



CLIMATE FINANCE AND INCLUSIVE GROWTH IN SUB-SAHARAN AFRICA

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Cite this article:

Shamwil Abdul-Karim,
Kassim Alabani (2026),
Climate Finance and Inclusive
Growth in Sub-Saharan
Africa. African Journal of
Economics and Sustainable
Development 9(2), 39-67.
DOI: 10.52589/AJESD-
FQYZZHPM

Manuscript History

Received: 7 Mar 2026

Accepted: 9 Apr 2026

Published: 30 Apr 2026

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ABSTRACT: *This study investigates the impact of climate finance on inclusive growth in sub-Saharan Africa, focusing on income inequality, poverty, and employment issues. Using panel data for 23 countries from 2000 to 2022 and applying second-generation panel estimators that account for cross-sectional dependence and heterogeneity, the analysis finds that climate finance has weak and statistically insignificant effects on inclusive growth indicators. The results suggest that climate finance, in its current form, has not translated into broad-based social and economic inclusion in the region. Instead, inclusive growth dynamics are largely shaped by institutional quality, demographic pressure, and regional trends. These findings highlight the importance of complementary institutional and social policies to enhance the inclusiveness of climate-related financial flows in sub-Saharan Africa.*

KEYWORDS: Income inequality, Poverty, Employment, Institutional quality, Panel data analysis, Sustainable development, Economic inclusion.

JEL Classification Codes: E62, O15, O47, Q54, Q56



INTRODUCTION

Climate change presents a significant challenge to sustainable development, particularly in vulnerable regions (Benney, 2018). Climate finance has gained prominence as a potential solution to address both issues (Robinson & Herbert, 2001). This approach aims to mitigate the impacts of climate change while promoting economic growth (Akhakpe, 2022).

The sub-Saharan African region is characterised by distinctive challenges that impede its progress towards inclusive growth (Oyinlola et al., 2021). Extensive poverty, stark income disparities, and pervasive unemployment plague the region (Kouladoum, 2023). These socioeconomic difficulties are exacerbated by the region's pronounced vulnerability to climate change, which threatens developmental progress and intensifies inequalities (Van Niekerk, 2020). Climate-related phenomena such as prolonged droughts, catastrophic floods, and erratic weather patterns disproportionately affect the most impoverished and vulnerable populations, widening the gap between affluent and disadvantaged groups (Lin et al., 2020). Sub-Saharan Africa's dependence on climate-sensitive sectors, notably agriculture and natural resources, further amplifies its susceptibility to adverse consequences (Blomfield 2019). This reliance can precipitate economic instability, social upheaval, and deteriorating living standards, underscoring the urgency of exploring solutions that address these interlinked challenges (Kushawaha et al., 2021).

Considering these critical challenges, the strategic allocation of financial resources can enhance adaptive and mitigating measures that simultaneously address current needs and promote long-term sustainability goals (Lu, 2022). For instance, climate finance has emerged as a vital tool for bolstering efforts to mitigate and adapt to climate change while fostering economic growth and social inclusivity (Bowen et al., 2011). The term 'climate finance' refers to monetary resources allocated to initiatives aimed at reducing greenhouse gas emissions and enhancing resilience against climate-related impacts (Hsu, 2023). Climate finance encompasses a wide range of financial instruments and mechanisms, including grants, concessional loans, equity investments and risk management tools (Chirambo, 2016). These financial instruments support climate change-related projects and initiatives that advance sustainable development (Mume and Mohammed, 2022). By channelling investments into crucial areas such as renewable energy, sustainable agricultural practices, climate-resilient infrastructure, and capacity-building programmes (Raghupathi & Raghupathi, 2017), climate finance has the potential to generate new economic opportunities, create employment, and significantly improve the overall living standards of communities in sub-Saharan Africa (Lu, 2022).

Despite the increased focus on climate finance as a sustainable development tool, significant research gaps remain regarding its effectiveness in promoting inclusive growth in sub-Saharan Africa. Most existing studies have focused on literature reviews, policies, case studies, and qualitative methods without quantifying the social and economic impacts of climate finance (Bowen et al., 2011; Asongu & Moor, 2015; Asongu & Simplicie, 2015; Ibrahim et al., 2016; Chirambo, 2017; Singer et al., 2017; Ivanyina et al., 2021; Desalegn & Tangl, 2022; Van Niekerk, 2024). However, these studies often lack empirical data and robust statistical analysis.

Additionally, many studies are limited by short timeframes and narrow scopes, missing the long-term and multifaceted impacts of climate finance on inclusive growth (Sarpong & Nketiah-Amponsah, 2022; Desalegn & Tangl, 2022; Mamman et al., 2023). The intricate



relationship between climate change and socioeconomic systems requires a long-term perspective to fully understand the implications of climate change funding. Short-term studies may overlook the crucial long-term effects and cumulative impacts of sustained climate finance, leading to an incomplete understanding of its potential benefits and its drawbacks.

Moreover, scholarly work often conflates climate finance with related concepts such as green finance, foreign aid, and financial inclusion, resulting in a lack of clarity regarding the specific role of climate finance in fostering inclusive growth (Asongu & Simplice, 2015; Asongu & Moor, 2015; Singer et al., 2017; Sarpong & Nketiah-Amponsah, 2022; Desalegn & Tangl, 2022; Van Niekerk, 2024). This conceptual ambiguity hampers efforts to identify the unique contributions of climate finance and develop targeted strategies to optimise its impact on inclusive growth in sub-Saharan Africa.

Furthermore, many studies utilise a limited range of indicators to measure inclusive growth, potentially overlooking critical aspects of economic and social progress (Asongu & Simplice, 2015; Mamman et al., 2023; Van Niekerk, 2024). Inclusive growth encompasses social elements, such as poverty, education, healthcare, and essential services, as well as economic factors, such as income and employment. A narrow set of indicators may fail to capture the full spectrum of climate finance's effects on inclusive growth, necessitating a comprehensive approach to understand how climate finance contributes to broader developmental goals.

Finally, numerous studies have focused primarily on developed nations (Asongu & Simplice, 2015; Ibrahim et al., 2016; Desalegn & Tangl, 2022), creating a geographical imbalance and a lack of empirical evidence on the specific impacts of climate finance in sub-Saharan Africa. This hinders the development of tailored policies and interventions to effectively address local needs.

This study aims to fill existing knowledge gaps by examining the impact of climate finance on inclusive growth in sub-Saharan Africa. Specifically, it seeks to address three primary research questions: (1) How does climate finance correlate with changes in income disparity across sub-Saharan Africa? (2) What is the effect of climate finance on employment rate in sub-Saharan Africa? (3) To what extent does climate finance influence poverty rates in sub-Saharan Africa?

LITERATURE REVIEW

Introduction

This study investigates the intersection of climate finance and inclusive growth in sub-Saharan Africa (SSA). This study explores how climate finance can simultaneously promote inclusive growth and address economic and social inequities. A comprehensive literature review is crucial for establishing a solid foundation for this study (Saher et al., 2024). This provides an understanding of existing research, theories, and empirical studies related to climate finance and inclusive growth (Ngepah, 2017). By synthesising the relevant literature, this review identifies knowledge gaps and effective interventions and contextualises the research questions (Carè & Weber, 2023). The literature review begins with a theoretical review, outlining key relevant theories, analysing empirical evidence, and identifying gaps in the literature, informing the study's objectives and research questions.



