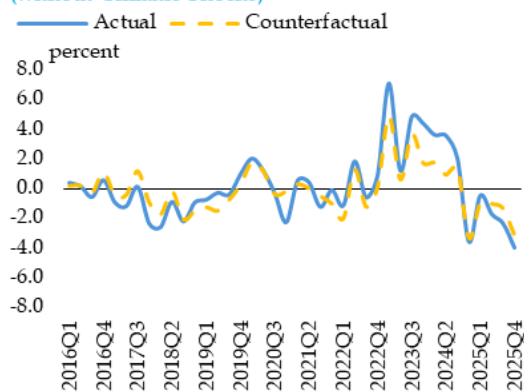
temperature is negative but statistically insignificant in the short-run. This contrasts with earlier studies for Pakistan, which estimated the impact of temperature on GDP separately from rainfall.

The HD-based period-wise contributions of climatic shocks to RGDP are shown in **Figure 6.1.2**. The results suggest that RGDP responds negatively to flood shocks. As far as the impact of temperature is concerned, the period-wise results suggest no significant impact on economic growth. In addition, the findings suggest that monetary policy, fiscal position, input prices (proxied by WPI), and exchange rate movements play pivotal role in the determination of economic growth during 2017 to 2025. The counterfactual analysis confirms the robustness of these results. The findings show that economic growth would have been higher in the absence of climatic shocks (**Figure 6.1.3**).

**Impact on inflation:** As expected, inflation has positive response to climatic shocks in terms of heavy rain or floods in the country. The results exhibit that one standard deviation (SD) shock to rain (flood) has a positive and immediate effect on inflation which, unlike the case of RGDP, decreases but remains positive up to fourth quarter (**Figure 6.1.4**). This is also consistent with (Hussain et al., 2025) who used rainfall as a proxy for floods and found that the impact of floods is inflationary but for short-term. A positive shock to temperature is likely to increase inflation in the long-run with no immediate or short-run effect.

The HD of inflation is reported in **Figure 6.1.5**. The findings suggest that climatic shocks both in terms of floods and higher temperature have positive and statistically significant impact on inflation. Compared to temperature, floods have a higher impact on inflation throughout the estimation period. Counterfactual analysis also shows lower inflation without climatic shocks (**Figure 6.1.6**).

**Counterfactual Analysis of Inflation (without Climatic Shocks)** Figure 6.1.6



Source: SBP Staff estimates

\*The contribution of Shah Hussain and Syed Qamar Hussain is acknowledged in writing this box.

**Box 6.2: EU's Carbon-related Trade Regulations and Potential Implications for Pakistan's Exports**

Adapting to climate change related regulations is becoming instrumental for staying in business and remaining competitive in global markets. This is particularly true in the case of the EU, which is placing carbon-related conditions on its imports, non-compliance of which threatens Pakistan's market access and export competitiveness (Senate of Pakistan, 2025). This Box discusses major climate-related regulations introduced by the EU, and its implications for Pakistan's textile exports.

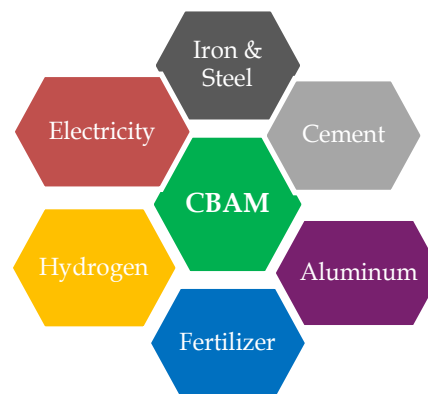
**Background:**<sup>68</sup> In 2005, the EU implemented a domestic carbon pricing mechanism called the Emissions Trading System (ETS), which was the world's first carbon market. This cap-and-trade mechanism set a limit on the amount of GHG emissions allowed to energy-intensive industries and power generation.<sup>69</sup> In 2019, in response to growing public pressure for stronger climate action and environmental protection, the European Green Deal (EGD) was introduced, which was the EU's overarching strategy to transform the economy towards a climate-neutral future. The EGD announced legally binding targets to cut emissions by at least 50–55 percent by 2030 and become carbon neutral by 2050. It drives change across energy, transport, and industrial sectors. Under the EGD, carbon pricing and industrial reforms were also introduced that have implications for EU's industrial sector as well as for global exporters. One of these reforms was the introduction of Carbon Border Adjustment Mechanism (CBAM) aimed at providing a framework for reaching the EU's climate objectives.

**CBAM:** Implemented in October 2023 with its initial transition lasting until 2025, the CBAM will eventually help the EU in phasing-out earlier allocation of free emission permits under ETS. Under the initial phase, EU importers were required to report data on embedded emissions during the production cycle of goods entering the EU borders. This data allowed the European Commission to prepare a mechanism for entry of goods before the start of definitive phase beginning January 2026.

The CBAM is currently applied to imports of goods related to six sectors (Figure 6.2.1) and a limited number of downstream products, such as screws and bolts. Under this phase importers of CBAM-related products sectors need to apply for CBAM certification before the import of goods. The cost of this certification will reflect the auction price of EU ETS allowances, expressed in euros per tonne of CO<sub>2</sub> emitted.

**Implications for Pakistan:** The CBAM does not currently have any major impact on Pakistan's exports. This is because with the exception of cement Pakistan exports a negligible quantity of the goods currently under CBAM to the EU or anywhere else in the world.<sup>70</sup> However, after 2030 other ETS sectors, as well as textile – being one of the major

Sectors covered under CBAM Figure 6.2.1



Source: European Commission

<sup>68</sup> European Commission (n.d.a).

<sup>69</sup> Electricity and heat generation, energy-intensive industry sectors, including oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals, aviation and maritime. Source: (European Commission, n.d.b).

<sup>70</sup> Based on SBP data, exports of products currently under CBAM accounted for a meagre 0.2 percent of total exports to EU in FY25. This accounted for 0.05 percent of total exports in FY25, based on the SBP data.

contributors to global GHG emissions<sup>71</sup> – may also be a part of CBAM as under the EGD, the EU has committed to become climate neutral by 2050 (CDPR, 2025; APTMA, 2023; APTMA 2025). In addition, there is another major development in the EU related to textile sector, i.e. the EU's Sustainable and Circular Textiles Strategy (SCTS), which focuses on how textiles are made and used, while recognising the sector's economic and social importance.<sup>72</sup> The SCTS incorporates EGD's goals, the EU's Circular Economy Action Plan, and the European Industrial Strategy. This along with the expected expansion of CBAM's scope to textile and other sectors may have significant implications for Pakistan.

