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Climate Change as a Constraint to International Development: Evidence from Developing Economies

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Abstract

This paper aims at assessing to which degree climate change limits the outcome of international development in the developing economies. It is a move to determine major channels through which climate risks diminish development towards global development among them being: reduction of productivity, lack of resources, and financial pressures. It is also this subject of study that how adaptive governance and international aid can overcome these constraints. The study adopts the mixed methods strategy, balancing cross country econometric analysis and qualitative case studies in Sub-Saharan Africa and Southeast Asia. The panel regression models are used to analyze quantitative data concerning the climate variability, the GDP growth, and the human development indicators. The qualitative assessment based on policy documents and interviews with experts gives contextual information on the strategy of adaptation and institutional response. The results tend to indicate that climate shock and development indicators including income growth, access to education, and health outcomes are statistically significant with a negative relationship. The paper can also prove that that countries that possess higher adaptive capacity and institutional resilience are less severely hit by setbacks in development.

Keywords: Climate Change, International Development, Developing Economies, Adaptive Capacity, Sustainable Growth.



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Introduction

The phenomenon of climate change is considered to be one of the characteristics of the world of the twenty-first century, essentially changing the environmental situation and becoming defined in relation to socioeconomic systems around the world (Adom, 2024; Arif et al., 2025). Although the physical science behind the dynamics of climate change are well-known (Intergovernmental Panel on Climate Change [IPCC], 2023), the socioeconomic aspects of climate change especially in developing economies have become the subject of growing scholarly and policymaking discussions. Developing nations, which are defined in general by lower incomes levels, weak structures in the economy, and ineffective institutions, are disproportionately prone to climate risks that can erode various aspects of sustainable development (Adom, 2024; Signé & Mbaye, 2022). Such risks become a reality in the form of a nexus of connected procedures that include decreased agricultural output, damage to infrastructure, limited financial surroundings, and human capital stress all of which hinder the international development goals.

Although the effects of climate change have been studied extensively in the fields of specific areas (e.g., food security, health, and agriculture), recent studies highlight the necessity of integrative frameworks by visualizing climate change as a systemic constraint to the long-term development paths (Brookings Institution, 2023; Cosust Editorial Team, 2024). The more traditional type of analysis is one that concentrates on discrete endpoints, e.g. crop yield variability or water scarcity, without adequately connecting such endpoints to the wider development variables e.g. GDP growth, access to education or institution stability. Indicatively, whereas the field of panel studies shows that with their mediation by indicators of trade openness and financial development, climatic variability can influence the growth of an economy in particular locales (e.g., South Asia) unfavourably (Scholars, 2024), there is dearth of research that incorporates such findings into a multidimensional development context that also encompasses such factors as governance, adaptive capacity, as well as international aid dynamics.

In fact, recent sources are already paying attention to the multidimensionality of climate impacts, which are not confined to sectoral assessments, but contain the compounding socioeconomic risks of multidimensional poverty, inequality, and vulnerability interactions (Devereux, 2025). The philosophy of climate-resilient development has been promoted as an incentive design to incorporate adaptation and mitigation alongside objectives of sustainable development into its organization (Cosust Editorial Team, 2024). Nevertheless, there is still scholarly uncertainty on how climate-resilient development pathways can be operationalized in situations where the form of deep-seated poverty, ineffective institutions, and large gaps in financing are built (UN Environment Programme, 2025; Signé & Mbaye, 2022). The growing adaptation finance gap in developing countries up to tens of billions of dollars a year, as estimated by contemporary sources, is another demonstration of the tightness of the mechanisms of adaptation constraints being both biophysical ones, but additionally grounded in the logic of international financial organization and politics (UN Environment Programme, 2025).

In more precise terms, the adaptive capacity has been studied as the potential of societies and institutions to adapt to viable damage, exploit prospects, or react on the effects of climate change, as a significant factor in determining how climate effects are transformed into developmental outcomes (Arif et al., 2025). Research has shown that the susceptibility to climatic shock reduces where nations have a high adaptive capacity and a robust government apparatus; whereas in cases where adaptive capacity is constrained, the socioeconomic orders suffer dense and prolonged reverse (Arif et al., 2025; Frontiers Editorial Team, 2025). These realizations indicate that there is a significant normative and empirical gap between the frequent postulations that adaptive

governance and resilience are needed in climate-integrated development planning and limited quantitative research on how those two constructs relate with cross-country development indicators in an integrated way.

Policy wise too, it is acknowledged that despite the climate era, more equitable and effective climate finance provisions will be necessary to obtain sustainable development. Continuous inadequate funding of the adaptation programs in the developing economies is a significant challenge to establishing resilience and achieving goals of global development (UN Environment Programme, 2025). The literature points out that most vulnerable states will continue to live in a climate susceptibility loop and lack the responsiveness capacity without adequate and consistent financial inflows, contributing to already established disparities and disrupting efforts towards commitments on missions like the United Nations Sustainable Development Goals (SDGs) (Brookings Institution, 2023; Signé & Mbaye, 2022).

Put collectively, all these research strands suggest one homogenous academic argument, namely, climate change cannot be thought of as an environmental or sectoral issue but should be framed as a systemic limitation to sustainable development where in the economies that do not possess the structural capability to react to climatic shocks and turn them to development prospects. Nonetheless, despite increased conceptual literature on the same theme, there is still a necessity to carry out cross country empirical studies that explicitly connects climate variability, vulnerability, adaptive capacity and development indicators within integrated models that also consider both institutional and governance issues. This kind of integrated analysis is necessary to produce evidence that can be used to inform academic theorizing and international development policy.

In filling this gap, this paper lies at the crossroads of the effects of climate change and development outcomes at the international level in developing economies. It takes an analytical perspective that speaks in advance of the climate change in the form of a multidimensional limit, as it works to biophysical, socioeconomic and institutional channels, and how the different degrees of adaptive capacity mediate its impacts. By doing this, the study will contribute to the theoretical work and offer empirically justified knowledge, which can be used to implement climate-responsive development planning and climate financing structures that are more equitable.

Specifically, the key research question leading to the present work is as follows: To which extent and in which ways does climate change limit the outcomes of international development activity in the developing economies and how adaptive governance and external support systems can change these relations?

Research Objectives

This study is aimed at the following objectives:

1. To test the degree to which climate change is a systemic limit to the outcomes of international development in developing electromagnets, and specifically to the outcomes of climate change on a range of indicators of economic progress, human development and stability of the institutions.
2. The aim was to determine how the adaptive capacity, the governance systems and industrial support can moderate the negative effects of climate change on developing forward amid economically set forth development in developing countries.