Theoretical Review

Institutional Theory

Institutional theory examines how formal and informal structures, such as laws, regulations, cultural norms, and practices, affect societal behaviour and economic outcomes (Woodhouse, 2024). In sub-Saharan Africa, the efficacy of institutions varies considerably, influencing governance, policy implementation, and investment climate (Alence, 2004). Inadequate institutions can result in corruption, mismanagement, and a lack of accountability, impeding efficient climate financing (Hilson & Maconachie, 2008).

Robust institutions are essential for effective climate finance deployment in sub-Saharan Africa (Bird & Fafchamps, 2004). For instance, Rwanda has implemented significant institutional reforms, enhanced climate fund management, and fostered inclusive growth in recent years. Its governance framework prioritises transparency and community involvement, ensuring that climate finance reaches its intended beneficiaries (Niyonzima & Ndamsa, 2023). Conversely, countries with weak governance, such as Somalia and South Sudan, may experience misappropriation or diversion of climate finance through corruption, exacerbating inequalities (Checchi et al., 2022).

This theoretical framework elucidates the critical role of governance in shaping economic outcomes and demonstrates how institutional structures can facilitate or impede climate finance (Riak, 2013). Understanding the institutional landscape enables policymakers to design interventions that strengthen governance and improve the effectiveness of climate finance (Nor & Mussa, 2024).

A limitation of institutional theory is its potential to neglect broader socioeconomic factors and its insufficiency in addressing the power dynamics and conflicts within institutions (Kawabata, 2021). Furthermore, the varying institutional quality across sub-Saharan Africa suggests that findings from one country may not be applicable to another, thus complicating the development of universal strategies (Browne, 2022). Therefore, understanding the interaction between institutional frameworks and climate finance is essential for achieving inclusive growth, as it underscores the necessity for adaptive and resilient governance structures.

Development Economics Theory

Development economics focuses on improving economic conditions in developing nations by analysing factors influencing growth, poverty reduction, and wealth distribution (Abisuga-Oyekunle et al., 2019). Understanding these dynamics in sub-Saharan Africa is essential for effective policymaking because of the ongoing colonial legacy and economic dependence on the West (Ijaiya & Ijaiya, 2004).

Climate finance is crucial in development economics because it supports initiatives that enhance agricultural resilience, infrastructure, and sustainable livelihood (Meltzer, 2016). Investments in climate-smart agriculture can help farmers adapt to changing weather conditions, reduce poverty, and foster economic stability (Ikendi et al., 2024). Microfinance programmes that allow subsistence farmers to invest in sustainable practices can increase productivity and income, thereby directly contributing to inclusive growth (Aragón et al., 2021). Development economics also emphasises human capital development (Tsauroi, 2020).

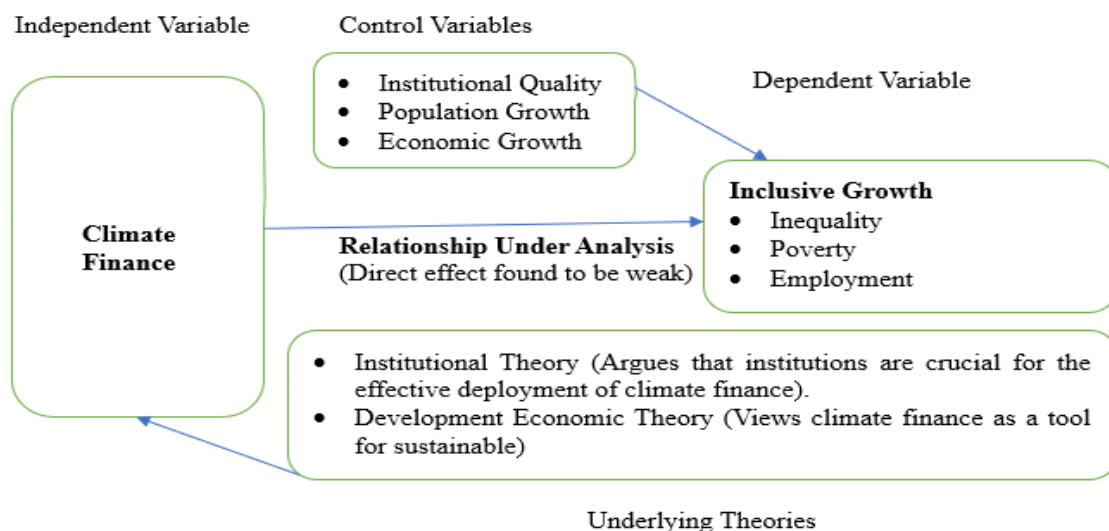


Climate finance can fund educational and training programmes, equip individuals with skills for sustainable economies, and promote long-term growth and social equity (Mandal, 2019).

Conceptual Framework

Figure 1 illustrates the central argument and analytical structure of this study. The research is grounded in Institutional Theory and Development Economics Theory, examining the relationship between climate finance and inclusive growth. The framework shows Climate Finance (Independent Variable) and Inclusive Growth (Dependent Variable), assessed through income inequality, poverty, and employment indicators. The connecting arrow represents their relationship, with the findings showing that this direct effect is weak and insignificant. The Controlling Influences include Institutional Quality, Economic Growth, and Population Growth, which affect the climate finance-inclusive growth link. This study finds that these variables, especially Institutional Quality and Population Growth, significantly determine inclusive growth outcomes. Institutional quality is key to transforming climate finance into inclusive growth. While a direct connection between climate finance and inclusive growth is theoretically expected, empirical findings show that this link is weak, with institutional and demographic contexts having a greater influence on inclusive growth in sub-Saharan Africa.

Figure 1: Conceptual Framework



Source: The study output

Empirical Review

This empirical review synthesises various studies on climate finance and inclusive growth and categorises them into key themes for future research directions. Each study was examined for its methodology, findings, and identified research gaps, providing a comprehensive understanding of the current landscape and highlighting areas for further investigation.



Climate Change and Economic Growth

Bowen et al. (2011) explored the relationship between economic development and the consequences of climate change, emphasising the need for inclusive, pro-poor growth in low-income nations. Their literature review synthesises existing research to identify effective growth strategies, such as enhancing skills and improving access to financial resources, for small businesses. However, this study's reliance on qualitative synthesis lacks empirical data and original statistical analyses, which limits its ability to substantiate claims regarding the complex interactions between climate finance and inclusive growth. This study addresses this gap by incorporating quantitative data and employing robust statistical methods to provide a clearer understanding of these interactions, thereby offering a more comprehensive analysis that can inform policy decisions.

Mamman et al. (2023) conducted an empirical study examining the effects of climate change on inclusive growth across 51 African nations from 1996 to 2020 using the Augmented Mean Group (AMG) estimator. They found that temperature anomalies positively influenced poverty and income inequality, indicating that warmer climates exacerbate these issues. Although GDP growth mitigated some negative effects, population growth intensified them. However, their focus on poverty and inequality overlooks other critical indicators such as employment and access to education, which are essential components of inclusive growth. In addition, the timeframe of 1996-2020 may limit its applicability to current policy decisions, suggesting the need for updated data. This study builds upon their findings by broadening the scope to include employment and social metrics and utilising a more recent dataset to enhance relevance, thus providing a more holistic view of the impacts of climate change on inclusive growth.