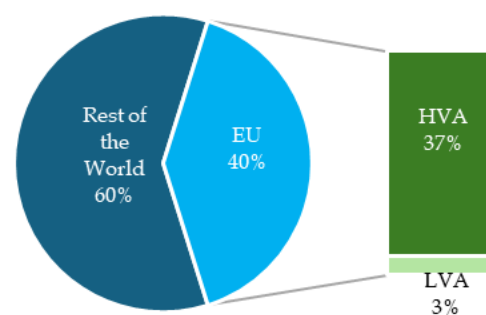
The EU is the largest destination of Pakistan's textile exports (**Figure 6.2.2**). To maintain competitiveness in the EU region, Pakistan's textile sector must reduce its carbon footprints given SCTS's focus on the entire lifecycle of textile products – from design and production to use and disposal. The SCTS outlines a range of actions, which include the need to make durable, repairable, and recyclable textile, and removal of microplastic pollution from synthetic textiles.<sup>73</sup>

In this context, Pakistan is at risk of losing industrial competitiveness due to three interlinked challenges (APTMA, 2025). These are (a) higher industrial emissions due to increasing reliance on coal between FY15-FY25; (b) carbon embedded in imported inputs which adds to the footprint of export value chains; and (c) a potential implication of taxes on gas for captive power plants that may further push industries towards a more carbon-intensive grid. These trends not only increase Pakistan's exposure to higher cost associated with CBAM but may also complicate the compliance with international climate commitments, such as under the UNFCCC, the Paris Agreement, and SDGs (APTMA, 2025).

The EU actions in the past illustrate that trade preferences can be withdrawn or market access curtailed when compliance gaps persist. Pakistan has previously faced an EU ban on seafood exports on sanitary and phyto-sanitary grounds (MOFA, 2013), and its football industry came under severe commercial pressure over documented child-labour concerns (HRBDF, n.d.). More recently, repeated EU quality and pesticide-residue alerts for Pakistani rice consignments have led to heightened scrutiny and shipment rejections (European Commission, n.d.d).<sup>74</sup> These actions suggest that even though textiles are not yet covered by CBAM, their expected inclusion by 2030 implies that similar compliance-based risks for Pakistan's textile exports are material rather than hypothetical.

**Way Forward:** Against this backdrop, preparedness appears to be weak, as evident from the fact that less than 40 percent of the country's textile firms hold

**Composition of Pakistan's Textile Exports** Figure 6.2.2  
percent of total exports



Note: HVA: High value added; LVA: Low value added.  
Source: SBP

<sup>71</sup> Textile consumption in the EU is one of the biggest environmental concerns as textile ranks fifth in overall GHG emissions, and third for water and land use in the EU (European Commission, n.d.c). In Pakistan, the textile sector is responsible for nearly 5 percent of the country's overall industrial emissions (WB, 2025).

<sup>72</sup> European Commission (n.d.c).

<sup>73</sup> The Eco-design for Sustainable Products Regulation passed in June 2024, included textiles in the list of products for EU market that needs to be designed to improve their circularity, energy performance, recyclability, and durability.

<sup>74</sup> European Commission (n.d.d).

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eco-label certification.<sup>75</sup> Most of these firms are large export-oriented firms (SBP, 2025), which indicates that carbon neutrality is not pursued across the industry nor across the value chain. This requires urgent attention given the lead time for retrofitting industrial process for carbon neutrality. To this end, several actions need to be taken. Fiscal and financial incentives need to be linked to energy efficiency and emission reduction targets alongside access to financing for climate neutral technologies; central mechanism for monitoring and benchmarking energy efficiency needs to be put in place; knowledge of climate neutral technologies needs to be made available; and awareness needs to be increased that textile firms certified under voluntary environmental standards demonstrate higher profitability, stronger stock performance and better sustainability outcomes (WB, 2025; SBP, 2025).

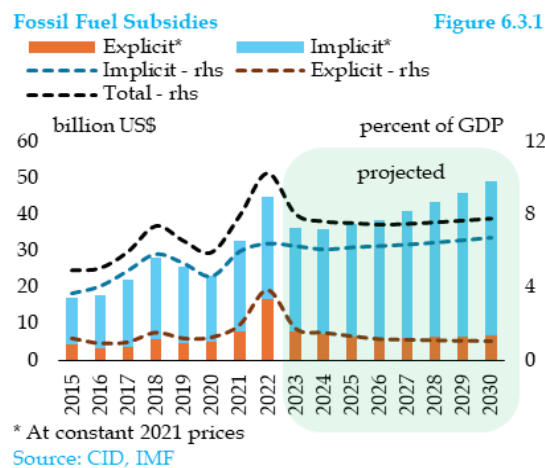
*\*The contribution of Syed Qamar Hussain and Ravi Kumar is acknowledged in writing this box.*

**Box 6.3: The Challenge of Climate Mainstreaming in Pakistan**

The large-scale and broad-based nature of climate action requires it to be integrated with economic policies. Global best practices, such as the EU Green Deal, suggest that this integration requires a comprehensive review of existing policies and laws across all federating units. Such an exercise has not been initiated in Pakistan yet. There have been some efforts to incorporate climate considerations in policies as envisaged in the Framework for Implementation of Climate Change Policy (FICCP) 2014-2030. Similarly, the recently launched Pakistan Climate Prosperity Plan is also a step in the right direction given its aim to embed climate resilience at the core of economic planning through a dynamic modelling system; and its vision to adopt whole-of-society and whole-of-government approach to address the challenges of climate change (MoF, 2026). However, successful execution of this plan would depend on the addressing of institutional challenges discussed in Section 6.3, and comprehensive review and revision of federal, provincial and sectoral policies and laws that have not yet been undertaken. In this context, the significant gaps highlighted in the discussion below, demonstrate limited climate mainstreaming in Pakistan.

**Fiscal policy:** Fiscal policy seems to be sending mixed signals vis-à-vis climate action. On the one hand, carbon levy has been introduced as part of reforms under IMF's RSF to mobilise revenue for clean development. On the other hand, sales tax exemption on import or supply of solar panels has been withdrawn, which undermines transition towards clean energy (PwC, 2025). Moreover, while the share of explicit fuel subsidies is declining, the implicit subsidies, in the form of undercharging environmental costs and foregone consumption tax on fuel prices, is projected to increase (Figure 6.3.1) (IMF, n.d).

