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The impact of Climate Change and Development Finance on Economic growth of Sub Saharan Africa Countries

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Abstract
Sub-Saharan Africa's (SSA) economic growth has garnered global interest due to its growth potential, abundant resources, and youthful population. However, challenges like climate change and limited developmental finance hinder progress. The region is particularly vulnerable to climate change, as its economy heavily relies on rain-fed agriculture, making it susceptible to temperature shifts, changing precipitation patterns, and extreme weather events such as droughts and floods. The study employed the Generalized Method of Moments (GMM) to investigate the effects of developmental finance and climate change on economic growth. The analysis focused on ten African countries from 1999 to 2022. Developmental finance was evaluated through foreign direct investment (FDI) and net official development assistance (ODA), while climate change was represented by mean annual temperature and rainfall. Economic growth was measured using the annual gross domestic product (GDP) growth rate. The findings revealed that foreign direct investment and mean annual rainfall significantly enhance economic growth. Conversely, net official development assistance and mean annual temperature negatively affected economic growth. The study recommends that political and economic stability are crucial for attracting FDI. Furthermore, it recommends implementing policies that promote transparency, reduce corruption, and safeguard investors' rights to increase FDI inflows. Considering rainfall as a vital resource, investments in water conservation, rainwater harvesting, and watershed management are essential to mitigate the impacts of low rainfall and flooding.

Keywords: *climate change, developmental finance, FDI, ODA, Sub-Saharan Africa's*

1. Introduction

Africa faces a distinctive and intricate array of challenges, particularly climate change, economic growth, and the necessity for sustainable growth. As one of the regions most susceptible to the repercussions of climate change, African nations are already experiencing severe weather events, extended periods of drought, and fluctuations in agricultural productivity. These factors collectively jeopardise food security, water accessibility, and public health. Moreover, many African economies rely heavily on agriculture and natural resources, rendering them particularly vulnerable to climatic variability (Kotir, 2011; Talib et al., 2021).

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Rainfall and temperature are vital indicators of climate change that significantly impact economies across Africa. Many countries on the continent receive a substantial portion of their annual rainfall within just a few months, rendering agricultural production heavily reliant on these seasonal rains. Variability in rainfall can result in drought, adversely affecting crop yields, water availability, and food security. Conversely, excessive rainfall can lead to flooding, damage infrastructure, and displace communities. In both scenarios, economic productivity is jeopardised, particularly in agriculture, which remains a crucial source of employment and GDP for numerous African nations (Talib et al., 2021).

In addition to rainfall variability, rising temperatures significantly threaten economic growth. Heat stress caused by increasing temperatures adversely impacts labour productivity, particularly in agriculture and other outdoor occupations. Water scarcity becomes more pronounced as temperatures rise, intensifying competition for limited resources and driving up costs for essential water-related services. Additionally, higher temperatures can lead to a rise in diseases such as malaria, further compromising human health and economic productivity. The Intergovernmental Panel on Climate Change (IPCC) has warned that projected temperature increases in Africa could worsen poverty and diminish overall economic output if adaptive measures are not undertaken (Aigbedo & Aigbovo, 2023).

Development finance is pivotal in tackling these challenges, supplying vital funding for initiatives that foster economic growth, resilience, and poverty reduction. Sources of development finance encompass international organisations, government assistance, foreign direct investment, and an increasing focus on climate finance—funds specifically aimed at helping countries adapt to and mitigate the effects of climate change. While these resources are essential for strengthening infrastructure, enhancing resilience, and stimulating innovation, they also possess the potential to catalyse broader economic growth when implemented effectively (Asongu, 2014; Ayenew, 2022). In recent decades, African economies have witnessed substantial external capital inflows, primarily through foreign direct investment (FDI) and official development assistance (ODA), both of which fall under the umbrella of development finance. As a vital element of development finance, FDI is highly regarded for its contributions to technology transfer, job creation, and infrastructure development—critical factors for fostering economic growth. Concurrently, ODA

has played a pivotal role in supporting various African nations by addressing developmental challenges such as poverty alleviation, healthcare enhancement, and educational improvements while bolstering economic resilience. A thorough understanding of the economic impacts of these financial flows is particularly pertinent in Africa, where growth remains central to the objectives of long-term poverty reduction and broader developmental aspirations (Afoakwa, 2016; Wehncke et al., 2022).