Financial Inclusion and Development

Asongu and Moor (2015) provided a comprehensive survey of recent developments in finance for inclusive development, reviewing approximately 170 papers. Their methodology contextualises financial inclusion issues within the existing literature, categorising innovations into areas such as rural/urban disparities and women's empowerment. Singer et al. (2017) investigated the relationship between financial inclusion and inclusive growth through a literature review. They discuss various financial products and their contributions to economic development, highlighting the challenges of achieving greater financial inclusion (FIs). Despite its global perspective, the study's applicability to sub-Saharan Africa is limited, and it does not address climate finance's role in promoting inclusive growth. The focus on short- to medium-term impacts suggests the need for long-term research to understand these sustained effects. This study diverges by focusing specifically on sub-Saharan Africa and examining the long-term impacts of climate finance on inclusive growth, thereby filling a crucial gap in the literature and providing insights that are particularly relevant to the region's unique challenges.

Sarpong and Nketiah-Amponsah (2022) examined the relationship between financial inclusion and inclusive growth in sub-Saharan Africa using panel data from 46 countries (2004-2018). They employed Random Effects (RE), Fixed Effects (FE), and the Arellano-Bover/Blundell-Bond system Generalised Method of Moments (GMM) for analysis. Their findings indicate a significant positive impact of financial services on inclusive growth, with additional factors such as quality infrastructure and human capital development, which also play crucial roles. However, their ad hoc weighting scheme for the inclusive growth index may introduce subjectivity, and the linear assumption of relationships may overlook the potential nonlinear



dynamics. This study addresses these methodological concerns by employing a more rigorous and transparent indicator selection process, allowing for a more nuanced understanding of the relationships involved and ensuring that the findings are both robust and reliable.

Green Finance and Foreign Aid and Sustainable Development

Ibrahim et al. (2016) proposed a novel framework for integrating climate finance and sustainable development in Malaysia. While this study emphasises a holistic approach to tackling climate change and sustainable development concurrently, it lacks original empirical data and focuses primarily on policy analysis. Despite focusing only on Malaysia, where the findings may not apply to other regions, such as sub-Saharan Africa, this study makes important contributions. The current research could enhance this framework through comparative analyses with other developing countries in the region. This study builds on Ibrahim et al. by applying their framework to sub-Saharan Africa and providing data that highlight the unique challenges and opportunities in this region. It tests the framework's applicability while enriching the discourse on climate finance and sustainable development in climate-vulnerable regions.

Van Niekerk (2024) examined the interrelationship between green finance and economic inclusion through a qualitative methodology. The study revealed significant synergy, demonstrating that green finance can facilitate economic inclusion and support the attainment of Sustainable Development Goals (SDGs). However, the lack of comprehensive statistical analyses and empirical data limits the ability to draw robust conclusions from these studies. This study also faced challenges in integrating environmental, social, and economic aspects, suggesting the need for more comprehensive data collection and standardised metrics in future studies. This study diverges from previous research by employing rigorous quantitative methods to substantiate qualitative findings, thereby providing a more robust analysis of the relationship between green finance and inclusively growing. It also proposes a framework for integrating environmental, social, and economic metrics that can serve as a model for future research in the field.

This empirical review highlights the multifaceted relationship between climate finance, inclusive growth, and related themes, such as financial inclusion, green finance, and foreign aid. Although the reviewed studies provide valuable insights and recommendations, significant gaps remain, particularly in terms of empirical data collection and analyses. This study aims to address these gaps by incorporating diverse methodologies, expanding the scope of enquiry to include a broader range of indicators, and focusing on context-specific challenges in sub-Saharan Africa. This enhances our understanding of how climate finance can effectively contribute to sustainable and inclusive growth in the region, ultimately providing a foundation for evidence-based policymaking that can lead to meaningful improvements in the lives of vulnerable populations. Through this comprehensive approach, this study not only fills existing research gaps but also lays the groundwork for future investigations into the complex interplay between climate finance and inclusive development in China.



METHODOLOGY

Data Description

The research encompasses data from 23 nations in sub-Saharan Africa: Botswana, Burkina Faso, Burundi, Cameroon, Chad, Republic of the Congo, Democratic Republic of the Congo, Côte d'Ivoire, Lesotho, Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, and Zambia. The selection of these nations ensured diverse representation across sub-Saharan Africa, which encompasses various stages of economic development, government structures and ecological challenges (Chukwudum, 2024). The selected nations show different levels of vulnerability to climate change, enabling research on how these susceptibilities affect climate finance efficacy (Amponsah et al., 2023). Countries such as Botswana and Mauritius show greater economic resilience than Chad and the Democratic Republic of the Congo, which face major governance and environmental challenges (Ziegler et al., 2020). This diversity enables the examination of how contextual factors influence climate finance and inclusive growth relationships, leading to nuanced policy recommendations (Amponsah et al., 2023).

This research spans 2000-2022, a period of significant economic and environmental changes in sub-Saharan Africa (Lutz, 2011). This era includes the Millennium Development Goals (MDGs) and the Paris Agreement, which have impacted climate finance allocation and sustainable development initiatives (Michael, 2024). The evolving nature of climate finance, marked by increased international funding and a sustainability focus, provides the context for this analysis (Michael, 2024). This period enables the assessment of the influence of these global agreements on national policies and climate finance effectiveness in promoting inclusive growth (Ibe & Amikuzuno, 2019). The data were sourced from the OECD.

Measurement of the Variables

Climate Finance

Climate finance was operationalised as the independent variable and measured using a metric to assess the amount of climate finance allocated per capita in each country, providing insights into the accessibility and distribution of funds among the population (Blekking et al., 2022). This includes both public and private financial contributions directed towards climate-related projects and initiatives, such as renewable energy, climate adaptation, and mitigation efforts (Michaelowa et al., 2020). The data were sourced from the OECD databases.

Inclusive Growth

This constitutes the dependent variable and examines employment, poverty, and income disparity, following Stawska and Jabłońska (2021), who delineated the determinants of inclusive growth, and the framework proposed by Seers (1970). This study uses the Gini coefficient to analyse income distribution. The Gini coefficient, which ranges from 0 (perfect equality) to 1 (extreme inequality), is a widely employed statistical tool that facilitates comparisons across time and regions (Davies, 2017). Such comparability is essential for assessing the impact of climate finance on inclusive growth in sub-Saharan Africa (Amponsah et al., 2021). Mitra and Das (2018) proposed an ad hoc weighting scheme to construct a composite index of inclusive growth; however, we rejected it because it was not robust. Such



schemes introduce subjectivity, as weights may reflect researchers' biases rather than objectively assessing the importance of dimensions (Ali & Son, 2007). This study-maintained objectivity by using established measures, such as the Gini coefficient (Amponsah et al., 2023). It focuses on employment, poverty, and income inequality, which are fundamental to inclusive growth, avoiding the complexities of additional variables with arbitrary weights (Aimon et al., 2020).

Control Variables

The investigation utilised three control variables: institutional quality, economic growth, and population increase. These variables are instrumental in providing a comprehensive framework for examining the impact of climate finance on inclusive growth (Gasimov et al., 2023) and are expected to validate the studies of Kumeka et al. (2023), Adeleye et al. (2023), Oyinlola et al. (2019), Ajide et al. (2021), Cui et al. (2022), Peretto (1998), and Kurniawan and Managi (2018).