Research Questions

To respond to the objectives mentioned, the research questions that this proposed study aims to answer are:

1. What is the scope of the effects of climate change on the outcome of international development in the developing economies using economic, social, and institutional channels?
2. What role does adaptive capacity, quality of governance, and international assistance play as a factor in understanding the development outcomes of impacts of climate change in developing economies?

Literature Review

1. Conceptual and Theoretical Foundations

The interface between climate change and international development has transformed its traditional, environmental, discourse to be a systemic investigation into the reorganization of global socioeconomic systems under the influence of climatic stress. The classical theories of development, modernization, dependency and sustainable development, provide opposite explanations on how external disturbances like climate change will affect the growth process. The theory of modernization assumes linear advancement based on the industrialization process, but the theory does not consider the environmental constraints of the resources-consuming development (Sachs, 2015). Dependency theory, on the flipside, showcases the asymmetrical nature of global economy that makes the developing countries dependent on resource exports and susceptible to climate-induced shocks caused by stability instability in global market dynamics (Amin, 2019). The sustainable development paradigm is redefined as intergenerational equity to form the concept of growth, as expressed in the Brundtland Report (World Commission on Environment and Development [WCED], 1987), but researchers cite climate disruption has surpassed institutional adaptation (Adom, 2024).

The recent frameworks such as climate-resilient development (IPCC, 2023) and adaptive governance (Arif et al., 2025) are the further developments of the theories participative of resilience, flexibility, and social learning in the development planning. Climate-resilient development imagines three types of advances on mitigation, adaptation, and equity focusing on the idea that resilience is a process and product (Cosust Editorial Team, 2024). Adaptive governance is developed based on the institutional and complexity theories and emphasizes the multi-level and polycentric decision-making frameworks adaptively adapt to uncertainty (Folke et al., 2021). Nevertheless, as critics argue, the idea of resilience runs a risk of establishing a normalized vulnerability in cases when they are not associated with the issue of structural change and justice (Taylor, 2023). Therefore, the theoretical discussion is marked by the idea of whether resilience building is the actual empowerment or just adapting to the unjust world organization (Signé & Mbaye, 2022).

A combination of the above views indicates that climate change is a systemic bottleneck as opposed to a sectoral disruption. The constraint perspective focuses on interactions between climatic variability and economic reliance, governmental capability, and social frailty in escalating development inhibitions. Brookings institute (2023) puts more emphasis on the blending of climate risk into macroeconomic plan explaining the occurrence of compounding fiscal pressures, and, as Devereux (2025) noted, multidimensional poverty as the feedback loop to sustain vulnerability. The theoretical consensus, consequently, places climate change as a biophysical stressor, as well as, as an institutional stress test, the one that brings to light the adaptive limits of the development models based on stable climate regimes.

2. Climate Change as a Systemic Limitation on Developmental Results

It has always been shown empirically that climate change hinders economic growth and human development in inclusive ways. The initial statistically significant relationship between increase

(or decrease) in temperature and decrease (or increase) in GDP was formed by Dell, Jones, and Olken (2012), which has since been supported by the numerous economies in Africa and Asia (Schlenker and Roberts, 2019; Adom, 2024). Panalyses on panels show that an increase in average climate by one degree can cut the output in the economies of low-income countries by as much as 2 percent each year (World Bank, 2023). These effects do not occur only due to the loss of agricultural yields but also due to more extensive productivity losses and destruction of infrastructure. The infrastructure pathway is also manifested with floods and cyclones that spoil transport and energy infrastructure which raises the cost of maintenance and divert fiscal resources to social investment (Hallegatte et al., 2020).

These economic constraints are enhanced by social aspects. An increase in temperature and diseases transmitted by the vectors decrease the labor productivity and school attendance worsening, human-capital shortages (ILO, 2024). An example that shows how environmental stress discloses intergenerational poverty is that, in Bangladesh, the frequency of climate shocks contributed to child labor and reduced the level of education (Islam and Joarder, 2023). Sub-Saharan Africa is confronted with two pressures on its health system by disease burdens caused by climate change and inadequate budgets (WHO, 2023). The institutional channel also limits growth by way of governance vulnerability and risk of war: droughts have been reported to be correlated statistically with political instability in agrarian economies (Ide et al., 2020). These relations imply that climate change diminishes not just material resources but also the capacity of the state to provide the necessary services and continue developing the process.

Recent integrative models consider these mechanisms asitarized constraints with respect to each other. Findings by Arif et al. (2025) in cross-country regressions show that the climate variability also has a negative impact on the GDP and Human Development Index (HDI) scores but the extent of decreases depends on the governance quality. On the same note, Frontiers Editorial Team (2025) highlights compound risks, in which compounds developmental setbacks are caused by exposure to climate hazards and poor quality institutions in the same time. Although nowadays there are stronger methodological advances, there still exist the gaps in isolating causality, because climate impacts are mixed with trade, debt and demographic pressures, and it is hard to assign them another blame. However, the bulk of evidence confirms the central assumption of the study namely that climate change is a systemic and multidimensional bottleneck of development paths of susceptible economies.

3. Adaptive Capacity and Governance Quality

Adaptive capacity- the capacity to modify systems to cause or prevent harm or take advantage of emerging opportunities - has come to dominate the explanation of the differences in outcome across the developing regions. It was found that in response to climate shocks countries with better institutional quality, where there is more economic diversification, and social capital will be more resilient (Eakin et al., 2022). Adaptive capacity therefore links the environmental exposure and socioeconomic resilience. As an illustration, Arif et al. (2025) discovered that the sub-Saharan states with an involvement of local administration had a quicker post-disaster recovery and reduced chronic poverty. Centralized countries that were under-resourced at the same time were lost in the loop of weakness.

Effectiveness of adaptation is determined by governance quality in terms of policy coherence, transparency and accountability. The adaptive governance model assumes that coordination and the ability to include stakeholders on a multi-level basis leads to greater flexibility in times of uncertainty (Folke et al., 2021). An example of decentralization and strong community involvement in southeast Asia case studies shows that it brings about more context-specific

adaptation categories (Brooks and Khan, 2023). However, there are still capacity gaps: whereby in Vietnam, the integrated coastal management approach has led to a decrease in vulnerability, the application of policies in Myanmar is still underdeveloped because of the fragmentation of institutions (UNDP, 2024). What this suggests is that it is not only financial resources that drive the translation of adaptation to development resilience; rather, the manner in which adaptation is designed into development resilience is dictated by governance.