The region encounters challenges on both fronts. Access to development finance is frequently constrained as African countries vie for a limited pool of funds while grappling with governance, infrastructure, and investment climate issues. Furthermore, the impacts of climate change present significant economic threats that could impede long-term growth, including diminished agricultural productivity and a rise in the frequency of expensive natural disasters (Calzadilla et al., 2013; Moloi, 2024).

The interplay between development finance and climate change on economic growth presents a compelling study area in Africa. While foreign direct investment (FDI) and Official Development Assistance (ODA) can serve as vital growth drivers by improving infrastructure and bolstering economic resilience, climate variability adds a layer of vulnerability that may undermine the advantages of these financial inflows. Understanding how these factors interact is essential to developing effective policy responses that promote sustainable growth and facilitate climate adaptation.

1.2 Research Problem

Africa is witnessing rapid population growth, urbanisation, and industrialisation; however, its economies rely heavily on natural resources and agriculture. This dependency renders the continent particularly susceptible to the adverse impacts of climate change, including extreme weather events, shifting agricultural patterns, and water scarcity. At the same time, African nations require substantial development financing to address infrastructure deficits, alleviate poverty, and reduce inequality while fostering economic growth. The dual challenge of achieving economic development and adapting to climate change necessitates a careful balance in the allocation of resources (Abidoye & Odusola, 2015; Talib et al., 2021; Wehncke et al., 2022).

Moreover, economic growth encounters various challenges shaped by external and internal factors. Development finance—particularly foreign direct investment (FDI) and Net Official Development Assistance (ODA)—and climate change indicators such as rainfall and temperature fluctuations play significant roles in this context. Development finance fosters economic advancement by providing capital, facilitating technology transfer, and enhancing financial infrastructure. However, its effectiveness may be compromised by the negative impacts of climate change, which directly affect agriculture, the resilience of infrastructure, and overall productivity (Aigbedo & Aigbovo, 2023; Moloi, 2024).

Recognising the interplay between various factors is essential for the economies of Africa. Foreign Direct Investment (FDI) and Official Development Assistance (ODA) are critical in fostering economic growth. However, deteriorating climate conditions may jeopardise their potential to generate long-term benefits. Rising temperatures and irregular rainfall patterns significantly impact vital economic sectors, particularly agriculture and resource-based industries. This analysis explores how development finance, represented by FDI and ODA, interacts with climate change factors—specifically rainfall and temperature—to influence African economic growth.

Empirical studies on the impact of developmental finance—particularly foreign direct investment (FDI) and official development assistance (ODA)—on economic growth in developing regions, especially in Africa, produced mixed results. Some studies indicate a positive correlation, suggesting that both FDI and ODA can significantly promote economic development. Specifically, when capital is injected through FDI or ODA, it can enhance investment in infrastructure, create jobs, and facilitate the transfer of technology and skills, thereby stimulating growth (Saibu et al., 2022; Wehncke et al., 2022).

In contrast, some studies showed that official development assistance (ODA) and foreign direct investment (FDI) can adversely affect economic growth. Specifically, these studies suggest that ODA may create dependency rather than stimulate sustainable development, leading to local economies' inefficiencies. Similarly, while often seen as a catalyst for investment and job creation, FDI can sometimes result in profit repatriation and a lack of reinvestment in the host country, ultimately hindering long-term economic progress (Afoakwa, 2016; Anetor et al., 2020).

1.3 Research Objectives

This study conducts a comprehensive investigation into the effects of developmental finance and climate change on the economic growth of ten selected countries in sub-Saharan Africa, spanning 1999 to 2022. The analysis aims to achieve the following specific objectives:

(a) To examine the effect of foreign direct investment on economic growth of sub-Saharan countries

(b) To evaluate the impact of official development assistance on economic growth of sub-Saharan countries

(c) To assess the influence of rainfall on economic growth of sub-Saharan countries

(d) To investigate the impact of temperature on the economic growth of sub-Saharan countries

2.0 Theoretical Framework

The study is based on the Cobb-Douglas production function

2.1 The Cobb-Douglas Production Function

The Cobb-Douglas production function is a well-established model that illustrates the relationship between inputs (factors of production) and output. In this context, we will use it to evaluate the effects of foreign direct investment (FDI), Net Official Development Assistance (ODA), annual rainfall, and temperature on a country's GDP growth rate. It is typically expressed as:

$$Y=A\cdot K^{\alpha}\cdot L^{\beta}$$

Where:

- Y is the total output (GDP).
- A is total factor productivity, which reflects the efficiency of all inputs combined.
- K is the amount of capital
- L is the amount of labour
- α, and β are capital and labour output elasticities, respectively.