1) **Institutional Quality:** The concept of institutional quality encompasses the efficacy and productivity of organisations that oversee economic and social activities (Munir et al., 2022). This incorporates the regulatory standards. This study uses regulatory quality to measure institutional quality, enabling an evaluation of selected countries (Nawaz et al., 2023).

2) **Economic Growth:** Economic growth refers to a nation's expanding production of goods and services, measured by the rate of increase in Gross Domestic Product (GDP) (Charles & Francis, 2019). The annual percentage change in real GDP is the primary indicator of economic growth (Narayan & Popp, 2011). World Bank data were collected to evaluate economic performance over various temporal periods.

3) **Population Growth:** Population growth, defined as the annual percentage increase in the total population, is a demographic phenomenon with substantial implications for economic resources, labour markets, and social services (Brueckner & Schwandt, 2014). Data from the United Nations Population Division were used to ensure consistent measurement of demographic trends. These data were used to calculate the annual percentage increase in the aggregate population.

Empirical Strategy

The primary objective of this study was to examine the impact of climate finance on inclusive growth in sub-Saharan Africa (SSA). This study employs the Augmented Mean Group (AMG) estimator developed by Eberhardt and Teal (2010, 2011), which effectively addresses short- and long-term fluctuations in panel data (Onifade et al., 2021). The AMG estimator's ability to account for inter-country variations makes it suitable for sub-Saharan Africa, where economic and institutional contexts show significant diversity (Brandt et al., 2011). By incorporating error correction components, the model addresses temporary deviations from the long-term equilibrium (Brandt et al., 2011). Unlike the Generalised Method of Moments (GMM), Fixed Effects (FE), and Random Effects (RE) models, the AMG estimator eliminates the need for robust instruments (Ullah et al., 2018). The selection of the AMG is justified by its capacity to address heterogeneity in diverse regions such as sub-Saharan Africa (Bank et al., 2015; Brandt et al., 2011). A primary limitation of this approach is its reliance on high-quality longitudinal data for each cross-section (Hall, 2015). Many sub-Saharan African nations face challenges in



providing reliable data, which could introduce biases that affect the validity of the results (Onifade et al., 2021).

Estimation Process

The Augmented Mean Group (AMG) approach commences with the calculation of individual country regressions, followed by averaging the coefficients (Maclachlan et al., 2006). This methodology allows for coefficient variation across nations while capturing shared panel dynamics (Bank et al., 2015).

The AMG incorporates error correction components to address short-term deviations from long-term equilibrium, rendering it suitable for examining the immediate and enduring effects of climate finance on inclusive growth (Brandt et al., 2011).

Model Specification

The AMG approach involves estimating the following model:

$$Y_{it} = \alpha_i + \beta_i X_{it} + C_i(Y_{t-1} - \theta_i Y_{it-1}) + \varepsilon_{it} \dots \dots \dots 1$$

Where:

Y_{it} is the dependent variable (inclusive growth) for country i at time t .

X_{it} represents the vector of independent variables (climate finance and other factors)

α_i It captures the country-specific effects.

C_i where represents the error-correction coefficient.

θ_i represents long-run coefficients.

ε_{it} is the error term

Incorporating the variables into model one:

$$InclG_{it} = \alpha_0 + \beta_1 CFinance_{it} + \beta_2 InstQ_{it} + \beta_3 EcoG_{it} + \beta_4 PopG_{it} + C_i(Y_{t-1} - \theta_i Y_{it-1}) + \varepsilon_{it} \dots \dots \dots 2$$

Where:

$InclG_{it}$ represents the inclusive growth

$CFinance_{it}$ represents the climate finance for country i at time t

$InstQ_{it}$, $EcoG_{it}$ and $PopG_{it}$ represents institutional quality, economic growth, and population growth for country i at time t .



RESULTS AND DISCUSSIONS

Descriptive Statistics

Table 1 presents the descriptive statistics of the variables employed in the analysis for the period 2000–2022, covering 23 sub-Saharan African countries and yielding a balanced panel of 529 observations with no missing values for any of the variables. The statistics provide initial insights into the distributional properties, variability, and overall trends of climate finance and inclusive growth indicators in this region.

Climate finance, measured in millions of US dollars, has a mean value of 2.09 and a large standard deviation of 8.69. This wide dispersion, together with a maximum value of 171.20, indicates substantial heterogeneity in climate finance inflow across countries. While some countries receive sizable climate-related financial support, others experience very limited inflows, reflecting differences in absorptive capacity, project readiness, and institutional frameworks. A minimum value of zero suggests that climate finance was not consistently or evenly distributed throughout the study period.

The logarithmic transformation of climate finance shows a mean of 0.372 and a standard deviation of 0.788, indicating a more compressed distribution after the scaling. This transformation helps mitigate the influence of extreme values and is more appropriate for econometric estimation, particularly in a heterogeneous panel context such as sub-Saharan Africa. The presence of zero minimum values, even after transformation, underscores the intermittent nature of climate finance access in the region.

Regulatory quality, used as a proxy for institutional quality, has a negative mean value of -0.579 , which is consistent with the institutional challenges that many sub-Saharan African countries face. The range of values from -1.668 to 1.197 highlights the considerable cross-country variation in governance performance. This variation provides a suitable basis for examining how institutional conditions mediate the effectiveness of climate finance in promoting inclusive growth in developing countries.

Economic growth, measured as annual GDP growth, records an average of 4.45 percent, suggesting moderate growth performance over the study period. However, the large standard deviation of 3.88 and the wide range from -20.49 to 33.63 percent reflect pronounced macroeconomic volatility. Such volatility is characteristic of developing economies that are highly exposed to external shocks, fluctuations in commodity prices, and climate-related disturbances.

Population growth averages 2.64 percent annually, with relatively low dispersion. This reflects the persistently high population growth rates in sub-Saharan Africa, which have important implications for employment creation, poverty reduction, and overall inclusiveness of economic growth. Rapid population growth can place pressure on social services and labour markets, potentially diluting the gains from climate finance if not accompanied by adequate institutional and economic capacity.

Income inequality, measured using the Gini coefficient, has a mean value of 42.07, indicating relatively high inequality in the sampled countries. The variation between a minimum of 31.5 and a maximum of 61.7 suggests that inequality remains a significant structural challenge in



the region, reinforcing the relevance of examining whether climate finance contributes to more inclusive development.

The lagged log of climate finance shows a mean of 0.383, which is closely aligned with the contemporaneous measures. This supports the use of lagged climate finance in the robustness analysis to capture delayed effects and reduce concerns about simultaneity or reverse causality.

The median institutional quality value of -0.635 confirms a weak governance environment in the sample. Based on this median, a high institutional quality dummy variable was constructed, with a mean of 0.501, indicating an almost even split between countries above and below the median. This distribution is suitable for heterogeneity analysis, allowing the study to assess whether the impact of climate finance differs across the institutional regimes.