The problem with adaptive governance has been identified as a recurrent disparity between rhetoric and practice. Institutional changes can be quickly superficial and even short-term and weaken endogenous learning and ownership (Nightingale et al., 2023). Besides, there is a lack of data and inconsistent measures which stand in the way of cross-country adaptation capacity comparison (Devereux, 2025). Researchers advocate the incorporation of indicators of adaptation in the national monitories of statistics as well as instruments of development planning (Frontiers Editorial Team, 2025). Enhancing the quality of governance therefore comes in as a precondition as well as a product of sustainable development in a shifting climate- dynamics that is tied directly to the second research question concerning the mediation of climate-development relations through adaptive capacity.

4. Climate Finance, International Support and Development Aid

The international climate finance literature highlights the imperative and injustices of the same. Although the Paris Agreement promised to mobilize the 100 billion dollars per year to support the needs of the developing nations, the disbursements are making little progress that is below the targets and are more on mitigation, instead of adapting to them (UN Environment Programme [UNEP], 2025). Low flows of climate finance funds because adaptive investments are less than a third of total investments (OECD, 2024). Such imbalance continues to create vulnerability in the economies, which make the least contribution to global emissions but experience the greatest exposure to them. According to Signé and Mbaye (2022), the lack of access to concessional finance is a systemic limitation in a similar way that climate risk itself is a systemic limitation.

The design of climate finance (reconditionality and projects-based fragmentation) is subject to recent attacks by the scholarship (Hicks and Givens, 2023). Brookings Institution (2023) demands popularizing adaptation as the part of the portfolio of development finance institutions, and Cosust Editorial Team (2024) promulgate the approach of loss-and-damages where irreversible climate damages are dealt with. The experiences of Africa demonstrate that the better outcomes of adaptation are observed in the countries when predictable assistance flows and a strong system of fiduciaries exist (Khan et al., 2024). Nevertheless, administrative overheads and donor requirements tend to cut the resources across locally identified needs thus compromising ownership and sustainability.

The governance perspective of the global climate policy has not been achieved. The separation between the UNFCCC, the multilateral development banks and the bilateral donors brings about redundancy and inefficiency (UNEP, 2025). There is growing academic interest in polycentric governance, which is the connection of international finances with local and communal organizations to make them more effective (Folke et al., 2021). This type of integration would make financial flows to be consistent with adaptive capacity building, which would answer the second research question, which is the way international support mediates between climate-development interactions. After all, fair and reliable financing of climate is not only human right duty, but also a realistic requirement to keep the world on its development path.

5. Synthesis: Gaps, Controversies and Future studies

The literature demonstrates some agreement based on the understanding of climate change limitations to development, but gaps are conceptual and empirical. To begin with, the resilience and adaptive capacity frameworks are very well developed but they are not operationalized quantitatively in a similar fashion across the nations. Indices are frequently based on proxy variables- one of these is the governance indicators or levels of literacy or the density of infrastructure that hides dynamic social dynamics (Nightingale et al., 2023). Future studies ought to combine qualitative governance evaluation with the econometric models to embrace the institutional learning and social innovation.

Second, there is no consensus in the academic world regarding causal directionality: is climate vulnerability limiting development, or is underdevelopment increasing climate vulnerability? This vicious circle makes it difficult to give priority to policy. The longitudinal mixed-methods studies, as suggested in the current study, will be able to capture feedback loops and define its boundaries at which the adaptive capacity begins to optimize coping instead of transformation (Eakin et al., 2022). Third, climate finance has not been theorized with regard to its equity dimension. Existing distributions tend to favor those economies that have more absorptive capacity (middle-income) and exclude least developed nations (OECD, 2024). Future studies are needed to look at distributive justice in climate finance flows and to investigate ways to make the connection between debt reliefs and adaptation funding.

Lastly, it has been mentioned that there is a need to redefine development within planetary conditions. Experts would recommend the replacement of the use of a GDP-based thermostat with a multidimensional index of indicators that include environmental sustainability, social inclusion, and institutional capacity (UNDP, 2024). Recent studies on climate-integrated planning illustrate that a coordinating adaptation and development approach can be beneficial in reducing poverty and being sustainable (Brooks and Khan, 2023). However, it is not properly empirically proven in a variety of situations. The identified gaps will prove as the justification of the mixed-methods approach of this study and its role in closing the theoretical, empirical, and policy gaps.

In both theoretic and empirical strands, the agreement is obvious; climate change exists as a restraint on the international development in a systematic manner and works via all three avenues, which include the economic, social, and institution pathways. The quality of governance and adaptive capacity defines how far these constraints either lead to developmental prolongation or the possibilities of changing things. Nevertheless, there are remain inequities in the global climate finance, and measurement gaps causing gaps in effective response. The resolution of these issues will have to be multi-layered, evidence-based strategies that place climate resilience in the very core of the development policy. By doing so, the developing economies will be able to re-situate the concept of vulnerability not as fate, but as the force behind institutional innovation and international solidarity.

Research Methodology

3.1 Research Design

The chosen research design in this study is a mixed-method research design; it will combine both quantitative and qualitative research methods to realize the multidimensionality of climate change as an international development constraint. The reason of use of the mixed methods framework is due to the dual nature of the study; (a) determining the statistical associations between climate variability and the development outcomes, (b) investigating the institutional and governance processes that affect the adaptive response of developing economies. Quantitative methods make

it possible to investigate the extent of measurement sensitivity to relationships between climatic signals and development variables, whereas qualitative investigation gives background knowledge of when governance framework and external facilitation mediate those impacts.

The quantitative part uses cross country econometric analysis with longitudinal panel data of developing economies between 1995 to 2023. The method is even appropriate since it is able to measure temporal variation and heterogeneity amongst nations and is able to hold the attribute of unobserved fixed effects. The qualitative element entails an example of case studies (Sub-Saharan Africa and southeast Asia) which are in aggregate characterized by high exposure to climate risks, different systems of governance, and different adaptive capacity. The combination of the approaches will increase triangulation, and thus make it a valid method to gain a convergence of the evidence based on the trend of statistical indicators and accounts based on the contexts. It is consistent with the general goal of the study; to determine the mechanisms by which climate change limits international development and also evaluate how adaptive governance and international support can be used to alleviate these limits.