Pakistan's fiscal architecture remains structurally less aligned with its climate policy objectives. Although Climate Budget Tagging (CBT) has been recently introduced at federal level, it is yet to be introduced in provincial budgets, which significantly limits effectiveness within Pakistan's decentralised



<sup>75</sup> Around 100 out of the 456 ecolabels tracked worldwide, apply to the textile sector with the major focus on energy, water, and chemical efficiency.

fiscal system (IMF, 2025c). At intergovernmental level, the NFC award allocates resources without recognizing, incentivising, or conditioning transfers on climate action, leaving provincial development budgets under no obligation to prioritise NDC commitments or climate resilience. This weak incentive structure contributes to tangible delays in necessary investments, such as, in flood resilience infrastructure) (Sheikh, 2025). Similarly, climate change is also not adequately embedded in public investment management. For instance, although the Planning Commission has revised project proposal guidelines (PC-1) to require integration of climate action in projects, most development projects continue to be approved using outdated formats that ignore climate risks (Krogstrup & Oman, 2019; IMF, 2025c; Sheikh, 2025).

**Monetary policy and financial stability:** SBP recognises climate change as major financial stability risk and includes it as a major theme in its Strategic Vision 2023-28. The measures regarding climate mainstreaming for the financial sector include, but are not limited to Green Banking Guidelines, quarterly bank reporting on Environmental & Social Risk Management (ESRM) Manual, Green Taxonomy as part of reforms committed under IMF's RSF, and Draft Guidelines on Climate Stress Testing for Banks, and others.<sup>76</sup>

However, there is a need to further strengthen climate integration by improving analytical capability in macroeconomic modelling and forecasting for monetary policy (IMF, 2021) and accustoming economic actors to the risk of climate change and transition policies through central bank's communication (NGFS, 2020). Moreover, improvements in the quality of data that feeds climate analysis is important to advance the precision of the policy decision. Furthermore, tracking new climate-related risk indicators, such as carbon footprint of financial institutions' portfolios (and collaterals) and exposure to climate-related physical risk etc. can improve supervisory framework (IMF, 2021).

**Trade policy:** Despite having a comprehensive climate change policy in place, the Strategic Trade Policy Framework (STPF) 2020-25 did not explicitly prioritise climate concerns in trade. As a result, the average tariff on imports of environmental goods (EG) remains elevated compared to that on non-environmental goods. Import tariffs on EGs are also higher compared to Bangladesh, China, India and Vietnam, and thus discouraging adoption of green supply chain. Moreover, Pakistan applies non-tariff measures to very few categories of EGs, due to which EG import quality assurance remains challenging. (Iqbal et al., 2024). The STPF have also not conceptualised exports of green manufacturing as potential opportunities (Sohail, 2025a), nor the need to adequately facilitate trade through digitisation of trade documents and reduction of trucks' waiting time, which can significantly reduce GHG emissions (Iqbal et al., 2024).

**Industry:** Mitigation policies are weakly integrated at the sectoral level in manufacturing. The absence of mandatory reporting by industrial units on emissions makes it difficult to regulate emissions. In the absence of strong regulatory framework, the impetus for green innovation; disclosure of climate related risk; and ESG compliance remain either low, slow, or voluntary (Sohail, 2025b; Bashir, 2025). While green industrialisation, which refers to a set of processes aiming to decouple economic growth from GHG emissions, is building momentum, reliable data to evaluate progress is rather scant. Under the FICCP, industry is not listed among the sectors in need of climate adaptation but only of mitigation, signalling a narrow conceptualisation of climate strategy. Even the most recent NAP 2023 does not assign green manufacturing as a priority in terms of adaptation, when in fact industrial adaptive measures, such as supply chain resilience, heat-resilient factor design and cooling systems, are common practices in other countries (MoCC&EC, 2023).

<sup>76</sup> SBP (2022); SBFN & IFC (2025)

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**Transport:** The bulk of passenger and goods cargo in Pakistan uses road transport rather than public or rail transport as mass transport can help mitigate some emissions. Both the trucking fleet as well as buses and other passenger transport mainly rely on outdated technologies (Hasan, 2025). There is also a lack of harmony between different transport modes; assigning agency-specific tasks to reduce emissions; and the absence of National Transport Masterplan, as envisioned in National Transport Policy 2018, which further slows the greening of transport sector.

Similarly, instead of creating incentives for the use of public transport, the country's auto policies, such as 2021-26, incentivise manufacturing and import of fossil fuel light vehicles through reduction in duties and taxes. Such incentives were not only environmentally unfriendly but altered land use through urban sprawl and increased emission through road congestion (Hasan, 2025). Moreover, whilst New Energy Vehicle (NEV) policy, and the reforms under IMF's RSF – including introduction of EV subsidy and internal combustion engine vehicle tax – are catalysing the transition to clean passenger cars, the incentive for electrifying commercial fleets, which have no emission standards, is minimal in the NEV Policy.

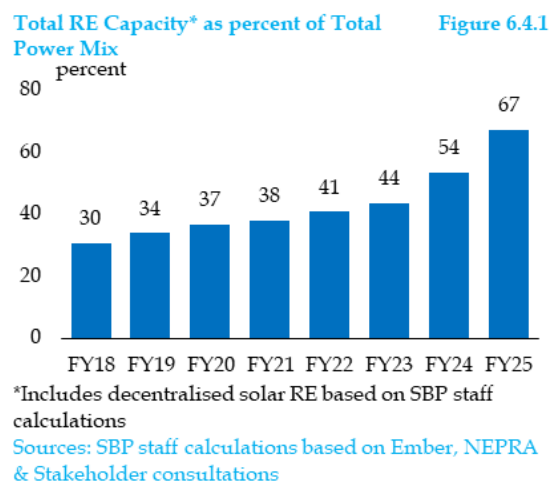
\* The contribution of Abdul Jabbar is acknowledged in writing this box.

### Box 6.4: Renewable Energy (RE) Transition in Pakistan: Phenomenal Growth Facing Headwinds

The phenomenal transition to RE in Pakistan during the last four years is good for climate change mitigation and for the economy. Like recent global trends, Pakistan's RE transition is mainly led by solar energy, amid expectations that solar power will continue to drive the global RE transition in the foreseeable future. This Box sheds light on recent growth in solar power, its main drivers, as well as the key challenges to its continued growth in Pakistan.

**Rapid adoption of solar power in Pakistan:** RE has a sizable share in grid capacity in Pakistan. In FY25, 35 percent of installed capacity was from on-grid renewable energy, up from 30.3 percent in FY10.<sup>77</sup> Official numbers show that a major source of RE in Pakistan has been hydel, with a 28 percent share equalling 11.5 GW in FY25. However, in terms of the total power mix (in terms of capacity), decentralised solar capacity – including off-grid and behind-the-meter (BTM) installations – has the largest share.