Table 1: Descriptive Statistics of Study Variables (2000–2022)

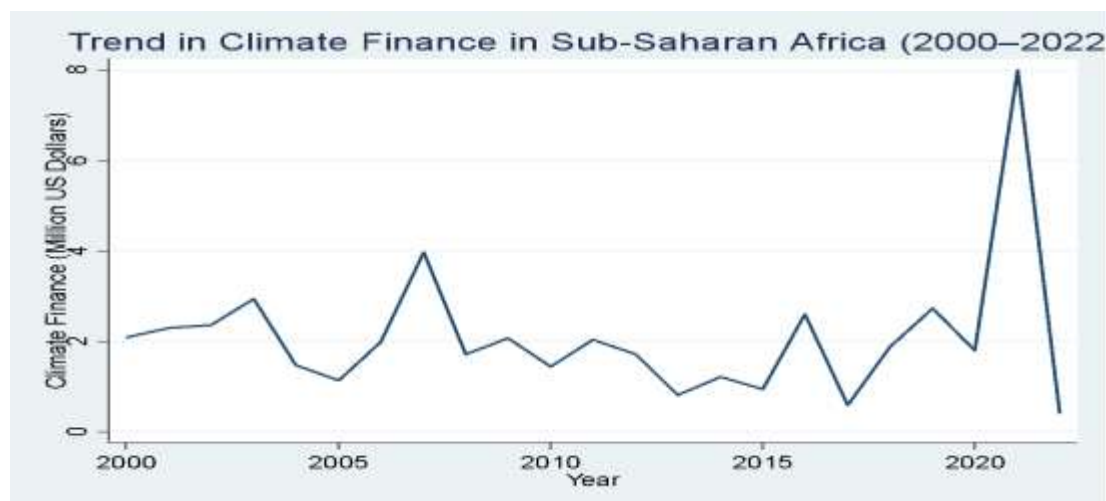
Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Climate Finance (Million US Dollars)	529	2.090	8.688	0.000	171.200
Log of Climate Finance (Million US Dollars)	529	0.372	0.788	0.000	5.149
Regulatory Quality (Institutional Quality Index)	529	-0.579	0.535	-1.668	1.197
Economic Growth Rate (Annual % GDP Growth)	529	4.449	3.883	-20.491	33.629
Population Growth Rate (Annual %)	529	2.639	0.836	-0.920	5.066
Income Inequality (Gini Coefficient)	529	42.073	5.880	31.500	61.715
Lagged Log of Climate Finance (t-1)	506	0.383	0.799	0.000	5.149
Median Institutional Quality	529	-0.635	0.000	-0.635	-0.635
High Institutional Quality Dummy	529	0.501	0.500	0	1

Source: *Researcher' construct based on data from the WDI*

The descriptive statistics reveal substantial heterogeneity in climate finance inflows, institutional quality, and growth indicators across sub-Saharan Africa. These patterns justify the use of estimators that account for cross-country heterogeneity and cross-sectional dependence and provide an important backdrop for interpreting the econometric results presented in the subsequent sections.



Figure 2: illustrates the evolution of climate finance inflows to sub-Saharan Africa over the study period, highlighting a gradual increase following major global climate agreements



Source: CFU (2021)

Table 2 presents the panel structure and variance decomposition of the key variables based on xtsum results. Decomposing variability into between-country and within-country components provides important insights into the nature of the data and the appropriateness of the chosen econometric approach.

Income inequality, measured by the Gini coefficient, exhibited substantial variability with a standard deviation of 5.88. Most of this variation is driven by differences across countries rather than changes within countries over time, as reflected in the relatively high between-country standard deviation of 5.84 compared to the within-country standard deviation of 1.39. This suggests that inequality in sub-Saharan Africa is largely structural and country-specific, shaped by long-standing institutional, economic, and social factors that influence the region. This pattern underscores the importance of accounting for cross-country heterogeneity in the empirical analyses.

Logged climate finance displays a different pattern. Although its overall standard deviation is 0.79, the within-country variation (0.73) is considerably larger than the between-country variation (0.30). This indicates that climate finance flows vary more over time within countries than across countries, reflecting fluctuations in annual funding commitments, project cycles, and shifts in international climate finance priorities. This dynamic behaviour supports the inclusion of time-varying climate finance measures and reinforces the relevance of a long-run estimator capable of capturing both short and long-term effects.

Institutional quality shows relatively limited within-country variation, with a within-standard deviation of 0.14, compared to a between standard deviation of 0.53. This pattern suggests that institutional conditions tend to evolve slowly within countries but differ markedly across them. Such persistence is consistent with the theoretical view that institutions are deeply embedded and change gradually over time. It also highlights the importance of exploring the heterogeneity



in climate finance effects across institutional regimes, as institutional differences are more cross-sectional than temporal.

Table 2. Panel Structure and Variance Decomposition (xtsum)

Variable	Overall SD	Between SD	Within SD
Gini	5.880	5.836	1.394
Log Climate Finance	0.788	0.303	0.730
Institutional Quality	0.535	0.527	0.143
GDP Growth	3.883	1.397	3.634
Population Growth	0.836	0.798	0.298

Source: *Researcher' construct based on data from the WDI*

GDP growth is characterised by high within-country variability, with a within standard deviation of 3.63 that exceeds the between-country variation of 1.40. This reflects the cyclical and volatile nature of economic growth in sub-Saharan Africa, where countries experience frequent macroeconomic shocks, fluctuations in commodity prices, and climate-related disruptions. In contrast, population growth exhibited greater between-country variation (0.80) than within-country variation (0.30), indicating relatively stable demographic trends over time, but notable differences across countries.

Cross-Sectional Dependence

Table 3 reports the results of Pesaran's cross-sectional dependence (CD) test. The CD statistic of -1.559 , with a p-value of 0.119, indicates that the null hypothesis of cross-sectional independence cannot be rejected at the conventional significance levels. The average absolute correlation of 0.177 suggests a moderate degree of correlation between countries.

Table 3: Cross-Sectional Dependence Test

Statistic	Value
CD statistic	-1.559
p-value	0.119
Average absolute correlation	0.177

Source: *Researcher' construct based on data from the WDI*

Although the test does not provide strong evidence of pervasive cross-sectional dependence, the presence of non-negligible average correlations points to the possibility of common shocks or regional spillovers affecting countries. In sub-Saharan Africa, such common influences may arise from global climate agreements, international financial flows, commodity price movements, and shared exposure to climate risks. To address this possibility and ensure robustness, this study employs estimators that explicitly account for unobserved common factors, such as the Mean Group framework with trends and the Common Correlated Effects Mean Group estimator. This approach strengthens the reliability of the estimated relationship between climate finance and inclusive growth.



Panel Unit Root Tests

Table 4 presents the results of the second-generation panel unit root tests based on the Cross-sectionally Augmented IPS (CIPS) methodology. This test accounts for potential cross-sectional dependence and is therefore well-suited for panels characterised by common shocks and heterogeneous dynamics.

The results indicate that income inequality, log climate finance, institutional quality, and GDP growth are all stationary, implying an integration of order zero, $I(0)$. The CIPS statistics for these variables are statistically significant at conventional levels, suggesting that their stochastic properties do not exhibit unit root behaviour. However, population growth is found to be non-stationary in levels and stationary after differencing, indicating integration of order one, $I(1)$.