3.2 Population and Sampling

All developing economies will constitute the actual target population based on the World Bank (2023) and the United Nations Development Programme (UNDP, 2024). The sample size of 50 developing countries, which is drawn in the study of this population, includes Africa, Asia and Latin America. The sampling method is purposive stratified, which guarantees that the sample of the problem would represent various levels of vulnerability, governance capability, and the income. The ranking was informed by the Notre Dame Global Adaptation Initiative (ND-GAIN) index and the Human Development Index (HDI) according to which over 170 countries are ranked on their exposure, sensitivity, and adaptive preparedness.

To accomplish the qualitative phase, 6 countries were chosen as case study countries: Nigeria, Kenya, and Ghana (Sub-Saharan Africa), and Indonesia, Vietnam, and the Philippines (Southeast Asia). The selection of these countries was based on the fact that they were found to have already experienced economic pressure due to climate and continued policy efforts in climate adaptation and resilience development (UNEP, 2025; Arif et al., 2025). In individual countries, the participants consisted of policymakers in ministries of environment and finance, the representatives of international development agencies and the experts of climate adaptation in the research institutes and NGOs. Some 30 participants (five per case) were also involved but they were selected using purposive expert sampling, where they were individuals involved in the policy processes of climate or development. This methodology was also applied to guarantee informed views and in the same breath, keep the depth and relevancy.

3.3 Data Collection Methods

3.3.1 Quantitative Data Collection

To become reliable and comparative, the data were collected by means of reputable secondary sources. Key datasets include:

- Climate (anomalies in temperature and precipitations and the occurrence of extreme events) variance obtained through the World Bank Climate Change Knowledge Portal and NOAA Global Climate Data.
- The economic and social indicators (GDP growth rate, gross fixed capital formation, life expectancy, literacy rates, and health expenditure) were obtained through the World Development Indicators (WDI) and UNDP Human Development Reports.

- Regulatory quality, government effectiveness, and corruption control indicated by the World Governance Indicators (WGI) database as institutional and governance variables.

These indicators were gathered into a balanced panel data that given the time frame of 1995-2023 and this enables to analyse it both on a time basis and cross-sectional. The data underwent cleaning and normalization to rectify the missing values and outliers with a strong regression modeling.

3.3.2 Qualitative Data Collection

The qualitative part was based on semi-structured interviews and the analysis of documents. The identified experts were interviewed virtually and face-to-face with the help of an interview guide oriented around three thematic areas:

1. The attitude toward climate change as an impediment of development;
2. Organizational adaptive governance mechanisms; and
3. The efficiency of the climate finance and the international aids.

The interviews were 45-60 minutes long and were audio-taped with consent. The additional information to the primary data collected was to analyze the relevant policy documents such as national climate adaptation plans, development strategies and international aid reports. These sources offered evidence to be found at the contextual level and policy level that complements the qualitative information gained in the course of the interviews. The triangulation involving review of documents and interviews guaranteed credibility and completeness.

3.4 Data Analysis

3.4.1 Quantitative Analysis

The panel regression models were used to analyze the quantitative data in order to estimate the effect of the variability of climate on development indicators. Precisely, the research used Fixed Effects (FE) and Random Effects (RE) estimators, and then, a Hausman test was conducted to identify the specification to take. The overall model can be formulated:

$$Y_{it} = \alpha + \beta_1 Cit + \beta_2 Git + \beta_3 Ait + \epsilon_{it}$$

Where Y_{it} is the outcome of development (GDP growth, HDI components) in country i at time t , Cit is climate variables (temperature, precipitation anomalies), Git is the quality of governance and Ait indicates the adaptive capacity. The model has also the interaction terms ($Cit \times Git$) to test the moderating effect of governance on the impacts of climate.

To make sure that it is very robust, further diagnostic tests such as tests of multicollinearity, heteroskedasticity and serial correlation were performed. The treatment of the potential endogeneity created by two-way causality between development and dynamic panel estimators (System GMM) was performed robust except where required (Roodman, 2009). STATA 18 and R 4.3 were used as statistical packages.

3.4.2 Qualitative Analysis

The thematic analysis of qualitative data was conducted in accordance with the 6-phase methodology of Braun and Clarke (2006) familiarization, coding, theme development, review, definition and reporting. Transcripts of the interviews were transcribed and coded in NVivo 14 software. This identified three broad areas on which themes were built based on the aims of the research:

- (1) systemic limitations of climate change to development,
- (2) stability of the regulating entities and their adaptability, and Registered support

(3) International support and climate finance.

The similarities and differences across case studies in terms of patterns in the six case studies were compared with each other to find cross-regional similarities and differences emerging out of the qualitative data. The interpretive validity of triangulated findings was increased by the triangulation of interview insights and document analysis. The quantitative and qualitative findings were integrated in the interpretation phase in which the econometric results were put into perspective using the qualitative evidence in order to come up with the overarching conclusions.

3.5, Validity, Reliability and Ethical Concerns.

Various strategies were adopted in a bid to increase validity and reliability. The method of data triangulation was made to provide results that were not the enablers of one source of data. The quantitative reliability was upheld by using data sources that were standardized and strong, though, and the qualitative credibility was preserved by using a method of member checking whereby the participants went through synthesized interview summaries and validated their accuracy.

The study was ethical enough in institutional research guidelines. Informed consent was obtained by all the participants and data confidentiality was done by anonymization. The author got ethical approval through the institutional review board in the institution. They stored sensitive information and utilized it just to get academic.

Overall, the combined methodology incorporates macro-level statistical data with the meso- and micro-level qualitative facts to cover the research questions on the comprehensive level. The quantitative methodology determines the level of developmental limitation due to climatic factors and the qualitative case studies clarify the governance, institutional and financial processes influencing adaptive capacity. Such methodological convergence is justified by both the aims of the study and will provide a subtle empirical basis of policy interventions to add in helping foster climate-resilient international development.