The measurement of decentralised solar energy is a challenge in Pakistan. Except for net-metered systems, no official measures exist for decentralised solar energy. This lack of data is due to the bottom-up nature of these installations, with no exact figures available for BTM and off-grid installations. However, estimates based on China's solar panel exports to Pakistan (which constitutes around 99 percent of Pakistan's total solar panel imports) suggest that the quantum of decentralised solar power capacity in FY25 was around 40.8 GW.<sup>78,79</sup> As a result, total RE (including estimated decentralised



<sup>77</sup> Includes Hydel, Wind, Solar, Bagasse energy as a percent of total grid capacity as of June 2025. Source: NEPRA (2025)

<sup>78</sup> SBP Staff calculations based on import data from Ember, NEPRA, and stakeholder consultations.

<sup>79</sup> This 40.8 GW is around 99 percent of total grid capacity. Even conservative estimate of decentralised power puts the number at around 27.5 GW or 67 percent of grid capacity. Source: TZ (2025) based on satellite imagery.

capacity) was around 67 percent of total power mix (in terms of capacity) (Figure 6.4.1). Moreover, with an estimated installation of 9.2 GW of decentralised solar capacity during H1-FY26, total decentralised solar capacity could be around 50 GW. This is expected to further improve Pakistan's already leading position among countries with high share of solar in total power generation mix (Figure 6.4.2).

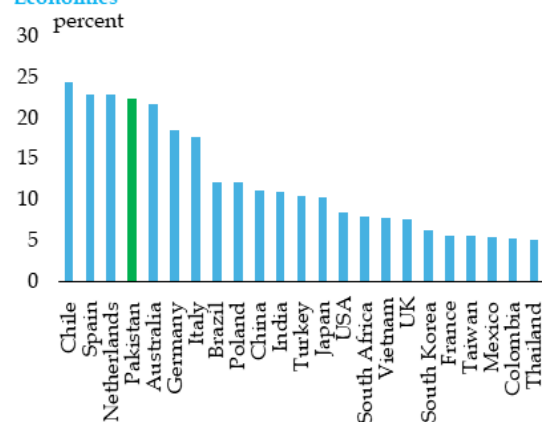
This transition to solar power has led to a gradual but consistent increase in gross foreign exchange savings on account of lower energy imports, cumulatively estimated to be around US\$ 7.1 billion in last six years.<sup>80</sup> SBP staff estimates suggest that the estimated installed solar capacity as of December 2025 will reduce annual energy import bill by around US\$ 5.2 – 7.8 billion in 2026. Overall, SBP staff calculations suggest that the cumulative solar panel import in dollar terms is now broadly offset by the resulting foreign exchange savings in fuel imports from solar-based electricity generation in recent years and is likely to generate net FX savings going forward.

**Drivers of solar power boom:** According to a survey, the residential sector leads Pakistan's decentralised solar adoption, accounting almost for 50 percent of total installed capacity. This is followed by the industrial, agriculture and commercial sectors, reflecting a broad-based adoption and a move towards self-generation.<sup>81</sup> A combination of four key factors are behind Pakistan's solar growth. First, Pakistan has a natural endowment for solar energy because of high solar irradiance along with low seasonality. Some estimates hold that the country can generate more than 100,000 MW of electricity,<sup>82</sup> which positions Pakistan among the top countries with RE potential.

Second, to capitalise on this potential, Pakistan introduced the Policy for Development of Renewable Energy (DRE) in 2006 to create an initial policy framework for wind and solar energy, followed by the Distributed Generation and Net Metering Regulations (DGNMR 2015). DGNMR allowed households and businesses to monetise surplus solar generation. The Alternative and Renewable Energy (ARE) Policy 2019 further mainstreamed renewables by shifting policy from fixed tariffs to competitive auctions and least-cost procurement, embedding RE within national planning targets. Till June 2025, total net metered capacity was 6.5 GW, equalling 16 percent of total decentralised solar power.

Third, a lack of access to grid and weaknesses in Pakistan's grid infrastructure accelerated decentralised solar adoption, as an underfunded and outdated transmission and distribution system faces high losses, congestion, and creates unreliability of grid energy. Fourth, and the single biggest reason of decentralised solar power growth is the declining

Estimated Share of Solar in Total Power Generation Mix in 2025\* - Selected Economies\*\* Figure 6.4.2



\* Data for El Salvador is available up to Jun 2025; data for other countries are available till Oct 2025 or Dec 2025.

\*\* Economies with less than 80 twh of total electricity generation and less than 5 percent share of solar power have been excluded from the list of countries

Source: Ember

<sup>80</sup> SBP Staff estimates based on estimates of annual increases in installed solar capacity.

<sup>81</sup> Sectoral adoption studies categorise sectors based on scale which follows a pattern with solar adoption. For instance, the solar adoption in Pakistan is strongest amongst high-income households, medium scale business, large scale industries, particularly textile, and medium farm, driven by affordability, grid unreliability and greater capital. Source: PRIED, 2025; Shah, 2025.

<sup>82</sup> Mirza et al. (2011); Muhammadi et al. (2024)

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costs of solar infrastructure, which has fallen sharply worldwide. Moreover, global prices for battery and storage technology have also been declining (Figure 6.4.3), making solar energy cheaper and more reliable than before.

**Challenges to RE transition in Pakistan:** The continued growth in distributed and utility-scale solar power faces a range of structural and policy challenges.

**Capacity purchase price (CPP):** The growth in the adoption of solar power has created the conditions of a utility death spiral (UDS), reducing grid consumption and further increasing idle capacity (Shah, 2025). This translates into higher electricity cost for grid-reliant consumers. The policies to mitigate the challenge of UDS, such as net billing,

and removal of GST exemption on import and sales, etc., are expected to discourage decentralised solar adoption, as already evident by a 40 percent reduction in solar capacity imports from China in 8M-FY26. However, rising fuel prices due to the war in the Middle East, declining battery costs and gradual behavioural change are expected to continue decentralised solar uptake, leading to continued UDS and further increase in CPP. Consequently, the government may be forced to frequently revise decentralised solar regulations to address UDS, translating into policy confusion, and deterring smooth growth in decentralised solar.

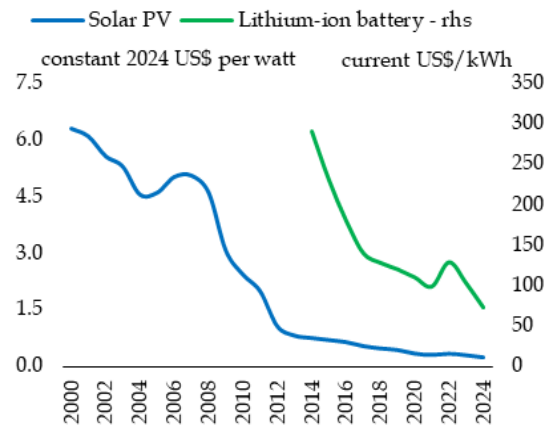
**Grid and transmission readiness:** The existing infrastructure was not planned for a massive decentralised RE network. Grid stability issues and technical constraints lead to reverse power flows and transformer overloading, thus limiting the growth of solar in absence of advanced technologies, such as smart transformers, automated control centres and real-time monitoring systems (SDPI, 2024).