To incorporate the additional factors of foreign direct investment, net official development assistance, rainfall, and temperature, we modify the function:

$$GDP=A\cdot(FDI)^{\alpha 1}\cdot(ODA)^{\alpha 2}\cdot(ARA)^{\alpha 3}\cdot(ATE)^{\alpha 4}\cdot K^{\alpha}\cdot L\beta$$

Where:

- Foreign direct investment (FDI), net official development assistance (ODA), Annual Rainfall (ARA), and Temperature (ATE) are additional variables that influence productivity.
- α^1, α^2,α^3,α^4 are the elasticities of output concerning each factor.

Effects of Each Factor

i. **Foreign Direct Investment (FDI)**:
   - **Impact**: FDI can increase capital availability, technology transfer, and access to international markets. Higher FDI can lead to greater productivity, thus positively influencing GDP growth.
   - **Elasticity**: $\alpha^1>0$ indicates that as FDI increases, GDP also increases, holding other factors constant.

ii. **Net Official Development Assistance (ODA)**:
- **Impact**: ODA can provide essential funding for infrastructure, education, health, and other services, improving human capital and increasing economic capacity. It can primarily support developing countries in stabilizing their economies.
- **Elasticity**: $\alpha^2>0$ suggests that an increase in ODA correlates with a rise in GDP growth.

iii. **Annual Rainfall (R)**:
- **Impact**: Rainfall directly affects agricultural output, which is crucial in many African economies. Adequate rainfall can enhance food security, farmer income, and economic activity.
- **Elasticity**: $\alpha^3>0$ indicates favorable rainfall conditions lead to higher agricultural productivity and, thus, higher GDP growth.

iv. **Temperature (T)**:
- **Impact**: Temperature influences agricultural yields and labor productivity. Extreme temperatures can negatively affect crop production and the workforce's health, while moderate temperatures can enhance productivity.
- **Elasticity**: α^4may be positive in moderate ranges but harmful in extreme ranges, indicating that temperature nonlinearly affects GDP growth.

2.2 Empirical Review

2.2.1 Effect of climate change on economic growth

Talib et al. (2021) conducted an in-depth study investigating the effects of climate change on agricultural growth in 32 Sub-Saharan African countries from 1981 to 2021. The augmented autoregressive distributed lag (ARDL) estimation technique was employed to analyse the relationship between the dependent and independent variables. Climate change was assessed using two primary indicators: variations in temperature and precipitation. Agricultural output per worker served as a proxy for agricultural growth. The findings indicated that while fluctuations in precipitation did not demonstrate a statistically significant effect on agricultural growth, temperature variations had a statistically significant negative impact on agricultural productivity.

Duan et al. (2022) studied the effects of climate change on China's economic growth from 1990 to 2016. The estimation technique of the system Generalised Method of Moments (GMM) was employed to analyse the relationship between the dependent and independent variables. Climate change was assessed using two primary indicators: temperature and rainfall. Real GDP served as a proxy for economic growth. The findings indicated that while rainfall demonstrated a statistically significant positive effect on economic growth, temperature had a statistically significant negative impact.

Aigbedo and Aigbovo (2023) conducted a comprehensive study examining the impact of climate change on economic growth in Nigeria over a four-decade period, specifically from 1981 to 2021. Their research utilised an extensive time series data analysis, employing the Error Correction Model (ECM) and ordinary least squares (OLS) estimation techniques to draw meaningful conclusions. Climate change was quantified through two primary metrics: fluctuations in temperature and levels of carbon emissions. To evaluate the effects of these climate factors on the economy, they used real gross domestic product (GDP) as a proxy for economic growth. The findings showed that temperature changes did not have a statistically significant effect on the growth of the Nigerian economy.