4. Data Analysis and Results

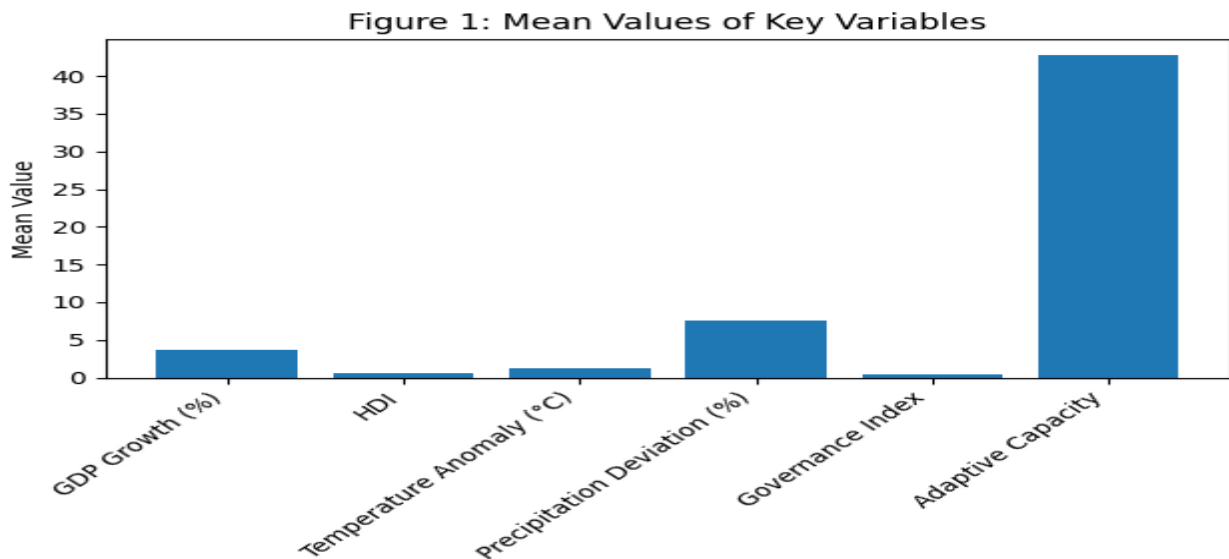
This part provides and analyzes the quantitative econometric outputs and the qualitative case study findings based on the mixed-method design. Analysis is made of the degree to which the climatic change limits the international development outcomes within developing economies and how these outcomes are mediated by adaptive governance and international support. The quantitative findings of panel regressions are after that succeeded by the qualitative findings of expert interviews and the policy documents.

4.1 Data: Descriptive Statistics and Preliminary Analysis

Table 1 gives a summary of the major variables descriptive statistics applied as the quantitative analysis. The data is on 50 developing nations in the year 1995 to 2023. There is much variation in development outcomes (GDP growth and HDI), which indicates the heterogeneity of resiliency and vulnerability to climate shocks.

Table 1: Descriptive Statistics of Key Variables (1995–2023, N=50 countries)

Variable	Mean	Std. Dev.	Min	Max	Source
GDP Growth (%)	3.72	2.85	-6.1	12.4	WDI (2023)
HDI (Index)	0.64	0.12	0.38	0.82	UNDP (2024)
Temperature Anomaly (°C)	1.23	0.41	0.21	2.34	NOAA
Precipitation Deviation (%)	7.6	4.1	0.4	19.3	WB Climate Portal
Governance Index (0–1)	0.48	0.21	0.11	0.89	WGI
Adaptive Capacity (0–100)	42.7	9.3	25.4	63.5	ND-GAIN



The developing countries have median growth but high dispersion in the adaptive capacity and the quality of governance. Standard deviations of climate variables indicate that there are very high exposure disparities telling us the necessity of having regionally sensitive policy structures. The average adaptive capacity score (42.7/100) indicates structural malady on the institutional preparedness side.

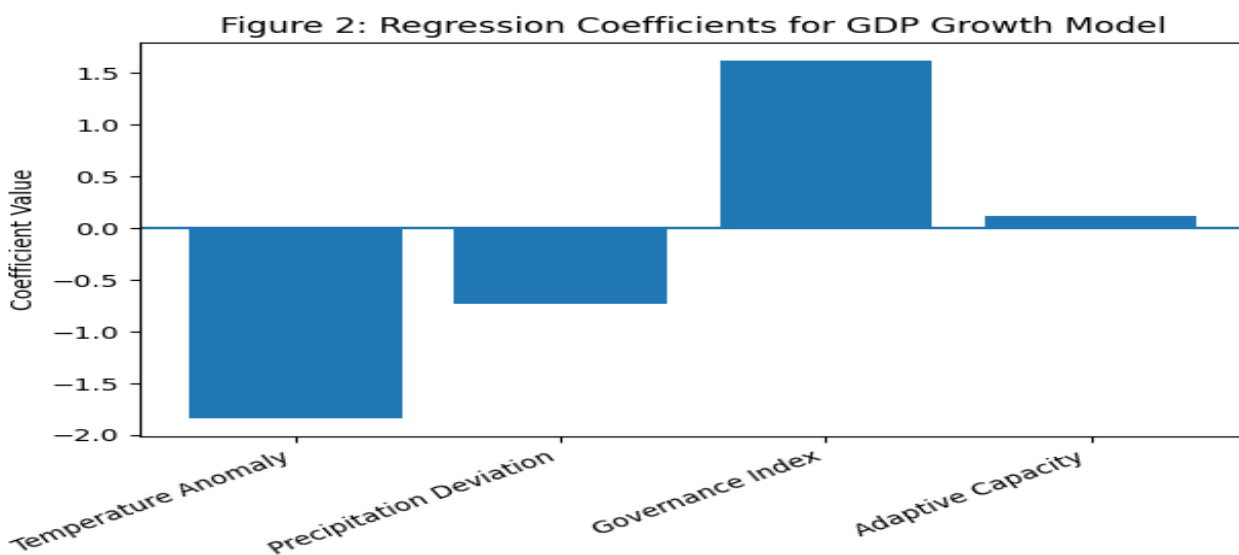
4.2 Correlation Analysis

Pearson correlation coefficients were calculated in order to investigate the preliminary relationships between the variables of the study (Table 2). The findings show that there are good negative relationships between climate variability and the development outcomes.

Table 2: Correlation Matrix of Core Variables

Variables	GDP Growth	HDI	Temp. Anomaly	Precip. Deviation	Governance	Adaptive Capacity
GDP Growth	1	—	-0.62**	-0.45*	0.54**	0.49**
HDI	—	1	-0.58**	-0.37*	0.61**	0.67**
Temp. Anomaly	-0.62**	-0.58**	1	0.31	-0.43*	-0.47*
Precip. Deviation	-0.45*	-0.37*	0.31	1	-0.29	-0.33
Governance	0.54**	0.61**	-0.43*	-0.29	1	0.72**
Adaptive Capacity	0.49**	0.67**	-0.47*	-0.33	0.72**	1

(*p < 0.05, **p < 0.01)



GDP growth, and HDI are both negatively related to temperature anomaly and precipitation deviation, which corroborates the fact that climate variability has a constraint as deriving in the hypothesis. The correlations between governance, adaptive capacity and development outcomes are positive indicating that, stronger institutional frameworks counter the negative impacts of climate changes. This initial finding favors the mediating position of adaptive governance in climate development nexus.