Moreover, transmission bottlenecks and insufficient evacuation capacity limit integration of utility scale RE generation (RF, 2024). Pakistan's utility-scale renewable energy potential is geographically concentrated in the southern region, whereas demand hubs are concentrated in the central region. In addition, poor grid connectivity and inadequate transmission infrastructure has left substantive electricity potentially unutilised (NEPRA, 2026).

The grid is also insufficiently equipped to manage the variability of solar and wind energy, due to inflexible grid infrastructure; lack of utility scale storage to save excess energy; absence of advanced technologies, such as smart transformers, automated control centres and real-time monitoring systems; and demand-side tools to shift consumption (SDPI, 2024). In contrast, higher reliance on thermal plant, outdated dispatch protocols and baseload centric planning has limited operational flexibility.<sup>83</sup>

**Institutional factors:** From the perspective of utility-scale RE projects, overlapping mandates, delayed tariff approvals, and weak inter-agency accountability are considered primary barriers to scaling

**Solar Panel & Battery Prices** Figure 6.4.3



Source: Our World in Data

<sup>83</sup> Baseload power refers to the minimum level of electricity demand that must be met consistently to ensure the reliability and stability of the grid. Traditional baseload demand is met by plants that can operate continuously, such as coal, oil, or nuclear plants.

renewable deployment (Elahi et al, 2024). The bidding process for utility-scale RE faces poorly defined criteria, lack of standardisation, and opaque evaluation mechanisms, creating inefficiencies and deterring investment (SDPI, 2024).

From the perspective of decentralised solar, official planning frameworks have chronically understated actual market activity, particularly the surge in distributed and off-grid solar installations. With the surge in solar decentralisation, power sector planning needs to evolve from old era of power shortages to new era of surplus capacity, which requires change in tariff design; demand volatility management; and adoption of large-scale Battery Energy Storage system (BESS). Another challenge remains unnecessary delays in the approval of net metering applications by DISCOs, even when applications have met all requirements.

**Financing constraints:** Utility scale RE projects are inherently capital-intensive, with majority expenditure incurred upfront and recovered over time. However, these projects face acute financing challenges as the cost of capital in EMDEs has doubled compared to that in AEs (RF, 2024). In addition, limited technical expertise and dealing with disruptions often leads to cost and schedule overrun, leading to significant delays in utility scale solar and wind project (IEEFA, 2022). Financing of decentralised solar power is also limited due to low bank credit, amid concerns of collateral and recoverability (RF, 2025). The recently proposed transition to net-billing can affect bank financing because lower export rate lengthens the payback period, raising loan premium. Moreover, continued fossil fuel subsidies distort pricing signals by reducing the relative cost of thermal generation, weakening RE competitiveness and transition (Black et al., 2025). Instead of subsidizing fossil fuel consumption, such fiscal allocations can be used for the development of a cleaner energy mix.

*\*The contribution of Ali Ahsan, Ali Ahmed Shah, Abdul Jabbar and Umar Mashood is acknowledged in writing this box.*

### Box 6.5: Developing Carbon Markets (CM) in Pakistan

Amid the growing importance of carbon markets for climate action, Pakistan issued the 'Policy Guidelines on Trading in Carbon Markets' in 2024. However, a variety of policy, institutional and capacity challenges must be addressed to develop the market. This Box outlines how carbon markets enable climate action, the challenges in developing one in Pakistan and its broad solutions.

**Background:** Originating in 1997, CM emerged as a market-based mechanism for issuing tradable carbon credits against GHG emission reductions. Carbon credits – are independently verified, aligned with recognised standards (either international, national or independent) and then retired to meet voluntary or mandatory climate obligations.<sup>84</sup> Typically, one carbon credit represents one tonne of CO<sub>2</sub> equivalent emission reduced (offset),<sup>85</sup> or permitted (allowance) in some systems.

**How CMs function:** CM are regulatory or voluntary. Regulatory markets impose binding emission limits through carbon pricing instruments, such as emissions trading systems (ETS), output-based benchmarks, or carbon taxes (**Table 6.5.1**). These markets generate fiscal revenues, transmit carbon pricing signals and create binding incentives for firm-level decarbonisation. Globally, the value of traded credits in compliance markets was US\$ 947 billion in 2024 – with the EU ETS representing 84 percent of this value (ICMA, 2025). While the EU remains the largest CM by transacted value, China operates the largest ETS

<sup>84</sup> Carbon credit retirement is the permanent removal of a carbon credit from circulation, ensuring that it cannot be reused or resold after it has already been used to offset emissions.

<sup>85</sup> For e.g. through emissions reduction activities, such as transitioning to green energy, or destroying methane generated at landfills.

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Instruments of Carbon Markets		Table 6.5.1
Instrument	Mechanism	Market type
Cap-and-trade Emissions Trading System (ETS)	Sets an emissions cap and then tradable allowances are sold by a public authority. Allowances represent an emissions quota. Emission caps are gradually reduced every year.	Regulatory
Rate-based/ Output-based Carbon Tax	Regulate emissions per unit of output rather than setting an absolute cap, incentivises production efficiency	Regulatory
Carbon Credits	Government levy per tonne CO <sub>2</sub> e emitted	Regulatory
	Credits from GHG reduction projects, representing carbon offsets. Credits can be verified by either international, independent or domestic crediting bodies.	Regulatory and/or voluntary

Source: World Bank (2025)

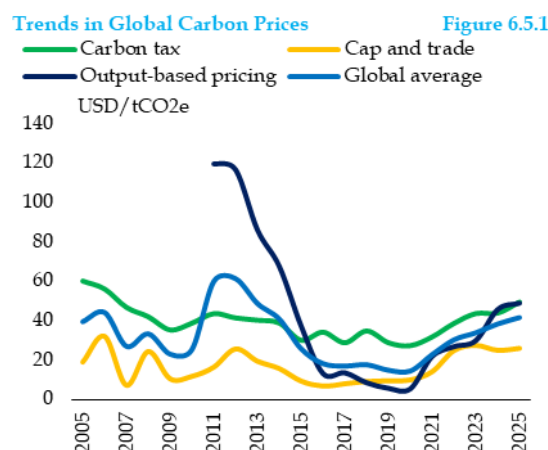
by coverage, while several EMDEs such as Indonesia, Türkiye and are accelerating the development of national regulatory markets (LRI, 2025).

In contrast, voluntary markets enable firms and governments to finance mitigation projects - generating carbon credits that can be sold for revenue or utilised to meet climate commitments. For firms, voluntary markets monetise emission reductions and attract private climate finance. Internationally, voluntary credits may be authorised for country-to-country transfers under the Paris Agreement (OIES, 2022).