Table 4 Second-Generation Unit Root Tests (CIPS)

Variable	CIPS Statistic	Stationarity
Gini	-4.536***	$I(0)$
Log Climate Finance	-2.642**	$I(0)$
Institutional Quality	-2.194*	$I(0)$
GDP Growth	-3.440***	$I(0)$
Population Growth	-1.339	$I(1)$

Source: *Researcher' construct based on data from the WD*

The presence of a mixture of $I(0)$ and $I(1)$ variables has important implications for the model selection. Specifically, it supports the use of flexible panel estimators that do not require all variables to be integrated in the same sequence. The Mean Group and Common Correlated Effects Mean Group estimators employed in this study are well-suited to such settings, as they can accommodate mixed integration orders without imposing restrictive homogeneity assumptions or requiring formal panel cointegration tests.

Climate Finance and Inclusive Growth: Baseline Results

Table 5 presents the baseline Mean Group estimates examining the relationship between climate finance and three dimensions of inclusive growth in sub-Saharan Africa: income inequality, poverty, and employment. The coefficient on log climate finance is positive in the inequality model and negative in the poverty and employment models; however, these coefficients are statistically insignificant across all three models. This suggests that, on average, climate finance inflows do not exert a strong direct effect on inclusive growth outcomes in the region when they are evaluated separately. While the signs are broadly consistent with theoretical expectations, indicating a potential poverty-reducing and employment-enhancing role, the lack of statistical significance implies that climate finance alone may be insufficient to generate measurable inclusive growth benefits without supportive structural and institutional conditions for climate finance.

Regulatory quality does not have a statistically significant effect on the three inclusive growth dimensions in the baseline models. This result indicates that improvements in institutional quality, while theoretically important, do not automatically translate into short- to medium-



term reductions in inequality or poverty or into higher employment levels, particularly in contexts characterised by structural rigidities and limited absorptive capacity.

Economic growth also shows no significant association with inclusive growth indicators. This finding reinforces the distinction between aggregate and inclusive growth, suggesting that economic expansion in sub-Saharan Africa does not necessarily lead to equitable distributional outcomes or broad-based employment gains.

Table 5: Climate Finance and Inclusive Growth in Sub-Saharan Africa

	(1) Inclusive (Inequality)	(2) Growth Inclusive (Poverty)	(3) Growth Inclusive (Employment)
Log of Climate Finance (million USD)	0.0527 (0.123)	-0.0422 (0.0290)	-0.161 (0.187)
Regulatory Quality (Institutional Quality Index)	0.435 (0.783)	-0.492 (0.781)	3.045 (2.797)
Economic Growth Rate (Annual % GDP Growth)	0.0102 (0.0301)	0.0146 (0.0201)	-0.0200 (0.0554)
Population Growth Rate (Annual %)	0.594* (0.321)	-0.645* (0.370)	-0.973 (1.372)
Common Dynamic Trend	-0.000661 (0.0119)	-0.0152** (0.00706)	-0.0444* (0.0266)
Constant	41.56*** (1.900)	48.30*** (3.031)	64.54*** (6.842)
Observations	529	529	529

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *Researcher' construct based on data from the WDI*

Population growth was the most consistently influential variable in the baseline analyses. It is positively associated with income inequality and negatively associated with poverty, both at the 10 percent significance level. These results reflect the demographic pressures faced by the region. Rapid population growth may widen inequality by intensifying competition for limited



resources and employment opportunities while simultaneously exerting downward pressure on measured poverty through demographic dynamics and labour supply effects. The common dynamic trend is statistically significant in the poverty and employment models, indicating the presence of shared time-varying factors, such as global economic cycles, climate shocks, and international policy shifts, which systematically influence inclusive growth outcomes across countries.

Robustness to Cross-Sectional Dependence: CCE–MG Results

Table 6 compares the baseline Mean Group estimates with results obtained using the Common Correlated Effects Mean Group (CCE–MG) estimator, which explicitly controls for unobserved common factors and cross-sectional dependence.

Across all three inclusive growth dimensions, the estimated coefficients of climate finance are statistically insignificant under the CCE–MG specification. Importantly, the signs and magnitudes of the coefficients are broadly consistent with the baseline results, indicating that the findings are not driven by unaccounted cross-sectional dependence or omitted common shocks.

Similarly, regulatory quality, economic growth, and population growth do not show robust or statistically significant effects in the CCE–MG framework. This consistency across estimators strengthens the credibility of the baseline findings and suggests that the limited direct impact of climate finance on inclusive growth reflects underlying structural realities rather than econometric mis-specifications or omitted variables.

The inclusion of cross-sectional averages and group-specific trends further confirms that inclusive growth outcomes in sub-Saharan Africa are influenced by common regional and global dynamics, reinforcing the need for estimators that allow for heterogeneous responses and unobserved common factors in the model's specification.

Table 6: Baseline vs CCE–MG

	(1) Inclusive Growth (Inequality)	(2) Inclusive Growth (Inequality)	(3) Inclusive Growth (Poverty)	(4) Inclusive Growth (Poverty)	(5) Inclusive Growth (Employment)	(6) Inclusive Growth (Employment)
Log of Climate Finance (Million US Dollars)	0.0527 (0.123)	-0.00623 (0.100)	-0.0422 (0.0290)	-0.0542 (0.0560)	-0.161 (0.187)	-0.225 (0.250)
Regulatory Quality (Institutional Quality Index)	0.435 (0.783)	-0.407 (1.152)	-0.492 (0.781)	-0.343 (0.676)	3.045 (2.797)	-3.476 (3.738)



Economic Growth Rate (Annual % GDP Growth)	0.0102 (0.0301)	0.0299 (0.0422)	0.0146 (0.0201)	-0.0272 (0.0272)	-0.0200 (0.0554)	-0.0563 (0.0681)
Population Growth Rate (Annual %)	0.594* (0.321)	0.462 (0.614)	-0.645* (0.370)	0.195 (0.592)	-0.973 (1.372)	1.692 (2.986)
Group-Specific Linear Time Trend	-0.000661 (0.0119)		-0.0152** (0.00706)		-0.0444* (0.0266)	
Constant	41.56*** (1.900)	17.44 (19.75)	48.30*** (3.031)	2.700 (19.24)	64.54*** (6.842)	34.35 (21.12)
Observations	529	529	529	529	529	529

Source: *Researcher' construct based on data from the WDI* Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Endogeneity Sensitivity: Lagged Climate Finance

Table 7 reports the results of specifications that incorporate lagged climate finance to address potential simultaneity and reverse-causality concerns.

The lagged climate finance variable remains statistically insignificant in the inequality, poverty, and employment models. This indicates that the absence of a strong inclusive growth effect is not due to the delayed transmission mechanisms. In other words, even when time is allowed for climate finance projects to materialise, their aggregate impact on inclusive growth is limited.

Population growth continues to have statistically significant effects on inequality and poverty, reinforcing its central role in shaping inclusive growth dynamics in this region. The stability of these results across contemporaneous and lagged specifications suggests that demographic pressures are a more immediate and persistent driver of inclusive growth than climate change finance.