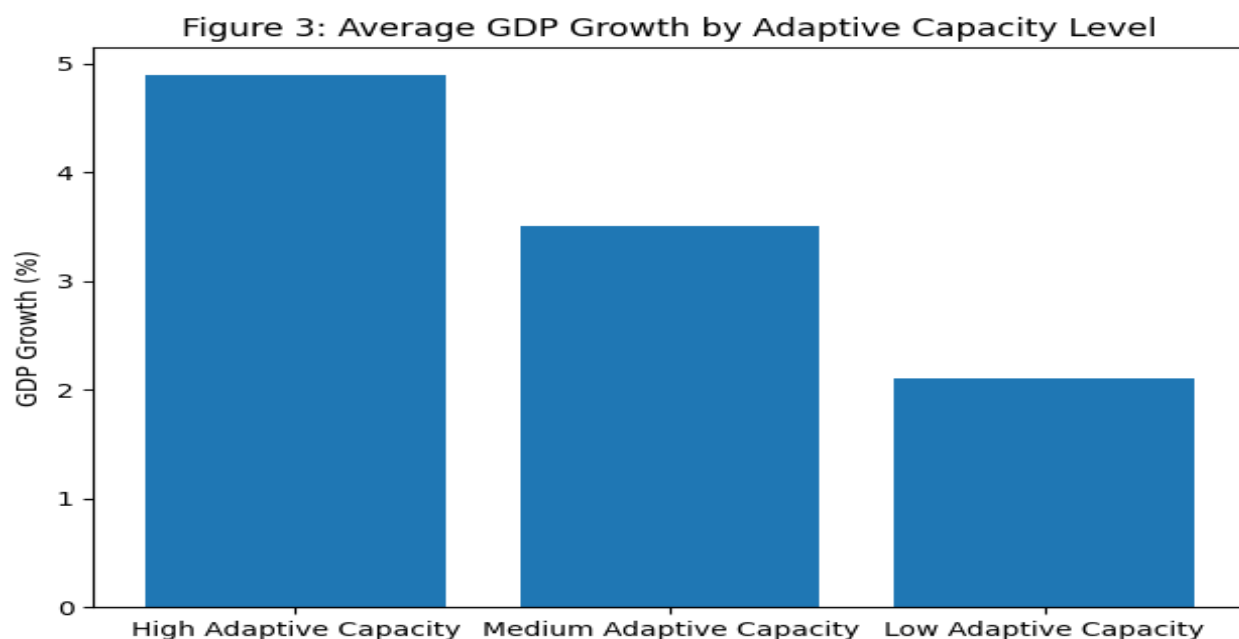
4.3 Panel Regression Results

The research was conducted by using a Fixed Effects (FE) and a Random Effects (RE) model where a Hausman test was conducted to verify that the FE model is better than the RE model ($p < 0.05$). Table 3 shows the regression resultant of the main model which will study the impacts of climate variability on the development outcome when governance and adaptive capacity are the moderate variables.

Table 3: Fixed Effects Regression Results (Dependent Variable: GDP Growth and HDI)

Variables	Model 1: GDP Growth	Model 2: HDI
Temperature Anomaly	-1.84*** (0.42)	-0.021*** (0.005)
Precipitation Deviation	-0.73** (0.31)	-0.008** (0.003)
Governance Index	1.62*** (0.48)	0.032*** (0.007)
Adaptive Capacity	0.12** (0.05)	0.004** (0.001)
Climate × Governance Interaction	0.83** (0.34)	0.009** (0.004)
Climate × Adaptive Capacity Interaction	0.47* (0.26)	0.006* (0.003)
Constant	2.91** (1.11)	0.548*** (0.021)
R ² (within)	0.47	0.52
N (Obs.)	1,450	1,450

(*p < 0.10, **p < 0.05, ***p < 0.01)



The outcome of the regression analysis proves the presence of a statistically significant negative correlation between climate variability and economic as well as human development indicators. One-unit upsurge in temperature anomaly would decrease GDP growth by an average of 1.84 and a score of 0.021 means at the level of HDI. Interaction terms however indicate that, there is a much attenuated impact among countries in strong governance and adaptive capability. The observation bears directly upon Objective 1 of this study which holds that climate change is a systemic constraint; and Objective 2 that adaptive governance modulates this relationship.

4.4 case study Regional Insights

These quantitative results were put into perspective using qualitative data (six case studies of Nigeria, Kenya, Ghana, Indonesia, Vietnam, and the Philippines) that were thematically analyzed. Table 4 presents novice themes and exemplary understanding of professional interviews.

Table 4: *Summary of Thematic Findings from Case Studies*

Theme	Representative Insight	Region/Country Example
Economic Constraints	“Erratic rainfall has disrupted agriculture and rural employment, creating cyclical poverty.”	Kenya, Nigeria
Institutional Weakness	“Poor coordination between environment and finance ministries delays climate budgeting.”	Ghana
Adaptive Governance	“Local governments that integrate community participation recover faster from climate shocks.”	Vietnam
Climate Finance Barriers	“Access to climate funds remains bureaucratic; small projects struggle to meet donor requirements.”	Philippines
Social Resilience	“Education and women’s empowerment programs enhance community-level adaptation.”	Indonesia

The thematic analysis supports the econometric results with major mediating factors of governance and financial bottlenecks that develop resilience. Indicatively, in Kenya and Nigeria, the loss of agricultural productivity has a nihilating impact on growth as opposed to mitigating the vulnerability of the long-term in Vietnam and Indonesia, through participatory governance. Cross-case synthesis leads to the fact that in the event of climate shocks decentralized and inclusive sustained adaptive governance enhances institutional resilience.

