

SDG 13 PROGRESS ASSESSMENT: PAKISTAN'S POSITION IN GLOBAL CLIMATE ACTION INDEX (2015–2025)

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DOI: <https://doi.org/10.5281/zenodo.17719418>

Keywords

SDG 13, Climate Action, Pakistan, Global Climate Risk Index, Renewable Energy, Adaptation, Policy, 2015–2025

Article History

Received: 13 September 2025
Accepted: 23 October 2025
Published: 05 November 2025

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Abstract

This study evaluates Pakistan's progress toward Sustainable Development Goal 13 (SDG 13) Climate Action over the period 2015–2025, with a focus on its performance in global climate indices, including the Global Climate Risk Index and the Climate Change Performance Index. Using a comprehensive secondary data approach, the research examines trends in greenhouse gas emissions, renewable energy adoption, climate finance mobilization, policy implementation, and disaster resilience. Findings indicate that Pakistan has made incremental progress in renewable energy deployment and ecosystem restoration, exemplified by initiatives such as the Ten Billion Tree Tsunami Program and the National Adaptation Plan. However, the country remains highly vulnerable to climate hazards, including floods, heatwaves, and glacial melting, which have periodically undermined policy effectiveness and global index performance. Institutional weaknesses, limited climate financing, technological gaps, and socioeconomic constraints, such as poverty and political instability, further hinder SDG 13 achievement. Comparative analysis with South Asian peers reveals both strengths, including low per-capita emissions, and gaps in adaptation infrastructure and early-warning systems. The study concludes that while Pakistan demonstrates policy commitment and moderate mitigation success, accelerated, coordinated, and multi-sectoral action is essential to achieve SDG 13 targets by 2030. Policy recommendations emphasize strengthening institutional governance, expanding renewable energy and adaptation infrastructure, mobilizing climate finance, promoting technology transfer, fostering community engagement, and integrating climate action with socioeconomic development. This research provides a comprehensive assessment of Pakistan's climate performance, offering evidence-based insights for policymakers, scholars, and development practitioners to enhance climate resilience and sustainability.

1. Introduction

The 2030 Agenda for Sustainable Development, adopted by the United Nations General Assembly in September 2015, established 17 Sustainable Development Goals (SDGs) as a universal roadmap for socio-economic development that is environmentally sustainable and socially inclusive (United Nations, 2015). SDG 13, “Take urgent action to combat climate change and its impacts,” is central to the entire Agenda because climate change is not only an environmental problem but one that threatens progress across health, food security, water, infrastructure and poverty reduction (United Nations, 2015). The Intergovernmental Panel on Climate Change (IPCC) has reinforced the urgency of accelerated climate action: the Sixth Assessment Report (AR6) and related special reports make clear that human influence has warmed the climate system, extreme weather events have increased in frequency and intensity, and limiting warming to 1.5 °C requires decisive and immediate emissions reductions as well as adaptation measures (IPCC, 2021; IPCC, 2018).

While climate change is global in origin, its impacts are highly uneven; low-emission developing countries frequently endure the most severe physical and socioeconomic consequences (IPCC, 2021). For Pakistan a lower-middle income country with hydrologically complex mountain systems and a large agrarian population dependent on river flows climate change is a systemic risk multiplier. Pakistan’s vulnerability manifests through recurring and intensifying floods, heatwaves, droughts and accelerated cryosphere change (glacier melt and glacial-lake hazards), each with measurable human and economic tolls.

The 2010 and 2022 floods exemplify Pakistan’s acute flood risk and its developmental consequences. In 2010, extensive monsoon flooding affected millions and caused severe economic disruption; however, the 2022 monsoon-related floods were unprecedented in scale. Post-disaster assessments concluded that roughly one-third of Pakistan’s territory was inundated and approximately 33 million people were affected, with nearly 8 million temporarily displaced; damage and economic losses were

estimated in the tens of billions of U.S. dollars by multi-agency assessments (World Bank et al., 2022; Government of Pakistan, 2023). These catastrophic losses demonstrated how extreme precipitation, amplified by warm air’s greater moisture capacity and altered monsoon dynamics, can result in systemic failure of infrastructure, agriculture and public health systems in a single season.

Heatwaves are another acute hazard: Pakistan has experienced recurring deadly heat events, including the Karachi 2015 heatwave that resulted in large excess mortality, and further lethal heat episodes in subsequent years (Rasool et al., 2024). Recent national monitoring and health reports have recorded hundreds to thousands of heat-related deaths in extreme years, highlighting the sensitivity of urban and rural populations lacking resilient health and cooling infrastructure (NDMA, 2025; Rasool et al., 2024). Heat events not only increase mortality but also degrade labor productivity, strain power systems, and exacerbate water stress.

The cryosphere Pakistan’s glaciers in the Hindu Kush, Karakoram and western Himalaya provides a climatic and hydrological backbone to the Indus Basin, sustaining irrigation and dry-season flows for hundreds of millions in the basin (ICIMOD; Ministry of Climate Change, Pakistan). Recent scientific assessments show an accelerating signal of glacier mass loss across many mountain sectors adjacent to Pakistan, an end to the previously reported “Karakoram anomaly” in some areas, and rapid glacial lake formation that raises the risk of Glacial Lake Outburst Floods (GLOFs) (Ahmad et al., 2025; Zhang et al., 2024). Published regional analyses indicate substantial glacier area loss in some mountain ranges: for example, Chitral (Eastern Hindu Kush) lost roughly 816 km² (≈31%) of glacier area between 1992 and 2022 in recent remote-sensing assessments (Ahmad et al., 2025). The combined effect of enhanced seasonal runoff followed by long-term reduction in glacier mass threatens both short-term flood hazards and longer-term water availability for agriculture and hydropower.