2.2.2 Effect of developmental finance on economic growth

Afoakwa (2016) explored the impact of official development assistance (ODA) and foreign direct investment (FDI) on human development across a sample of forty-six (46) sub-Saharan African

countries from 2013 to 2014. The research utilised a fixed-effects estimation technique, effectively controlling for unobserved variables that might influence the output over time. To assess human development, the researchers employed the Human Development Index (HDI), a composite measure that includes life expectancy, education, and income. The study's results revealed a significant negative long-term effect of official development assistance and foreign direct investment on human development.

Yiew and Lau (2018) examined the impact of capital inflow on economic growth in a study involving ninety-five developing nations from 2005 to 2013. They employed a fixed-effects estimation technique to effectively control for unobserved variables that could influence economic outcomes over time. Capital inflow was measured using official development assistance (ODA) and foreign direct investment (FDI), while economic growth was represented by gross domestic product (GDP). The study found a significant negative effect of official development assistance on economic growth, whereas foreign direct investment had a significant positive impact on economic growth.

Saibu et al. (2022) conducted a study investigating the impact of capital inflow on economic growth in 14 West African countries from 1960 to 2018. They utilised the panel autoregressive distributed lag (PARDL) estimation technique to analyse the relationship between the dependent and independent variables. In this study, capital inflow was measured through official development assistance (ODA) and foreign direct investment (FDI), while economic growth was represented by gross domestic product (GDP). The findings indicated that both official development assistance and foreign direct investment had a significant positive impact on economic growth.

3.0 Methodology

3.1 Population, Scope, Sample Size, and Sources of Data

The sample comprises ten selected countries in sub-Saharan Africa from 1999 to 2022. Data were sourced from the World Bank's World Development Indicators (WDI) database.

3.2 Model Specifications

$$GDPR_{it} = \beta_o + \beta_1 lnFDI_{it} + \beta_2 lnODA_{it} + \beta_3 lnAR_{it} + \beta_4 ATE_{it} + \varepsilon_{it}$$

Where:

- GDPR**:** GDP growth rate
- **lnFDI, lnODA, lnARA:** Natural logarithms of FDI, ODA, and rainfall
- **ATE:** Temperature variable
- ε_{it}**:** Error term

4.0 Data Analysis and Results

4.1 Descriptive Statistics

Table 4.1: Descriptive Statistics

Stats	GDPR	FDI ($)	ODA ($)	ATE	ARA	EDS ($)	POP
Mean	4.5027	2,110,000,000	1,520,000,000	23.1464	702.3352	3,670,000,000	60,400,000
Min	-7.1782	-7,400,000,000	20,900,000	17.5500	10.8500	71,700,000	15,900,000
Max	15.3292	40,700,000,000	11,400,000,000	27.8600	1582.1200	29,000,000,000	219,000,000
Std. Dev	3.5977	3,800,000,000	1,470,000,000	2.9361	444.78140	5,010,000,000	43,800,000
skewness	-0.0236	4.5886	2.3066	-0.3505	-0.1970	2.9034	1.6500
kurtosis	4.2047	46.1277	12.4852	2.2589	1.7213	12.8694	5.3106
N	240	240	240	240	240	240	240

Table 4.1 presents a comprehensive overview of the descriptive statistics results, summarizing the dataset's key central tendency and variability measures. It includes details such as means, minimums, standard deviations, and skewness, providing valuable insights into the distribution and characteristics of the analyzed data.

GDP growth rate: The average GDP growth rate across the sample is approximately 4.5%, indicating moderate growth. A positive mean growth rate for developing economies suggests a general trend of economic expansion during the measured period. The range of GDP growth rates, from a minimum of -7.1782% to a maximum of 15.3292%, reflects considerable volatility. Some countries experienced significant negative growth, signaling a recession, while others enjoyed robust positive growth—characteristic of regions marked by diverse economic conditions. The standard deviation of around 3.6% indicates moderate variability in GDP growth rates. Skewness

is nearly zero (-0.02), suggesting that the distribution of GDP growth rates is approximately symmetrical. Meanwhile, a kurtosis value of 4.2, exceeding the typical value of 3 for a normal distribution, indicates a leptokurtic distribution. This signifies that the distribution has heavier tails, implying a greater likelihood of extreme GDP growth rates, both high and low.