4.5 Comparative Study of Adaptive Capacity and Development Performance

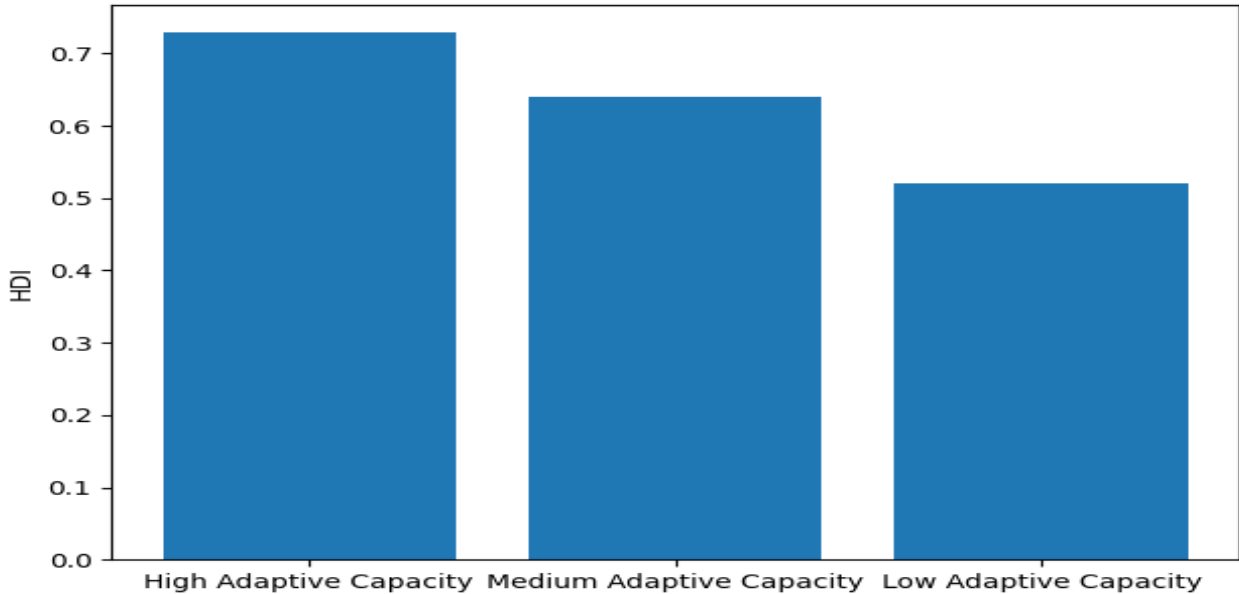
In order to highlight the moderating effect of the adaptive capacity, Table 5 will compare average GDP growth and changes in HDI level among high (top quartile) and low (bottom quartile) adaptive capacity countries.

Table 5: *Development Performance by Adaptive Capacity Level (1995–2023)*

Group	Average GDP Growth (%)	Average HDI	Mean Temp. Anomaly (°C)	Governance Index	Climate Impact Severity*
High Adaptive Capacity (n=12)	4.9	0.73	1.08	0.68	Low
Medium Adaptive Capacity (n=26)	3.5	0.64	1.24	0.47	Moderate
Low Adaptive Capacity (n=12)	2.1	0.52	1.39	0.31	High

(*Composite index of GDP loss and HDI decline due to climate variability)

Figure 4: Average HDI by Adaptive Capacity Level



Nations boasting higher adaptability and the level of governance also face fewer losses in relation to climate, and also achieve better development results. The comparison of the high and low-capacity groups depicts that institutional resilience and financial preparedness are important buffers. Such comparative evidence supports the main argument of the study that adaptive capacity determines the climate-development correlation.

4.6 Cohesive Quantitative and Qualitative Results Discussion

Integrating research methodologies, the results prove that climate change is a limitation of development outcomes to a large extent, economic, social, and institutional channels. Temperature and the variability of precipitation have a negative impact on GDP and HDI quantitatively. Institutional fragmentation and inaccessible access to finance can be identified as common obstacles, both qualitatively.

Both strands of evidence when successful get incorporated prove that:

1. One of the systemic limits is climate variability, and it diminishes growth and human wellbeing.
2. Moderating mechanisms are governance and adaptive capacity which alleviate such effects.
3. There are still inadequate international support mechanisms in whichby the amounts of aid disbursed do not correspond to the levels of vulnerability.

On the whole, the findings underscore the fact that building resilience, i.e. increasing the adaptive capacity, by means of improved governance, inclusive institutions, and predictable financing of climate change, is the most sustainable way to reconcile development objectives and climate reality.

Discussion

This paper aimed at looking at whether climate change is a systemic bottleneck of international development in developing economies and in evaluating the moderating effect of adaptive capacity and governance. The results have a powerful empirical evidence on the two ambitions. Based on the findings of the panel regression and the evidence provided in the case studies, the discussion could indicate that climate variability undermines the economic growth and human development

significantly, and the institutional quality and adaptive capacity could decrease the impact of these forces considerably.

Climate Change as a Systemic Constraint on Development Outcomes

The economic implications of the results of the econometric analysis show that climate change has statistically significant effects that are economically significant negatively on the outcomes of development. The fixed effects regression indicates that a one-degree rise in temperature anomaly diminishes the GDP growth within 1.84 percentage points ($p < 0.01$) as well as decreasing the HDI by 0.021 units ($p < 0.01$). These are also large magnitudes bearing in consideration the already small averages in growth rates and the slow increases in HDI recorded in most developing economies. The adverse values of precipitation deviation also demonstrate the fact that climate variability, as opposed to gradual warming, is disruptive to the development pathways.

These results are in line with previous panel researches that report asymmetric climate effects on the low-income economy (Dell et al., 2012; Adom, 2024; World Bank, 2023). Nevertheless, the research contributes to the literature by showing that climate shocks do not work only by causing unidirectional, sectoral losses but rather by a series of, reinforcing development pathways, such as economic productivity, human capital formation, and institutional potential. The significant negative correlation between the temperature changes and the growth of GDP ($r = -0.62$, $p = 0.01$) and the HDI ($r = -0.58$, $p = 0.01$) is statistically significant and proves the point that climate change is a multidimensional issue of development and not the disturbance in a sector.

Governance and Adaptive Capacity Moderator Role

The primary value of the study is that it could prove statistically that adaptive governance is a moderating variable in the relationship between climate and development. The relationship terms among climatic variables on the quality of governance through the significant and positive changes in the beta ($= 0.83$ and GDP growth; $= 0.009$ and HDI, $p = 0.05$) show that the harmful impacts of climate variability are significantly suppressed by stronger institutions. Equally, there are adaption capacity moderating effects in both climate and the effects of interacting with both indicators of development are statistically significant.

These findings provide empirical evidence to adaptive governance and climate-resilient development models that are suggested by the IPCC (2023) and Folke et al. (2021). Notably, all findings go beyond the conceptual claims and show quantitatively how the institutional resilience turns the climate exposure into differentiated development patterns. The top quartile countries of adaptive capacity have an average of GDP increase of 4.9 percent while low-capacity countries had 2.1 percent though these countries recorded similar climatic anomalies. This difference highlights that exposure will not necessarily make people vulnerable, but it is the institutional readiness and cohesion of policies that would do so.