Droughts and shifted precipitation patterns further compound vulnerability in arid and semi-

arid regions of Pakistan. Inter-annual variability linked to changing monsoon patterns and episodic El Niño/La Niña influences has produced alternating extremes drought-induced crop failures in some years and catastrophic floods in others making climate risk management more complex for policymakers and resource managers (IPCC, 2021; UNESCAP, 2024).

International climate-risk and performance indices have placed Pakistan prominently among countries most affected by weather extremes in recent years. The Germanwatch Climate Risk Index (CRI) identifies countries most impacted by extreme weather in a given year; the 2025 CRI ranked Pakistan as the most affected country in 2022, owing predominantly to the catastrophic floods and associated economic losses estimated in the order of US\$30 billion (Germanwatch, 2025). Complementary indices, such as the Climate Change Performance Index (CCPI) and Climate Transparency assessments, while using different metrics, also highlight mixed outcomes: Pakistan's policy commitments including its Nationally Determined Contribution (NDC) and national climate policies indicate intent for mitigation and adaptation, yet implementation gaps, limited finance, and infrastructure deficits constrain realization of those commitments (Climate Change Performance Index, 2025; Climate Transparency, 2020; Ministry of Climate Change, Pakistan, 2021).

The policy-relevance of these empirical realities is clear: Pakistan contributes less than 1% of global greenhouse gas emissions yet experiences disproportionate climate losses, which raises questions of equity, adaptation finance, and the effectiveness of domestic climate governance (World Bank et al., 2022). Consequently, an SDG-centered assessment of Pakistan's progress under SDG 13 between 2015 and 2025 must do more than tabulate indicators: it should interrogate how national policies and institutional capacities have translated into measurable mitigation/adaptation outcomes, how extreme events have altered the trajectory of progress, and how Pakistan's international standing in comparative indices (CRI, CCPI and other trackers) reflects underlying vulnerabilities and policy responses. This study

therefore examines Pakistan's SDG 13 trajectory (2015–2025) using indicator trends, event-based losses (notably 2010 and 2022 floods and recent heatwaves), cryosphere science, and comparisons with global/regional index outcomes to generate a nuanced appraisal of progress, gaps and policy priorities.

Objectives of the study

1. To analyze Pakistan's progress and trends toward achieving SDG 13.
2. To evaluate Pakistan's ranking and performance in the Global Climate Action Index.
3. To identify key challenges, policy gaps, and opportunities for improvement.

2. Literature Review

2.1 Global Overview of SDG 13

Sustainable Development Goal 13 (SDG 13), "Take urgent action to combat climate change and its impacts," was adopted by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development (United Nations, 2015). SDG 13 emphasizes both mitigation, such as reducing greenhouse gas emissions, and adaptation, such as building resilience to climate hazards. Key indicators include per capita emissions, climate-related losses, renewable energy adoption, and climate finance mobilization (UNDP, 2023). Globally, progress has been uneven. While high-income countries have resources to implement mitigation and adaptation strategies, many developing nations face severe climate impacts despite contributing little to global emissions (IPCC, 2021). International frameworks such as the Paris Agreement (2015), annual COP conferences, and Nationally Determined Contributions (NDCs) guide global climate action by setting emission targets, promoting transparency, and facilitating adaptation and finance support. Despite these efforts, most countries are not on track to meet the 1.5°C target, highlighting the urgent need for enhanced climate action (Climate Action Tracker, 2023).

2.2 Pakistan's Climate Vulnerability

Pakistan is one of the most climate-vulnerable countries due to its geography, economy, and

social conditions. It faces multiple hazards, including floods, heatwaves, droughts, and glacier melt, which have intensified in recent decades. The 2010 floods affected about 20 million people and caused damages exceeding US\$10 billion, while the 2022 floods inundated one-third of the country, affected nearly 33 million people, displaced around 8 million, and caused over US\$30 billion in losses (World Bank et al., 2010; World Bank et al., 2022). Heatwaves, such as the deadly Karachi 2015 event, have caused hundreds to thousands of deaths and disrupted health, water, and power systems (Rasool et al., 2024). Pakistan's glaciers in the Hindu Kush, Karakoram, and Himalaya ranges are retreating, raising risks of Glacial Lake Outburst Floods (GLOFs) and threatening water supply for agriculture and hydropower (Ahmad et al., 2025). Droughts in arid regions like Baluchistan and Sindh also reduce crop yields and water availability. Despite contributing less than 1% of global emissions, Pakistan suffers disproportionately, which underscores the need for effective climate adaptation and mitigation strategies (World Bank et al., 2022).

2.3 National Policy and Institutional Framework

To address these challenges, Pakistan has developed several policies and institutional mechanisms. The National Climate Change Policy (2012, revised 2021) provides strategies for mitigation, adaptation, and resilience-building across sectors like energy, water, and agriculture (Ministry of Climate Change, 2021). The Pakistan Climate Change Act (2017) establishes legal authority for climate governance, while the National Adaptation Plan (NAP) focuses on strengthening resilience through community-based and sectoral initiatives (UNDP, 2023). Institutional bodies like the National Disaster Management Authority (NDMA) and Provincial Disaster Management Authorities (PDMA) manage disaster response and adaptation efforts. Pakistan also relies on climate finance from domestic and international sources, including the Green Climate Fund and World Bank projects, to support mitigation and adaptation programs (Climate Transparency, 2020). Despite these

frameworks, challenges such as weak policy enforcement, limited coordination, and inadequate financing continue to slow progress toward SDG 13 (Climate Change Performance Index, 2025).