Table 7: Baseline vs Lagged Climate Finance

	(1) Inclusive Growth (Inequality)	(2) Inclusive Growth (Inequality)	(3) Inclusive Growth (Poverty)	(4) Inclusive Growth (Poverty)	(5) Inclusive Growth (Employment)	(6) Inclusive Growth (Employment)
ln_climate_finance_musdl	0.0527 (0.123)		-0.0422 (0.0290)		-0.161 (0.187)	
reg_quality_est	0.435 (0.783)	0.159 (0.564)	-0.492 (0.781)	-0.504 (0.993)	3.045 (2.797)	2.476 (2.796)



gdp_growth_pct	0.0102 (0.0301)	-0.00903 (0.0321)	0.0146 (0.0201)	0.0280 (0.0209)	-0.0200 (0.0554)	-0.0548 (0.0657)
pop_growth_pct	0.594* (0.321)	1.019* (0.562)	-0.645* (0.370)	-0.623* (0.373)	-0.973 (1.372)	-1.155 (1.656)
__000007_t	-0.000661 (0.0119)	-0.0122 (0.0128)	-0.0152** (0.00706)	-0.0121 (0.00841)	-0.0444* (0.0266)	-0.0233 (0.0299)
L1_lclimfin		-0.0236 (0.0463)		0.00421 (0.0326)		0.0953 (0.456)
Constant	41.56*** (1.900)	40.05*** (2.153)	48.30*** (3.031)	47.22*** (3.053)	64.54*** (6.842)	63.51*** (6.758)
Observations	529	506	529	506	529	506

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: *Researcher' construct based on data from the WDI*

Institutional Heterogeneity in Climate Finance Effects

Table 8 explores whether the impact of climate finance varies across institutional regimes by estimating separate models for countries with above- and below-median institutional quality.

The results revealed notable heterogeneity. In countries with high institutional quality, regulatory quality is positively and weakly significantly associated with income inequality, suggesting that institutional improvements may initially benefit certain segments of the population more than others, potentially widening distributional gaps in the short run. In contrast, institutional quality does not significantly affect countries with low institutional quality, highlighting the governance constraints that limit the effectiveness of institutional reforms.

Climate finance remains statistically insignificant across both institutional regimes and all-inclusive growth dimensions. This finding suggests that even in relatively strong institutional environments, climate finance does not automatically translate into measurable and inclusive growth gains. Instead, its effectiveness may depend on complementary policies, sectoral targeting, and implementation capacity, beyond aggregate institutional quality.

Population growth has a negative and statistically significant effect on employment in high-institutional-quality countries, indicating that even better-governed economies may struggle to absorb rapidly expanding labour forces. The common dynamic trend remains significant in several specifications, underscoring the importance of shared external influences in shaping inclusive growth trajectories.

**Table 8: Institutional Heterogeneity**

	(1) Inclusive Growth (Inequality)	(2) Inclusive Growth (Inequality)	(3) Inclusive Growth (Poverty)	(4) Inclusive Growth (Poverty)	(5) Inclusive Growth (Employment)	(6) Inclusive Growth (Employment)
ln_climate_finance_musd 1	-0.0202 (0.176)	-0.170 (0.295)	0.00272 (0.0399)	0.0172 (0.112)	0.466 (0.355)	-0.0769 (0.474)
reg_quality_est	-0.132 (1.563)	2.539* (1.355)	-0.491 (1.141)	-1.117 (0.904)	8.134 (6.172)	3.361 (4.959)
gdp_growth_pct	-0.000725 (0.0577)	-0.0121 (0.0222)	-0.00379 (0.0382)	0.0387 (0.0332)	-0.112 (0.169)	0.00534 (0.101)
pop_growth_pct	0.580 (0.961)	-0.424 (1.151)	-0.348 (0.636)	-0.543 (0.524)	-2.497* (1.416)	1.287 (3.049)
__000007_t	0.0265 (0.0267)	-0.00607 (0.0230)	-0.0234* (0.0135)	-0.0150 (0.0141)	-0.142** (0.0710)	-0.0164 (0.0479)
Constant	41.75*** (3.780)	43.23*** (2.608)	41.72*** (5.445)	52.10*** (2.664)	74.36*** (9.570)	47.66*** (9.920)
Observations	258	251	258	251	258	251

Source: *Researcher' construct based on data from the WDI*

Synthesis of findings

Taken together, these results indicate that climate finance, while theoretically positioned as a catalyst for inclusive development, does not exert a strong direct effect on income inequality, poverty reduction, or employment generation in sub-Saharan Africa at the aggregate level. The findings suggest that climate finance alone is insufficient to drive inclusive growth outcomes and that its effectiveness is constrained by structural, demographic and institutional factors. These results align with institutional and development economics theories, which emphasise that financial resources must be complemented by strong governance, targeted policy frameworks, and absorptive capacity to generate inclusive and sustainable results. This evidence highlights the need for climate finance strategies explicitly designed to address distributional objectives, rather than relying on indirect growth channels.



DISCUSSION OF RESULTS

This study investigates the relationship between climate finance and inclusive growth in sub-Saharan Africa using a multidimensional framework that captures income inequality, poverty, and employment (IPE) in three steps. By applying second-generation panel estimators that account for cross-sectional dependence, unobserved heterogeneity, and common shocks, this study extends earlier empirical work that relied on first-generation panel techniques. The discussion interprets the findings in light of both the theoretical frameworks and the empirical evidence reviewed earlier.

The baseline AMG results indicate that climate finance has a positive but statistically insignificant association with income inequality. This suggests that increased climate finance inflows did not translate into measurable reductions in inequality in sub-Saharan Africa during the study period. Empirically, this finding contrasts with the optimistic expectations embedded in parts of the green finance literature, which often assumes that climate-related investments will generate broad-based social benefits. Instead, the results align more closely with the concerns raised by Desalegn and Tangl (2022), who documented a persistent green finance gap driven by weak project targeting, limited inclusiveness, and governance constraints.

The insignificant inequality effect is also consistent with Mamman et al. (2023), who found that climate-related shocks tend to exacerbate inequality in Africa, with mitigation effects from policy interventions being either weak or unevenly distributed in their effective. While Mamman et al. (2023) focus on climate change rather than climate finance per se, both studies point to a similar conclusion: climate-related dynamics do not automatically improve distributional outcomes. This study extends this insight by showing that climate finance inflows may fail to reduce inequality when they are not explicitly poor.

When the CCE–MG estimator is employed, the climate finance coefficient becomes smaller and remains insignificant, reinforcing the findings from recent empirical work that stresses the importance of accounting for cross-sectional dependence. This result supports the arguments of Singer et al. (2017) and Sarpong and Nketiah-Amponsah (2022) that conventional panel models may overstate financial impacts if common shocks and spillovers are ignored. In this sense, this study contributes methodologically by demonstrating that earlier positive associations reported in the literature may reflect unobserved regional trends rather than country-specific climate finance effects.

The poverty results similarly show a negative, but statistically insignificant, relationship between climate finance and poverty. This suggests that climate finance has, at best, a weak poverty-reducing effect in sub-Saharan Africa. Empirically, this finding resonates with Bowen et al. (2011), who argue that growth- and climate-related interventions do not necessarily translate into poverty reduction unless they directly enhance the livelihoods and productive capacity of the poor.

The significance of the common dynamic trend in the poverty model provides important empirical insights. This indicates that poverty reduction during the study period was driven more by shared regional or global dynamics than by climate finance. This finding aligns with Mamman et al. (2023), who emphasise the role of common climate and macroeconomic shocks in shaping poverty outcomes in Africa. This also complements the observations of Asongu and



Moor (2015), who argue that financial interventions are most effective when embedded in broader development and inclusion strategies.