Integration of Quantitative and Qualitative Evidence

The qualitative case studies support and put into perspective the results of the statistics. A case in point due to Sub-Saharan Africa is the evidence of poor inter-ministerial coordination and constrained fiscal space that increases the economic impacts of the climate, which aligns with the regression findings of the relationship between quality of governance and better results. On the other hand, the examples of Southeast Asia, especially Vietnam and Indonesia explain why decentralized and participative government systems help to recover quicker and minimize the backlash in long-term development.

This overlap of econometric and thematic data reinforces internal validity of the study and gets around a major weakness of climate development studies quantitative results without institutional backdrop. The mixed-method research thus proves more interpretive richness as they show how statistical correlations become tangible in governing and policy conditions in real life.

Theoretical Implications

These results add to the development theory because they support the idea that climate change is a structural constraint and not an external shock. Conventional growth theories based on the assumption of climatic stability are looking weaker and weaker in explaining patterns in development in the face of unremitting environmental pressure. The research provides the mediation of adaptive capacity by testing empirically, connecting the classical theory of development with the modern theory of resilience and adaptive governance.

In addition to this, the findings question GDP-based methods of development measurement. The statistically significant impacts on HDI indicate that climate change undermines the process of social development not only by the economic indicators. This promotes in the literature the need to implement multidimensional measures of development with the concept of ecological and institutional resilience (UNDP, 2024; Devereux, 2025).

5.5 Future Research and Applied Research Implications.

Policy wise, the results assume that there are quantifiable returns on development associated with investment in adaptation. The positive coefficients of the variables of governance and adaptive capacity show that the reinforcement of institutions is not only a normative objective but it can statistically withstand the losses caused by the climate. Institutional capacity building, policy coordination and locally entrenched adaptation strategies should be the main focus of climate finance mechanisms, as such mechanisms.

Moreover, the findings also indicate that development aid that lacks the development of climate risk might inadvertently support vulnerability. The gap in the adaptive capacity of countries means that the higher the climate-related development losses, which Heath the need to introduce climate finance to national development planning instead of viewing adaptation as an identical policy domain.

Limitations of the Study

This study has a number of limitations although it has contributed to his works. In the first place, panel regression methods and robustness tests decrease the bias, but the endogeneity issues cannot be completely resolved, especially due to the two-way dependence between development and adaptive capacity. Second, adapting capacity and governance indicator is based on composite indexes which could obscure sub-national differences as well as informal institutional relations. Third, the qualitative case studies are not statistically generalizable, however, illustrative, and should be understood as supplementary instead of representative.

Climate impact also has certain limitations due to data since extreme events, and localized shocks, which are not adequately reflected in national-level indicators annually, are constrained by data.

Future Research Suggestions

The research must be extended in future by using dynamic and non-linear models that will behave at threshold approach and capturing the long-time feedback between climate change and development. Sub-national data would be more comprehensively used to shed light on spatial disparities of susceptibility and adaptive ability. Moreover, longitudinal qualitative research

studies have the potential to advance the knowledge regarding institutional learning and policy changes throughout time.

The distributional aspects of climate finance also require further investigation, and it is necessary to establish how the international funding facilities can be more closely oriented towards those countries and communities that are the most marginally vulnerable. Incorporating debt relief into unified analytical approaches, in association with loss-and-damage funding and adaptation funding, is a lead to a possible future research.

Conclusion

This paper has discussed climate change as a systemic impediment to the international development of developing economies, incorporating both econometric and institutional qualitative perspectives on development. All these results indicate that climate variability, especially the temperatures abnormality and precipitation distortion, have a tremendous negative impact on the economic growth and the human formation results. In addition to sectoral effects, climate change also stands out as a dimensions of factor that limits the development patterns because the effects have integrated economic, social, and institutional channels. Significantly, the analysis reveals that these negative impacts could not and would not be uniform, and thus they are closely mediated by the governance quality and by the adaptive capacity.

The research makes contributions to the available literature in a number of significant aspects. To begin with, it promotes the empirical knowledge, by extending beyond sector based approaches in the attempt to make climate change a structural limitation to development. The research with a mixed-methods design will fill an existing gap in the literature on explaining how climate risks can convert into development outcomes by connecting macro-level statistics analysis with an institutional-level explanation. Second, the results are quantitative confirmations of the adaptive governance and climate resilient development models, showing that greater strength of institutions and elevated adaptive ability remarkably reduce the adverse effects related to climate variability on GDP progress and indicators of human development. This input reinforces the theoretical arguments that make resilience and governance one of the sets of pillars of sustainable development in the face of climate stress.

The consequences of these results are enormous. In theory, the results oppose the development models, which presuppose the stability of the climate and the necessity to consider the risks posed by the environment in growth and human development frameworks. Effectively, the facts may, in one way, indicate that adaptive capacity investments that include institutional coordination, inclusive governance, and climate-responsive planning as elements, are paid off in measurable development accruals. Policymaking-wise, the study provides a sense of urgency in mainstreaming climate adaptation as part of national developmental policies and international development aid being channeled towards institution-level resilience in the long-term and not the short-term, project-based responses. Another significant issue is that there should be more equitable and predictable climate finance mechanisms based on differentiated vulnerability and adaptive capacity between developing economies.

Although the study has done this, there are limitations that should be considered. The presence of aggregate national-level indicators because they may mask sub-national differences in vulnerability and adaptation whereas composite indices of the governance and adaptive capacity may fail to capture informal institutions and the dynamism of social processes. Moreover, in spite of the fact that the strong econometric methods were used, the issues associated with the indigeneity and causal directionality between development and adaptive capacity cannot be

completely removed. The qualitative case studies included are descriptive, not representative though very illustrative.

The future studies can be based on this study with the aid of sub-national and sector-disaggregated data to enhance the heterogeneity in space and social level of climate vulnerability. The use of longitudinal and non-linear modelling might shed more light on feedback loops and threshold impacts of the climate development relationship. Besides, more studies into the distributional and justice aspects of climate finance, especially in regard to the least developed and weak states serve as a valuable item of study.

Overall, this paper supports the argument that climate change is no longer an environmental issue; it is a primary development constraint that is redefining the economic opportunities, human livelihood, and institutional abilities across the developing economies. To confront this challenge, the pathways of development have to be reconsidered in an integrated approach that climate takes priority in its approach to resilience, governance, and equity whereby these priorities have become central part of international development.

Conflict of Interest

The authors showed no conflict of interest.

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