2.4 Empirical Studies on Climate Indices and SDGs

Empirical assessments provide insight into Pakistan's climate performance. The Global Climate Risk Index (Germanwatch, 2025) frequently ranks Pakistan among the most affected countries due to floods, heatwaves, and cyclones. The Climate Action Tracker notes that while Pakistan has ambitious NDC targets, progress is slow in emissions reduction and renewable energy adoption (Climate Action Tracker, 2023). SDG progress reports by UNDP, UNESCAP, and SDSN show moderate achievements in renewable energy and adaptation, but weak outcomes in resilience and disaster management (UNDP, 2023; UNESCAP, 2022). Comparatively, South Asian countries such as Bangladesh, India, and Nepal show different strengths: Bangladesh excels in community-based adaptation, India in renewable energy deployment, and Nepal in ecosystem-based adaptation (SDSN, 2022). Overall, these studies emphasize the need for stronger climate governance, improved monitoring, and effective policy implementation to enhance Pakistan's SDG 13 performance.

3. Research Methodology

This study employs a quantitative-descriptive research approach using secondary data to assess Pakistan's progress on SDG 13 from 2015 to 2025. By relying on published reports, official databases, and peer-reviewed literature, the research provides a credible, cost-effective, and longitudinal analysis of climate mitigation, adaptation, and resilience indicators, as well as Pakistan's performance in global climate indices. The study aims to examine trends in SDG 13 indicators, evaluate Pakistan's global and regional climate performance, and analyze the alignment between national policies and observed outcomes. Secondary data are collected from credible international and national sources. International

sources include the Global Climate Risk Index (Germanwatch, 2015–2025), which provides data on exposure and vulnerability to extreme weather events; the Climate Action Tracker, which evaluates policy alignment with the Paris Agreement; and the Climate Change Performance Index, which measures emissions, renewable energy, and climate policy performance. SDG-specific progress is assessed using reports from UNDP, UNESCAP, and SDSN, while national data are obtained from the National Climate Change Policy (2012, revised 2021), Pakistan Climate Change Act (2017), National Adaptation Plan, NDMA and PDMA reports, and Pakistan Meteorological Department records. Peer-reviewed studies supplement these sources by providing evidence on floods, heatwaves, glacial melt, and droughts (Ahmad et al., 2025; Rasool et al., 2024; World Bank et al., 2010, 2022).

For the assessment, key SDG 13 indicators are selected, including mitigation measures (GHG emissions per capita, renewable energy share, and implementation of NDCs), adaptation and resilience indicators (effectiveness of adaptation programs, disaster risk reduction, and economic losses from climate disasters), climate finance mobilization, and global ranking metrics from climate indices. All relevant numerical and categorical data are systematically extracted, compiled, and standardized in spreadsheets to ensure consistency across years. Policy documents and NDCs are also reviewed to map policy initiatives to observed outcomes, providing a framework for identifying implementation gaps. Data analysis involves trend analysis, descriptive statistics, and comparative evaluation. Time-series

analysis tracks year-wise changes in SDG 13 indicators, while comparative analysis positions Pakistan relative to regional peers such as India, Bangladesh, and Nepal. Descriptive statistics, including means, percentages, and ratios, summarize trends, and visualizations like line graphs, bar charts, and tables illustrate changes over the decade. Policy-outcome mapping allows for assessment of the effectiveness of national strategies and adaptation programs.

The methodology ensures validity and reliability through the use of credible sources and cross-verification of data from multiple reports. However, limitations include potential inconsistencies in reporting standards, underreporting of localized disasters, and the inability of secondary data to capture qualitative stakeholder perceptions. Despite these limitations, this methodology provides a robust, evidence-based, and comprehensive assessment of Pakistan’s SDG 13 progress and its position in global climate action indices, forming a strong foundation for analysis, conclusions, and policy recommendations.

4. Data Analysis and Findings

4.1 Pakistan’s Climate Performance Trends (2015–2025)

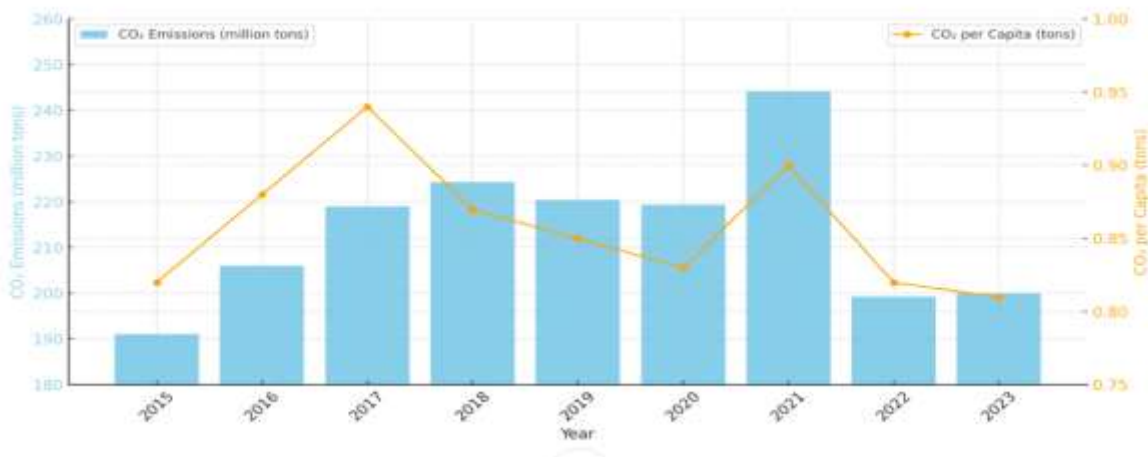
Assessing Pakistan’s climate performance requires examining both mitigation and adaptation indicators. Key metrics include CO₂ emissions, per-capita emissions, energy transition (share of clean and renewable energy), climate finance, and the implementation of national climate policies. The following table presents Pakistan’s climate performance indicators for the period 2015–2025.