In practice, voluntary and regulatory markets increasingly overlap, as some regulatory systems allow the use of credits for meeting compliance obligations and crediting mechanisms are often used to build MRV capacity ahead of market deployment. Regulatory markets establish explicit carbon pricing signals that drive demand for carbon credits both globally and domestically. Formal pricing instruments also help firms internalise the carbon cost which can support future decarbonisation decisions. Global carbon prices have been steadily rising since 2020 and are expected to continue rising as more national regulatory markets are established (Investcorp, 2024) (Figure 6.5.1).

**Challenges & way forward for Pakistan:** Pakistan's 2024 Policy Guidelines on Trading in CM demonstrate intent to deepen participation in voluntary markets while laying the foundation for a future regulatory market, supported by the establishment of a Carbon Market Working Group and plans for a national carbon registry (MOCC&EC, 2024c). Pakistan's has previously participated in international CM; notably through the Sindh Delta Blue Carbon Project from which Pakistan has earned approximately US\$ 40 million from selling carbon credits and is expected to earn US\$ 50 million annually (MoIB, 2025). The KP Billion Tree Tsunami Project is also designed to generate carbon credits for revenue purposes. Some assessments place Pakistan's carbon market earning potential at US\$ 400 million to US\$ 2.25 billion (TIP, 2025).

However, several constraints remain regarding Pakistan's CM readiness. These include the absence of a national emissions baseline; lack of formal MRV guidelines for carbon market participation; limited carbon accounting capacity; low private sector awareness; lack of domestic pricing signals and trading infrastructure. In the absence of binding carbon costs and emission caps, private firms face limited incentives to participate (TIP, 2025).



Source: WB carbon pricing dashboard

While it is important to urgently address these issues, the transition to CM needs to be phased out through sectoral pilots on emission-intensive industries to ease the transition to nation-wide deployment through a regulatory CM. Sudden introduction of emission targets or pricing instruments can lead to market distortions and price volatility, and undermine business confidence especially in a weak institutional setting like in Pakistan. International experiences offer some lessons in terms of building market readiness, institutional capacity and price discovery mechanisms to pave the way for an active CM in the future. China first piloted its ETS on the power sector, distributing emission allowances with output-based benchmarks adjusted to different types of power plants (CFAI, 2024). The pilot has since been expanded to include other sectors, such as cement, transport, and waste management. Similarly, South Korea is also implementing its national ETS in gradual phases, expanding sectoral coverage with each phase.

In parallel to this, transparent price discovery mechanisms should be developed to ensure market stability and maturity. For example, shadow carbon prices (reference prices published by a regulator) can help firms to factor in the carbon cost. This can serve as a price signalling tool without imposing compliance obligations and prepare markets in advance before formal pricing instruments are imposed (WB, 2025). As markets mature, auction-based allocation of carbon credits, such as those used in the EU, can allow competitive price setting. Additionally, the establishment of a centralised carbon registry or trading platform can help in tracking the issuance and retirement of credits and support secondary market trading. To this end, the carbon trading market may be set up at a national stock exchange, as done by Egypt since August 2024 (FRA, 2024).

Pakistan has made meaningful strides towards carbon market development; however, broadening private sector participation, designing price discovery mechanisms and building readiness for a CM through phased pilots will be essential to ensure a smooth transition. A sequenced approach along with clearer policy signals, and gradual introduction of sectoral benchmarks can minimise market distortions while positioning carbon markets as a credible tool for mobilizing climate finance. This needs to be anchored in the development of national MRV guidelines and reporting standards, similar to those introduced in other regulatory markets.

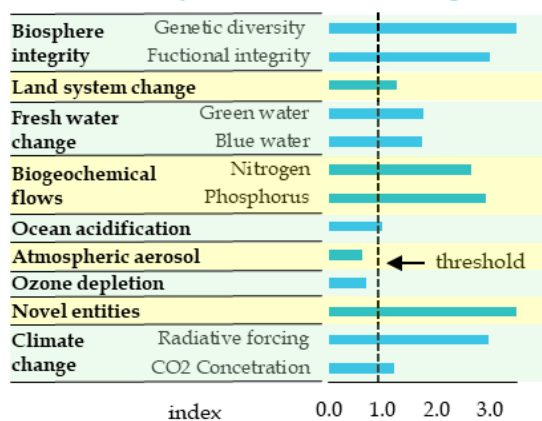
*\*The contribution of Mehreen Tariq Ghani is acknowledged in writing this box.*

### Appendix 6A: Planetary Boundaries (PB) and Risks to Global and Domestic Economy

The PBs refer to the environmental limits within which humanity can safely operate while maintaining the balance of earth's ecosystem (Rockström et al., 2009). The PBs are interlinked and driven by local stressors, such as burning fossil fuel; untreated waste; and pollution. Transgression of one PB can worsen the impact on other PBs (Gerten et al., 2025). For instance, climate change accelerates biodiversity loss, while land degradation can trigger droughts and heatwaves. As of 2025, human activities have pushed seven out of nine boundaries (including climate change) beyond safe limits (Figure 6.A.1). Although the transgression of these seven PBs does not imply immediate system collapse, it materially increases systemic risk with non-linear and cascading impacts. Continued pressure on the PBs increases the risk for the earth to cross the tipping points, causing irreversible damage to earth's ecosystem.<sup>86</sup> The monitoring of PB markers remains sparse in Pakistan (Ali, 2020), leading to material knowledge gaps about the pace of change, and its exact economic impact. This Appendix serves as a primer on the PBs that have been breached,<sup>87</sup> and its consequent risks to global and Pakistan's economy.

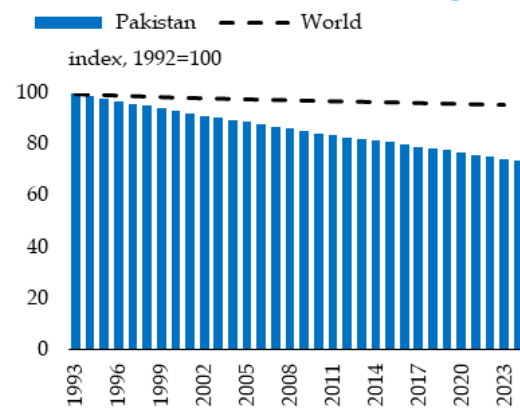
**Freshwater Change:** The increase in global GHG emissions, excessive water withdrawals, and expansion of agricultural land, have altered freshwater flows and stocks across land and atmosphere (PHC, n.d.a). As of 2025, more than one-fifth of global land area experienced significant dry and wet deviations in both blue and green water,<sup>88</sup> breaching the safe limits of freshwater change by 9.7 and 9.6 percentage points, respectively. This has led to increased frequency of droughts and disruption of river flows to oceans (PB Science, 2025). These deviations are far more pronounced in major river basins, such as the Indo-Gangetic Plain,<sup>89</sup> particularly in Pakistan where overextraction of ground water is depleting water resource at an alarming rate (Mohan et al., 2022). Since 1970, the world has lost around one-third of its wetlands, contributing to increase in water shortages and food insecurities; decline in freshwater biodiversity; and aggravating economic pressures (WWF,2023). Similarly, changes in water flows have impacted agricultural productivity in Pakistan (Naeem and Sulehri, 2019).