Under the CCE–MG framework, the persistence of poverty across countries becomes more evident through the significance of cross-sectional average terms. This supports the conceptual framework adopted in this study, which emphasises between-country effects and structural persistence. Empirically, this result suggests that climate finance operates within deeply entrenched poverty dynamics, echoing Van Niekerk’s (2024) findings, which highlight that green finance alone cannot overcome structural inequalities without institutional and policy alignment.

The results indicate that climate finance has no statistically significant effect on inclusive employment. This finding is consistent with empirical studies that question the labour absorption capacity of green and climate-related investments in developing regions. For instance, Desalegn and Tangl (2022) note that many green finance projects are capital-intensive and weakly linked to local labour markets, particularly in low-income countries.

The absence of significant employment effects also contrasts with policy narratives that frame climate finance as a major source of green-job creation. Empirically, this aligns with the observations of Singer et al. (2017), who cautioned that financial inflows do not automatically translate into employment gains unless supported by skills development and institutional capacity. This study adds to the literature by providing panel-based evidence that climate finance, as currently structured in sub-Saharan Africa, has limited employment effects.

The institutional heterogeneity analysis offers further empirical insights. Countries with stronger institutional quality appear to be better positioned to translate climate finance into employment outcomes, although the effects are weak in magnitude. This finding mirrors the conclusions of Sarpong and Nketiah-Amponsah (2022), who showed that institutional and infrastructural quality conditions the inclusiveness of financial interventions. This is also echoed in case-based evidence, such as Niyonzima and Ndamsa (2023), who documented more effective climate finance utilisation in governance-reformed contexts such as Rwanda.

Population growth is one of the most consistent drivers of inequality and poverty across all models. This result aligns closely with Mamman et al. (2023), who found that population pressure amplifies the adverse effects of climate-related shocks on inclusive growth indicators. It also supports broader development economics evidence that rapid demographic expansion can offset the gains from financial inflows by stretching public services and diluting capital accumulation.

Economic growth shows weak and statistically insignificant effects on inclusive growth indicators, reinforcing the argument that growth alone is insufficient for inclusivity. This finding is consistent with Bowen et al. (2011) and Sarpong and Nketiah-Amponsah (2022), who highlighted the limited trickle-down effects of growth in the absence of structural transformation and social investments. Institutional quality exhibits mixed effects and becomes more relevant when heterogeneity is explicitly modelled. This empirical pattern aligns with the institutional arguments advanced by Bird and Fafchamps (2004) and Hilson and Maconachie (2008), who stressed that governance quality shapes the effectiveness of development finance. The results suggest that institutional quality acts as a conditioning variable rather than a direct driver, which is consistent with both Institutional Theory and recent empirical evidence.



The inclusion of lagged climate finance does not significantly affect inequality, or poverty or employment. Empirically, this challenges the assumption in parts of the green finance literature that climate investment generates delayed, but substantial, inclusive benefits. Instead, the findings support the sceptical view advanced by Desalegn and Tangl (2022) and Van Niekerk (2024), who argue that without a deliberate pro-poor design, climate finance may fail to produce inclusive outcomes, even in the long term. The persistence captured by group-specific trends and cross-sectional averages underscores the strong path dependence of inclusive growth outcomes. This finding aligns with evidence from development economics that poverty and inequality are shaped by historical and structural factors that evolve over time.

CONCLUSION

This study examines the relationship between climate finance and inclusive growth in sub-Saharan Africa over the period 2000–2022, focusing on three core dimensions of inclusiveness: income inequality, poverty, and employment. Using second-generation panel estimators that explicitly account for cross-sectional dependence, unobserved heterogeneity, and common regional shocks, this study provides robust evidence of how climate finance interacts with institutional and structural factors in Africa's economy. The findings indicate that climate finance, in its current form, has not produced statistically significant improvements in income inequality, poverty reduction, or employment generation across regions. While the estimated coefficients generally point in the expected direction, their lack of robustness suggests that climate finance inflows alone are insufficient to alter entrenched inclusive growth outcomes. These results underscore the importance of moving beyond aggregate financial volumes to examine how climate finance is designed, allocated, and implemented in the real world.

The analysis further reveals the strong persistence and interdependence of inclusive growth outcomes across countries. Poverty and inequality dynamics are heavily influenced by common regional trends and demographic pressures, as reflected in the significance of common dynamic trends and the growth of the population. This highlights the structural nature of inclusive growth challenges in sub-Saharan Africa and reinforces the argument that climate finance operates within, rather than independently of broader socioeconomic and institutional contexts. Institutional quality emerges as a key conditioning factor rather than a direct driver of inclusive growth. While its direct effects are weak on average, the heterogeneity analysis suggests that stronger governance environments are better positioned to translate climate finance into inclusive outcomes than weaker ones. This finding aligns with institutional and development economics theories that emphasise absorptive capacity, accountability, and policy coherence as prerequisites for effective development finance.



RECOMMENDATIONS

Based on the empirical findings and theoretical insights of this study, several policy recommendations are proposed in the following section:

First, climate finance in sub-Saharan Africa should be explicitly aligned with inclusive growth objectives. Climate-related investments must be designed with clear distributional targets to ensure that projects directly benefit vulnerable populations through employment, livelihood support, and access to essential services. Without such targeting, climate finance is unlikely to meaningfully reduce poverty or inequality.

Second, strengthening institutional quality should be treated as a complementary priority for climate finance mobilisation. Improvements in regulatory quality, transparency, and accountability are essential to enhance the absorptive capacity of recipient countries and minimise the misallocation or elite capture of climate funds. Therefore, development partners should integrate governance reforms and capacity-building components into climate finance programmes.

Third, climate finance strategies should prioritise labour-intensive, locally embedded projects. Investments in climate-smart agriculture, decentralised renewable energy, and climate-resilient infrastructure have greater potential to generate employment and support inclusive growth when linked to local value chains and skills development initiatives. This requires closer coordination between climate, labour market, and education policies.

Fourth, population dynamics should be explicitly incorporated into climate finance. Rapid population growth continues to exert pressure on inclusive growth, diluting the potential benefits of financial inflows. Therefore, climate finance interventions should be complemented by investments in human capital, health, and demographic transition policies to enhance the long-term inclusivity of the poor.

Fifth, policymakers and researchers should adopt analytical frameworks that account for cross-country spillovers and common shocks. The findings demonstrate that inclusive growth outcomes in sub-Saharan Africa are highly interdependent, suggesting that regional coordination and shared policy learning can enhance climate finance initiatives' effectiveness.

Finally, future research should extend this analysis by disaggregating climate finance by type and sector, exploring non-linear and threshold effects, and examining micro-level transmission channels. Such work would deepen our understanding of how climate finance can be structured to support inclusive and sustainable developments.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this work, the author(s) used *elicit.ai* in order to reason. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.

Acknowledgement

The authors greatly appreciate every support received



Statement of Contributions of Joint Authorship

Shamwil Abdul-Karim

Writing and compiling of manuscript, establishing methodology, data collection and analysis, and presentation of tables and figures.

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Assisted with manuscript compilation, editing and co-authorship of manuscript

Funding Declaration: No Funding.

Clinical trial number: Not Applicable

Declaration of Competing Interests

The authors declare no conflict of interest. No financial support or personal relationships influenced the design, execution, analysis, or interpretation of this study.

Data Availability Statement

The data used in this study are available upon request.

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