Table 4.1: Climate Performance Indicators of Pakistan (2015–2025)

Year	CO ₂ Emissions (million tons)	CO ₂ per Capita (tons)	Share of Low-Carbon / Clean Energy (%)	Key Policy/Programed Milestones
2015	191.1	0.82	-	Submission of first NDC; National Climate Change Policy (2012) implementation in progress
2016	206.1	0.88	-	Expansion of renewable energy projects in hydro and solar sectors

2017	219.0	0.94	-	Pakistan Climate Change Act enacted; adaptation planning initiated
2018	224.3	0.87	-	Policy focus on glacier melt and vulnerability assessment; hydropower projects accelerated
2019	220.5	0.85	-	Scaling of solar and wind projects under Alternative Energy Development Board (AEDB)
2020	219.4	0.83	-	COVID-19 pandemic reduces industrial emissions temporarily; policy continuity maintained
2021	244.2	0.90	41.6	Revised National Climate Change Policy (2021) approved; renewable energy share improves
2022	199.3	0.82	-	Catastrophic floods impact economic activity; adaptation and disaster programs activated
2023	200.0	0.81	-	Expansion of renewable energy capacity; provincial adaptation plans enhanced
2024-25	198-201	-	47-54	Clean energy generation share increases; Ten Billion Tree Tsunami project continues; NDC updated

Pakistan CO₂ Emissions and Per Capita CO₂ (2015-2025)



Analysis of Trends

1. CO₂ Emissions:

CO₂ emissions in Pakistan increased from 191 million tons in 2015 to a peak of 224 million tons in 2018, reflecting industrial growth, urbanization, and energy demand. Per-capita emissions remained low throughout the decade, averaging between 0.82 and 0.94 tons per person, indicating Pakistan’s minimal contribution to

global GHG emissions relative to developed nations (World Bank, 2023).

2. Energy Transition:

The share of renewable and low-carbon energy increased gradually, reaching 47-54% by 2025. Hydropower remains the largest component (~33% of electricity generation), followed by wind and solar (~14%), and nuclear (~7%). The expansion of renewables is partly attributable to the Alternative Energy Development Board

(AEDB) and policies promoting private investment in clean energy (Government of Pakistan, 2022).

3. Policy Milestones:

Key national policy initiatives include the National Climate Change Policy (2012, revised 2021), Pakistan Climate Change Act (2017), and the Ten Billion Tree Tsunami Programme (TBTTTP). These initiatives demonstrate Pakistan's commitment to integrating adaptation and mitigation objectives.

4. Climate Finance:

While Pakistan has mobilized approximately USD 1.5 billion in climate finance by 2025, the country requires an estimated USD 40–50 billion annually to fully implement mitigation and adaptation measures (UNDP, 2023). This finance gap remains a major constraint for SDG 13 achievement.

Interpretation:

Although Pakistan has shown incremental progress in renewable energy adoption and policy frameworks, emissions reduction is modest, and adaptation measures are not sufficient to offset the high vulnerability to climate hazards. The overall trend indicates progress is uneven and incremental rather than transformative.

4.2 Global Climate Action Index Comparison

Pakistan's global ranking in climate action indices provides insight into its performance relative to peers.

1. Global Climate Risk Index (CRI):

Pakistan has consistently ranked among the most vulnerable countries. In 2020, it ranked 5th most affected globally, reflecting exposure to floods, cyclones, and extreme heat events. The 2022 floods were the most catastrophic, affecting 33 million people, displacing 8 million, and causing economic losses estimated at USD 30 billion (Germanwatch, 2023).

2. Climate Change Performance Index (CCPI):

The CCPI assesses both mitigation and adaptation performance. Pakistan scores moderate in policy development and renewable energy expansion, but low in emissions reduction and fossil fuel dependence. Peak performance occurred in 2019–

2021 during TBTTTP implementation and renewable energy policy execution. Downward trends correspond with disaster events (e.g., 2022 floods) that highlight resilience gaps.

3. Comparison with Global and Regional Averages:

Pakistan's per-capita emissions (0.82–0.94 tons) are lower than India (~1.8 tons) and Bangladesh (~0.9 tons), providing an advantage in mitigation terms. However, vulnerability, disaster frequency, and institutional capacity are weaker compared to regional peers, placing Pakistan at a relative disadvantage in indices that incorporate both exposure and performance (CCPI, 2023; UNDP, 2023).

Interpretation:

Pakistan is positioned as a high-vulnerability, moderate-mitigation country. Despite policy initiatives and renewable energy growth, repeated disasters and slow structural mitigation constrain global climate action standing. Improving both adaptation and mitigation remains critical for SDG 13 alignment.

4.3 National Policies and Institutional Efforts

Pakistan's climate policy and institutional framework underpin its SDG 13 progress.