Status of Planetary Boundaries in 2025 Figure 6.A.1



Source: SBP staff calculations based on PBScience

Forest Cover Figure 6.A.2



Source: CID, IMF

<sup>86</sup> Tipping points are the threshold beyond which the earth system changes irreversibly. For example, if Amazon rainforest crosses the threshold, it would lead to extreme weather patterns (IPCC, 2022; Germanwatch, n.d)

<sup>87</sup> This excludes climate change, which is already covered in detail in this chapter.

<sup>88</sup> Blue water refers to river, lakes, and underground aquifers; green water refers to soil moisture.

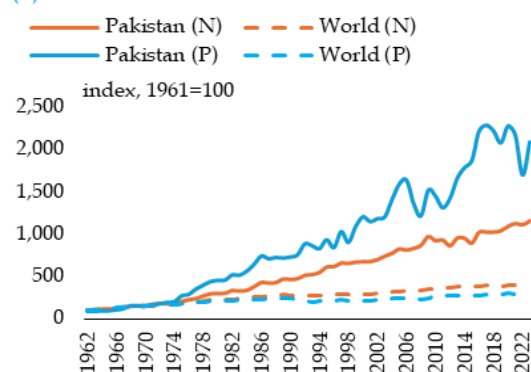
<sup>89</sup> Includes regions of Pakistan, India, Nepal, and Bangladesh

**Land System Change (LSC):** Driven primarily by expansion of agriculture land and urbanisation, alteration in LSC increases the risk of irrevocable environmental shifts and triggers adverse impacts across multiple PBs, such as climate change and freshwater change. The transgression of these PBs in turn impact LSC as increasing warming and alteration in rainfall patterns strain forest ecosystems and reduce their resilience. LSC is mainly measured through forest cover,<sup>90</sup> which is approximately 59 percent at global level, well below the safe threshold of 75 percent (**Figure 6.A.2**). In absolute terms, global forest cover has declined by approximately 4.2 percent in 2023 compared to 1992, whereas Pakistan experienced a far more severe loss of 26.4 percent. Deforestation has intensified Pakistan's environmental degradation (Hashmi and Asif, 2025), reducing land's capacity to absorb and regulate water runoff. The impact of the three recent floods in Pakistan – in 2010, 2022, and 2025 – was intensified due to changes in Pakistan's LSC (Khan, 2025).

**Biogeochemical Flows (BF):** Modification of BF refers to the alteration of natural nutrient cycles mainly due to application of mined phosphorus and industrially fixed nitrogen as fertilizers. Since only a fraction of these nutrients are absorbed by crops, a large amount accumulates in soil, discharges in surface water, and remains in the atmosphere. Therefore, breaching of this PB has extensive impact on marine life, terrestrial ecosystem, human health, alongside impact on agriculture and tourism. As of 2025, the total amount of anthropogenic nitrogen has exceeded that from all its natural sources, whereas growing demand for food has accelerated the phosphorus cycle two to three times beyond natural rates (PBSscience, 2025). Cropland nitrogen and phosphorus use is rising globally, with Pakistan exhibiting a notably steeper rise (**Figure 6.A.3**). Low fertilizer-use efficiency in Pakistan, particularly nitrogen, directly impacts the water and air quality (Raza et al., 2018), whereas phosphorus fertilizer has led to nutrient overload in aquatic systems harming marine biodiversity (Ogwu et al., 2025).

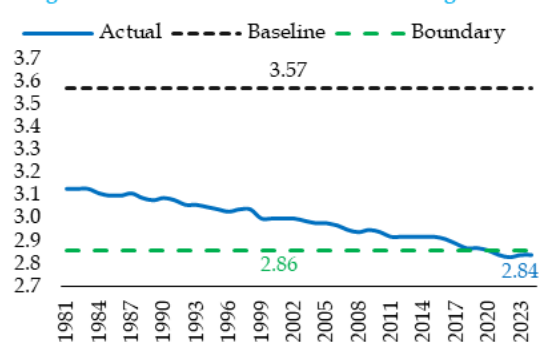
**Ocean Acidification (OA):** OA is the increase in acidity of seawater due to absorption of anthropogenic CO<sub>2</sub> from the atmosphere. Acidic seawater reduces the amount of carbonate in seawater, which is measured by aragonite saturation level (**Figure 6.A.4**).<sup>91</sup> This affects calcifiers and coral reefs, that are integral to the sustainability of marine ecosystem (IPCC, 2021). Global assessments conclude that OA is

**Cropland Nitrogen (N) and Phosphorus (P) Balance** Figure 6.A.3



Source: FAO

**Aragonite Saturation State\*** Figure: 6.A.4



\*Aragonite Saturation State is a dimensionless ratio and has no units.

Source: Planetary Health Check

<sup>90</sup> Existing forest area as a ratio of original forest cover, which would exist in the absence of anthropogenic LSC.

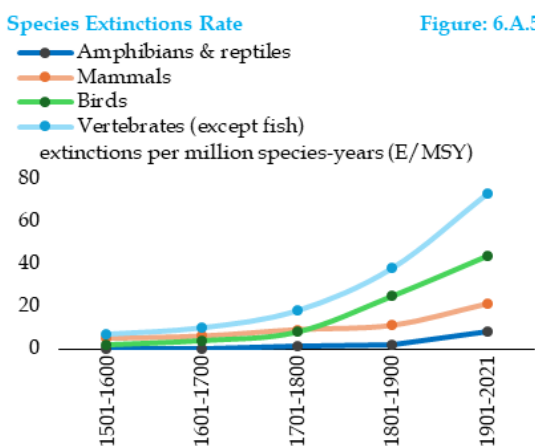
<sup>91</sup> Aragonite saturation state is a measure of the availability of carbonate ions in seawater for calcifying marine organisms (called Calcifiers) to build their shells and skeletons. It is a geochemical index of whether aragonite will precipitate or dissolve in seawater.