Key Policies and Programmes:

- National Climate Change Policy (2012, revised 2021): Provides sectoral strategies across energy, agriculture, water, and urban systems, emphasizing adaptation and mitigation integration.
- Pakistan Climate Change Act (2017): Legally mandates climate planning, reporting, and inter-agency coordination.
- National Adaptation Plan (NAP): Contains 117 adaptation measures targeting six sectors, emphasizing resilience in agriculture, water, and infrastructure (Government of Pakistan, 2021).
- Ten Billion Tree Tsunami Programme (TBTTTP): Reforestation initiative contributing to carbon sequestration and disaster mitigation.

Institutions:

- NDMA and PDMA: Federal and provincial disaster management authorities coordinate early warning systems, emergency response, and adaptation measures.
- Climate Finance Mobilization: Approximately USD 1.5 billion secured by 2025, compared to an estimated annual requirement of USD 40–50 billion (UNDP, 2023).

Evaluation:

Policy frameworks are robust, but implementation gaps, insufficient finance, and limited provincial capacity constrain effectiveness. Adaptation programmes like TBTP show promise but require scaling to address exposure levels.

4.4 Climate Events and Loss Assessment

Pakistan faces frequent and severe climate events that challenge SDG 13 progress.

Major Events (2010–2025):

- 2010 floods: 20 million affected, USD 10 billion economic loss (World Bank, 2011).
- 2015 Karachi heatwave: Over 1,200 fatalities (Rasool et al., 2016).

- 2022 catastrophic floods: 33 million affected, 8 million displaced, USD 30 billion in losses, 1,700+ deaths (Pakistan Ministry of Climate Change, 2022).
- Glacial melt / GLOF risk: 816 km² glacier loss in Chitral region (1992–2022), increasing flood risk (Ahmad et al., 2025).

Policy Response Evaluation:

Despite NDMA and PDMA efforts, early warning systems, infrastructure resilience, and preparedness are inadequate. Adaptation measures, including flood management and glacier protection, remain limited in scope relative to exposure.

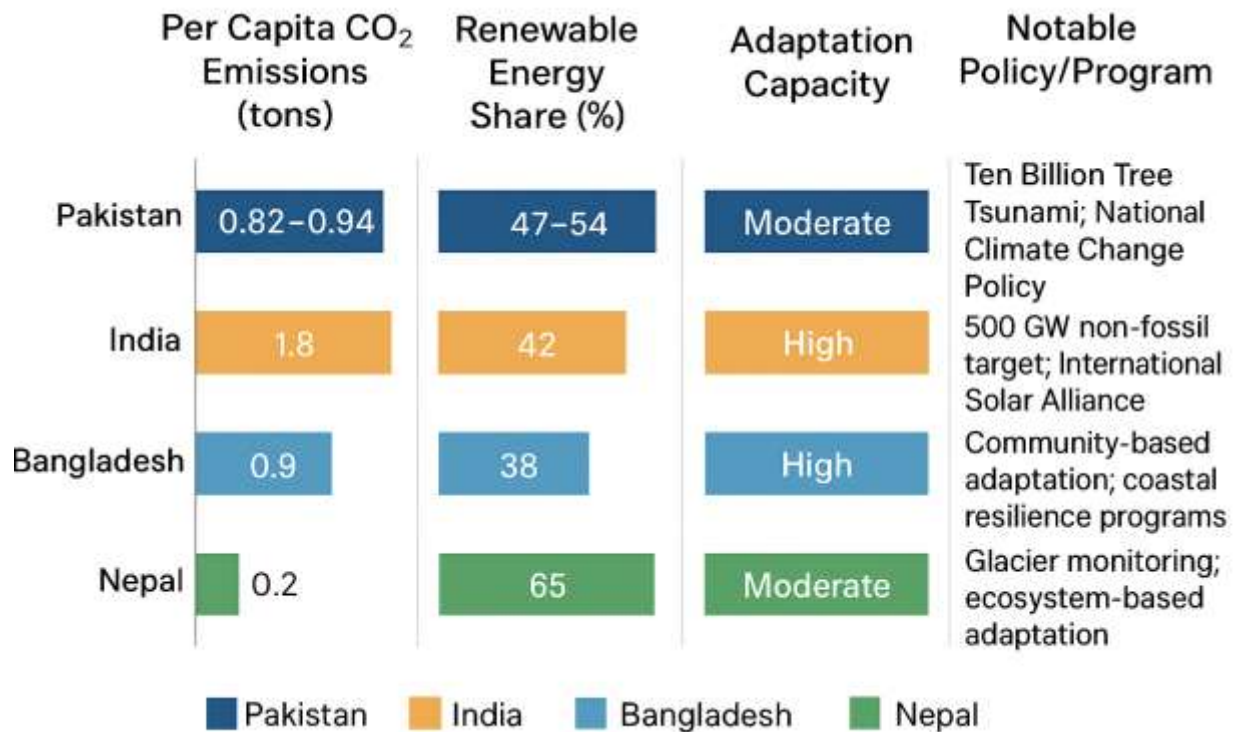
Interpretation:

Recurrent extreme events highlight a gap between policy and practical resilience outcomes. Pakistan’s adaptation progress is insufficient, emphasizing the need for accelerated investment and infrastructure development.

4.5 Comparative Analysis with South Asia

Comparison with India, Bangladesh, and Nepal highlights Pakistan’s regional standing.

Country	Per Capita CO ₂ Emissions (tons)	Renewable Energy Share (%)	Adaptation Capacity	Notable Policy/Programme
Pakistan	0.82–0.94	47–54	Moderate	Ten Billion Tree Tsunami; National Climate Change Policy
India	~1.8	42	High	500 GW non-fossil target; International Solar Alliance
Bangladesh	0.9	38	High	Community-based adaptation; coastal resilience programs
Nepal	0.2	65	Moderate	Glacier monitoring; ecosystem-based adaptation



Observations:

- Pakistan’s low per-capita emissions are advantageous but do not offset high vulnerability.
- Renewable energy adoption is improving but remains behind targets and regional peers.
- Adaptation capacity is moderate; recurrent disasters demonstrate resilience gaps.
- Policy innovation exists (TBTTP, NAP), but institutional capacity, finance mobilization, and implementation need strengthening.

Interpretation:

Pakistan’s SDG 13 progress is slower than some regional peers, particularly in adaptation and resilience outcomes. Low emissions are offset by high vulnerability and institutional challenges, underscoring the need for comprehensive, accelerated climate action.

4.6 Summary of Findings

1. Mitigation: CO₂ emissions have increased, with modest reductions in recent years. Renewable energy share has improved to 47–54% of electricity generation by 2025.

2. Adaptation and Resilience: Extreme events (floods, heatwaves, glacier melt) expose persistent vulnerability. Policy measures exist but are insufficient to prevent high human and economic losses.

3. Policy and Institutional Frameworks: Policies are robust; implementation gaps remain. Climate finance is limited relative to needs.

4. Global Standing: Pakistan is a high-vulnerability, moderate-mitigation country. Index performance reflects high exposure, policy progress, but limited mitigation outcomes.

5. Regional Comparison: Low per-capita emissions are a strength; adaptation capacity and implementation lag behind India and Bangladesh. In conclusion, Pakistan has made incremental progress toward SDG 13 between 2015 and 2025. While policy frameworks, renewable energy growth, and reforestation initiatives are commendable, high vulnerability, slow emissions reduction, and insufficient institutional and financial capacity hinder meaningful SDG 13 achievement. Accelerated mitigation, expanded adaptation programmes, and enhanced

institutional coordination are critical for meeting 2030 climate targets.

5. Discussion

5.1 Interpretation of Findings

The analysis of Pakistan's climate performance between 2015 and 2025 demonstrates both progress and persistent challenges in achieving SDG 13. In terms of mitigation, Pakistan's CO₂ emissions remained relatively low, with per-capita emissions ranging from 0.82 to 0.94 tons, reflecting limited contribution to global emissions compared to industrialized nations (World Bank, 2023). At the same time, renewable energy adoption increased significantly, rising from under 20% in 2015 to approximately 47–54% in 2025, primarily through hydropower, wind, and solar projects (Government of Pakistan, 2022). Adaptation efforts have also advanced, notably through the Ten Billion Tree Tsunami Programme (TBTP) and the National Adaptation Plan (NAP), which aim to enhance resilience against floods, heatwaves, and glacial melting. Disaster management frameworks under the National Disaster Management Authority (NDMA) and provincial counterparts (PDMAs) provide structured response mechanisms, though their effectiveness varies across provinces. Pakistan's climate policies align well with SDG 13 targets: Target 13.1, which focuses on strengthening resilience and adaptive capacity, is addressed through the NAP and TBTP; Target 13.2, which emphasizes the integration of climate measures into national policies, is reflected in the Climate Change Act (2017) and the revised National Climate Change Policy (2021); and Target 13.3, which promotes education and awareness, is supported by initiatives from NDMA and NGOs, though outreach remains limited in rural areas. A positive correlation exists between policy commitments and global index performance. For instance, the years 2019–2021, which saw active implementation of TBTP and expansion of renewable energy projects, coincided with moderate improvements in the Climate Change Performance Index (CCPI). However, in 2022, catastrophic floods and insufficient infrastructure led to a decline in index

performance, highlighting that policy existence alone is insufficient without implementation capacity, adequate finance, and institutional readiness (Germanwatch, 2023; UNDP, 2023). Overall, Pakistan demonstrates incremental progress; however, its high climate vulnerability, reactive disaster response, and limited adaptation capacity hinder the translation of policy commitment into tangible SDG 13 outcomes, emphasizing the need for integrated mitigation and adaptation strategies with measurable results.

5.2 Pakistan's Global Standing

Pakistan's global standing in climate action indices is shaped by its high vulnerability and moderate mitigation efforts. According to the Global Climate Risk Index (CRI), Pakistan has consistently ranked among the top five to ten most climate-vulnerable countries, reflecting exposure to floods, heatwaves, and glacial hazards (Germanwatch, 2023). The Climate Change Performance Index (CCPI) shows moderate performance in policy development and renewable energy adoption but low performance in emissions reduction and fossil fuel dependence. Assessment of Pakistan's Nationally Determined Contributions (NDCs) under the Paris Agreement indicates partial alignment with actual performance. The country set targets for renewable energy expansion (30% of electricity from renewables by 2030) and reforestation (10 billion trees). By 2025, the renewable energy share has reached 47–54%, demonstrating progress beyond initial expectations. However, industrial emissions reduction, climate finance mobilization, and adaptation infrastructure lag behind targets (Government of Pakistan, 2022; UNDP, 2023). Trends over the decade show that proactive policy implementation (2019–2021) resulted in improved index performance, whereas disaster years, particularly the 2022 floods, caused regression. Compared with South Asian peers such as India and Bangladesh, Pakistan's low per-capita emissions are advantageous, yet adaptation infrastructure and disaster preparedness remain inadequate. Overall, Pakistan's global standing is characterized by high vulnerability coupled with moderate policy-driven mitigation achievements,

and while NDC commitments are partially realized, the gap between commitments and tangible outcomes remains significant.