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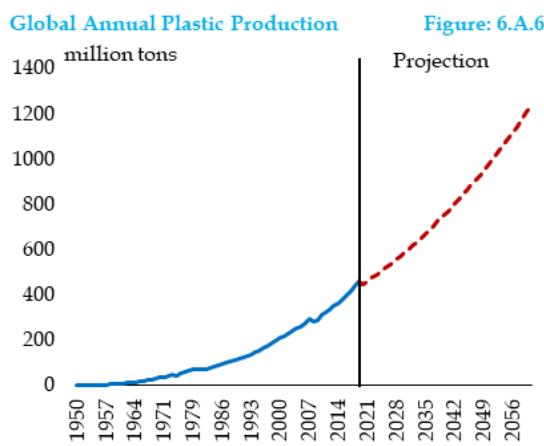
still ongoing, pushing ocean chemistry beyond safe levels (Findlay et al., 2025). Pakistan's coastal waters are exposed to global OA trend as well as local stressors, such as nutrient loading, turbidity and thermal stress that together exacerbate reef vulnerability (Ali, 2020; Sreeush et al., 2019). This puts the country's seafood export potential at risk and exposes the country's mainly artisanal<sup>92</sup> fisheries sector to income and poverty shocks. Reduced catch also risks further reducing seafood consumption, which is already significantly lower in Pakistan than global average, affecting public health and nutrition outcomes (HL, n.d; Andreoli et al., 2025).

**Biosphere Integrity (BI):** BI depends on health, diversity, and interactions of the organisms that make up Earth's ecosystems. Globally, human activities are putting increasing pressure on BI through land use changes, such as deforestation for urban expansion and agriculture amid population growth, and industry's overexploitation of natural resources, leading to habitat loss for species. The last century has seen a significant increase in the extinction rate of species across the animal kingdom (Figure 6.A.5).<sup>93</sup> Pakistan's land-use change, irrigation expansion and unsustainable extraction contribute to local BI erosion. For example, freshwater systems in Pakistan, Indus Basin in particular, have experienced species decline and altered flow because of water abstraction, dams, pollution and habitat conversion (Zahra et al., 2023). Biodiversity loss undermines the natural capital that supports agriculture, forestry and fisheries, leading to a variety of macroeconomic impacts, such as declining crop yields, food price volatility, and export losses to fisheries sector.<sup>94</sup>

**Novel Entities (NE):** NE boundary covers a wide class of substances and materials including human-made materials, synthetic chemicals, heavy metals, plastics, radioactive materials and genetically modified organisms. Scientists measure NE boundaries through various proxies, such as plastics, whose increasing production (Figure 6.A.6) has had a ubiquitous impact on global environment (Persson et al., 2022). Pakistan is a significant generator of plastic waste and faces high rates of mismanaged plastics with an estimate of around 2 million tons of annual plastic waste, 86 percent of which is not managed properly. This mismanagement harms human health and marine species, with over 1.7 million tons ending up in landfills, open dumping sites, waterways and food systems, placing Pakistan among the top 10 plastic-



Source: Planetary Health Check



Source: Our World in Data

<sup>92</sup> Artisanal fishing refers to small scale, traditional fishing practices carried out by households or local communities rather than large commercial companies. Pakistan's fisheries continue to be predominantly artisanal (FAO, 2009).

<sup>93</sup> PHC, n.d.b

<sup>94</sup> IPBES, 2019; Brander et al., 2014

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polluting countries globally (WWFP, 2025). Pakistan also faces the challenge of pesticide and industrial chemical released into rivers and soils, impacting riverine ecology and soil degradation (Abbas et al., 2024). The economic risk from NE transgression is two-fold; direct costs from health impacts and indirect longer run costs from altered ecosystem function such as soil contamination impacting agriculture and bioaccumulation harming fishing industry.

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**Appendix 6B: Policy Framework and Institutionalisation of Climate Action in Pakistan**

The institutionalisation of climate change in Pakistan reflects a gradual but uneven progress. It is characterised by the chronological expansion of institutions, policy layering, and periods of institutional restructuring. Early efforts were targeted towards environment protection in general, following international commitments, such as the Stockholm Declaration. This policy framework was followed by dedicated climate governance structure. However, as the table below suggests, the timeline exhibits implementation lag as indicated by delayed emergence of operational frameworks and enforcement mechanism of policies. The intensification of climate-related disasters, along with the Paris Agreement, has since accelerated transition from policy formulation toward implementation, giving renewed attention to climate action even as it remains inadequate.

**History of Policy Framework and Institutionalisation of Climate Action in Pakistan** Table 6.B.1

Year	Accomplishment	Year	Accomplishment
1974	Environmental and Urban Affairs Division established at the Federal Level following Stockholm Declaration	2012	National Disaster Management Plan approved
1983	Pakistan Environmental Protection Ordinance enacted, first comprehensive environment specific legislation	2012	National Sustainable Development Strategy
1989	Environmental and Urban Affairs Division upgraded to the Federal Ministry of Environment, Forestry and Wildlife	2013	Ministry of Climate Change downgraded to Division of Climate Change
1991-93	National Conservation Strategy prepared; National Environmental Quality Standards adopted in 1993		Global Change Impact Studies Centre granted autonomous status
1995	Cabinet Committee on Climate Change established, as policy coordination forum	2014	Framework for Implementation of Climate Change Policy adopted
1997	Pakistan Environmental Protection Act enacted	2015	Division of Climate Change upgraded to Ministry of Climate Change
2002	GCISCC, first research centre on CC, established	2016	NDC 1.0 in line with Paris Agreement
2004-05	PMM Committee on CC convenes National Environmental Policy	2016-18	National Forest Policy; National Water Policy of Pakistan
2006	National Energy Conservation Policy, National renewable Energy Policy, CDM implementation framework	2017-18	Climate Change Act was passed
2010	18th Amendment to the 1973 Constitution led to devolution of climate change policy implementation and related sectoral policies	2019	Clean Green Pakistan Movement (CGPM) launched
2011	Ministry of Environment ceases to exist	2021	Revised National Climate Change Policy of Pakistan
2012	The New Ministry of Disaster Management established; Ministry of Disaster Management renamed to the Ministry of Climate Change	2022	National Hazardous Waste Management Policy
2012	National Climate Change Policy approved by Federal Cabinet	2022	Implementation Framework reporting for NCCP
2012	Punjab and Balochistan Environmental Protection Acts prepared and enacted	2023	Progress on National Adaptation Plan (NAP)
2012	Green Benches established in all High Courts and the Supreme Court of Pakistan	2025	Pakistan Third National Communication; Third NDC Submission (NDC 3.0); Draft Pakistan Green Taxonomy; First Climate Budget
Institutional Development		Legal Development	
Policy Formulation		Policy Implementation	

Sources: MoCC&EC (2025a); Mumtaz (2023)

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