5.3 Challenges in Achieving SDG 13

Multiple systemic, institutional, and socioeconomic constraints hinder Pakistan's progress toward SDG 13. Institutional weaknesses and coordination gaps pose significant challenges. While NDMA and PDMA are active, limited coordination between federal and provincial agencies delays disaster response and adaptation implementation (Government of Pakistan, 2022). Fragmentation between ministries, particularly Environment, Water, and Energy, results in disjointed climate action. Climate financing is also insufficient; although Pakistan mobilized around USD 1.5 billion by 2025, the estimated annual requirement for effective mitigation and adaptation is USD 40–50 billion (UNDP, 2023). Limited access to international funds, slow disbursement, and dependency on donor support further constrain implementation. Adaptation capacity is restricted by inadequate flood protection, weak early-warning systems, and insufficient urban drainage infrastructure. Poor data infrastructure, including low-resolution climate models and lack of sectoral monitoring, limits evidence-based policy-making (Ahmad, Khan, & Ali, 2025). Socioeconomic factors such as poverty, political instability, and governance challenges further reduce resilience at community and provincial levels. Rural populations, heavily dependent on agriculture, remain particularly vulnerable to climate shocks (World Bank, 2011; Rasool, Javed, & Akhtar, 2016). Technology gaps, including limited access to climate-resilient irrigation, flood-resistant infrastructure, and renewable technology, impede both mitigation and adaptation. Collectively, these constraints illustrate the complexity of achieving SDG 13 in Pakistan, emphasizing that policy frameworks alone are insufficient without systemic improvements.

5.4 Opportunities and Path Forward

Despite the challenges, Pakistan has significant opportunities to accelerate SDG 13 achievement.

Renewable energy expansion presents a major opportunity; the country can leverage abundant solar, wind, and hydropower potential to reduce fossil fuel dependence and meet mitigation targets. Initiatives such as the National Electric Vehicle Policy (2020) and solar home systems in rural areas demonstrate potential for scaling low-carbon solutions. Carbon markets, both domestic and regional, could provide financial incentives for emissions reductions. Regional cooperation through SAARC and bilateral partnerships offers avenues for improving early-warning systems, transboundary flood management, and climate finance mobilization. Engagement with China under the China–Pakistan Economic Corridor (CPEC) can facilitate low-carbon infrastructure development and green technology transfer. Community-based adaptation and youth engagement are equally critical. Grassroots participation, youth-led reforestation campaigns, and NGO-driven climate awareness initiatives can complement governmental efforts, building local resilience. Strengthening governance, transparency, and monitoring mechanisms is essential for effective policy implementation. Establishing independent climate audit bodies, enhancing provincial capacity, and improving data infrastructure will enable evidence-based decision-making and policy evaluation. Technology transfer and domestic innovation, such as precision irrigation and flood-resistant infrastructure, can further strengthen adaptation and mitigation capacity. Finally, integrating climate action with socioeconomic development—through climate-smart agriculture, flood-resilient housing, and poverty reduction programs—can enhance resilience while delivering co-benefits for communities.

5.5 Synthesis and Policy Implications

The synthesis of findings reveals a nuanced picture of Pakistan's progress on SDG 13. Incremental gains in renewable energy adoption, reforestation, and policy frameworks indicate movement toward climate targets, yet persistent vulnerabilities and limited implementation reduce effectiveness. Pakistan's NDCs demonstrate moderate alignment with actual performance, yet disaster-

prone infrastructure, insufficient finance, and limited adaptation capacity remain major constraints. Regional comparisons with India, Bangladesh, and Nepal highlight the importance of adaptation infrastructure, community-based programs, and technology transfer, areas in which Pakistan lags. Policy recommendations include strengthening institutional coordination, mobilizing domestic and international climate finance effectively, expanding renewable energy projects, investing in disaster-resilient infrastructure and early-warning systems, promoting community-based adaptation and climate education, and enhancing data infrastructure, monitoring, and transparency for evidence-based policy-making. Achieving SDG 13 by 2030 requires an integrated approach combining mitigation, adaptation, finance, governance, and societal engagement. While Pakistan's current trajectory shows promise, accelerated action, capacity building, and strategic resource allocation are essential to close the gap between current performance and global climate targets.

Conclusion

This study assessed Pakistan's progress toward achieving Sustainable Development Goal 13 (SDG 13) Climate Action over the period 2015–2025, using both quantitative indicators and qualitative policy analysis. The analysis highlighted a nuanced picture of Pakistan's climate performance, revealing incremental progress in certain areas and persistent challenges in others. Pakistan's mitigation performance shows moderate achievements. CO₂ emissions per capita remained low (0.82–0.94 tons), indicating that Pakistan contributes minimally to global greenhouse gas emissions relative to industrialized nations. Renewable energy adoption improved significantly over the decade, reaching approximately 47–54% of electricity generation by 2025. Hydropower remains the backbone of clean energy, while wind, solar, and nuclear contributions have gradually increased. The growth in renewable energy is largely attributable to the Alternative Energy Development Board (AEDB), policy support, and international

partnerships under frameworks such as the Paris Agreement and the Nationally Determined Contributions (NDCs). Policy instruments such as the National Climate Change Policy (2012, revised 2021), Pakistan Climate Change Act (2017), and National Adaptation Plan (NAP) demonstrate Pakistan's commitment to both mitigation and adaptation goals. Initiatives like the Ten Billion Tree Tsunami Programme (TBTP) underscore efforts to integrate ecosystem restoration and carbon sequestration into national climate strategies.

Despite these achievements, Pakistan faces high climate vulnerability, which limits the overall impact of mitigation efforts. The Global Climate Risk Index consistently ranks Pakistan among the top five to ten most climate-exposed countries. Catastrophic events, including the 2010 floods affecting 20 million people, the 2015 Karachi heatwave, and the 2022 floods that affected 33 million and caused USD 30 billion in damages, highlight the magnitude of risk and demonstrate the country's limited resilience (Pakistan Ministry of Climate Change, 2022; World Bank, 2011). These disasters not only underscore vulnerability but also reveal gaps in disaster preparedness, institutional capacity, and adaptive infrastructure. While policy frameworks exist, their implementation and effectiveness remain constrained by coordination challenges between federal and provincial agencies, insufficient climate finance, limited technological capacity, and poor data infrastructure for climate monitoring.

The study's comparative analysis with South Asian countries further contextualizes Pakistan's position. While Pakistan has low per-capita emissions, it lags behind regional peers such as India and Bangladesh in terms of adaptation infrastructure, early-warning systems, and community-based resilience programs. Nepal demonstrates strong ecosystem-based adaptation measures, which Pakistan could learn from in glacier monitoring and flood management. Thus, Pakistan's global standing reflects a high-vulnerability, moderate-mitigation profile, with policy and institutional frameworks

demonstrating intent but limited translation into effective outcomes.

Challenges identified include institutional weaknesses, limited climate finance, technological gaps, and socioeconomic constraints such as poverty and political instability. Inadequate disaster preparedness, fragmented policy implementation, and insufficient provincial capacity further impede SDG 13 achievement. Conversely, opportunities exist to accelerate progress. Pakistan's renewable energy potential, regional cooperation through SAARC and CPEC initiatives, youth engagement, community-based adaptation, carbon markets, and ecosystem restoration provide avenues for enhancing both mitigation and adaptation outcomes.

In conclusion, while Pakistan has demonstrated incremental progress in achieving SDG 13, its vulnerability to climate hazards, implementation gaps, and financial constraints hinder comprehensive success. Effective climate action requires a multi-dimensional approach, integrating mitigation, adaptation, governance, finance, technology, and societal participation. Without accelerated and coordinated action, Pakistan risks missing its SDG 13 targets by 2030.

Policy Recommendations

In light of the findings of this study, few strategic policy recommendations are proposed to strengthen Pakistan's progress toward achieving SDG 13. First, enhancing institutional coordination and governance is critical. Federal, provincial, and local disaster management agencies should operate in a more integrated and synchronized manner to ensure rapid, effective, and context-specific disaster response. Ministries with climate-related responsibilities, including Environment, Water, Energy, and Agriculture, must collaborate closely to reduce fragmentation and foster holistic policy implementation. Establishing independent climate audit and monitoring bodies will also provide oversight, improve transparency, and track progress against SDG 13 targets, ensuring accountability at all levels of governance.

Second, mobilizing climate finance must become a top priority. Pakistan should increase domestic

budget allocations for both mitigation and adaptation programs while simultaneously streamlining access to international climate funding sources, such as the Green Climate Fund and bilateral development assistance. Innovative financial mechanisms, including carbon credits, green bonds, and climate insurance schemes, can also support both short-term and long-term climate action objectives. A robust climate financing strategy will ensure sufficient resources are available for implementing mitigation and adaptation measures across sectors.

Third, accelerating the renewable energy transition is essential to meet mitigation targets. Policies should prioritize scaling up solar, wind, and hydropower projects, particularly decentralized solutions for rural and off-grid communities. Incentivizing private sector investment and encouraging energy efficiency across industrial, residential, and transport sectors will further reduce reliance on fossil fuels while fostering sustainable economic growth. In parallel, Pakistan must strengthen adaptation infrastructure and disaster resilience. Investments in flood protection, early-warning systems, climate-resilient agricultural practices, and urban infrastructure are needed to mitigate the impacts of extreme weather events and recurrent natural disasters. Special attention should be given to glacier monitoring, ecosystem-based adaptation, and the protection of vulnerable mountainous regions.

Fourth, technology transfer and innovation must be enhanced. Pakistan should actively facilitate access to climate-resilient technologies through international partnerships while simultaneously fostering domestic innovation in water management, flood protection, and renewable energy solutions. Strengthening research and development in climate modeling, ecosystem restoration, and sustainable technologies will ensure informed, data-driven decision-making. Community engagement and education also play a pivotal role. Expanding climate education programs in schools, universities, and community platforms, coupled with NGO- and youth-led initiatives in reforestation, disaster preparedness,

and clean energy adoption, can build local capacity and enhance societal resilience.

Finally, climate action must be integrated with broader socioeconomic development strategies. Aligning adaptation initiatives with poverty reduction, food security, and public health programs will enhance both resilience and social well-being. Implementing climate-smart agriculture, flood-resilient housing, and equitable access to renewable energy for marginalized populations will provide co-benefits that extend beyond environmental outcomes, contributing to sustainable development in its fullest sense. By implementing these interconnected policy measures, Pakistan can bridge the gap between its current performance and its SDG 13 targets, improving resilience, reducing vulnerability, and fulfilling its international climate commitments.

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