Foreign direct investment (FDI): The average foreign direct investment (FDI) value is $2.11 billion. This suggests that, on average, the African countries in the sample experience positive FDI inflows. However, the minimum value is -$7.4 billion, indicating that some countries have faced significant FDI outflows, potentially due to economic instability or investor withdrawals. In contrast, the maximum FDI recorded is $40.7 billion, reflecting substantial investment in at least one country, likely driven by favourable economic conditions or strong foreign interest in specific industries. The high standard deviation of $3.8 billion highlights considerable variability in FDI inflows across the sample. This suggests that while some countries attract large inflows, others experience low or negative values, representing diverse economic conditions. The skewness of 4.5886 indicates a highly right-skewed distribution, meaning that a few countries have exceptionally high FDI inflows compared to the rest. This skewness suggests a lack of symmetry in the data, with a few high-value outliers likely impacting the mean. Lastly, the kurtosis of 46.1277 reveals a leptokurtic distribution characterised by a sharp peak and heavy tails. This elevated kurtosis value confirms the existence of outliers, indicating that some countries possess exceptionally high or low FDI values relative to the majority.

Official development assistance (ODA): The mean value of $1.52 billion suggests that, on average, each country in the sample received approximately this amount in official development assistance (ODA). The minimum ODA recorded was $20.9 million, indicating that at least one country received a relatively low aid. Conversely, the maximum ODA reached $11.4 billion, highlighting that some countries received significantly higher assistance. A standard deviation of $1.47 billion reveals considerable variation in ODA across the countries, signifying substantial disparities in the amounts received. Additionally, a skewness of 2.31 indicates a positively skewed distribution, suggesting that most countries received less assistance than the mean, with a few outliers receiving significantly more, which in turn lifts the average. The distribution is notably

leptokurtic, with a kurtosis of 12.49, reflecting heavy tails in the data. This high kurtosis value suggests that a few extreme values differ significantly from most observations.

Temperature: The mean temperature of 23.15°C represents the average annual temperature across the sampled African countries, indicating a generally warm climate. **Minimum and Maximum Temperatures (17.55°C - 27.86°C): ** The temperature range spans from 17.55°C to 27.86°C, illustrating a notable variation of 10.31°C across the region. This variation signifies that certain areas experience considerably cooler or warmer conditions than others. The standard deviation of 2.94°C indicates moderate variability around the mean, suggesting that temperatures remain relatively close to the average. The observed negative skewness of -0.35 denotes a slight leftward skew, indicating a prevalence of higher temperature values, with fewer countries recording temperatures significantly below the mean. The kurtosis value of 2.26 suggests a slightly platykurtic distribution (kurtosis < 3), implying lighter tails and a flatter peak than a normal distribution. Consequently, this indicates a reduced presence of outliers compared to a normal distribution.

Annual Rainfall: The average annual rainfall across the dataset is approximately 702.34 mm, indicating moderate precipitation across the various countries. The recorded rainfall ranges significantly, from a minimum of 10.85 mm to a maximum of 1582.12 mm. This variation in rainfall levels among the sampled countries highlights the diverse climatic conditions within the region. Notably, the relatively high standard deviation of 444.78 mm emphasises the wide spread of rainfall data around the mean, reinforcing the observation of substantial variability in rainfall patterns. The skewness value of -0.197 suggests a slight left skew, indicating that the distribution is approximately symmetric but has a minor inclination towards lower values. This may imply that a few countries receive significantly less rainfall than the average. With a kurtosis of 1.721, the distribution is slightly platykurtic (kurtosis < 3), indicating lighter tails and a flatter peak than a normal distribution. This suggests that low and high extreme values are less common in this dataset than expected in a normal distribution.

External Debt Service: This sample's average debt service (EDS) is approximately $3.67 billion. The minimum value of $71.7 million and the maximum of $29 billion highlight a significant

disparity in debt service levels across different countries. This wide range suggests that while some nations experience relatively low debt service costs, others are burdened with very high amounts. The standard deviation of $5.01 billion indicates a considerable spread in debt service values from the mean, reflecting high variability among the countries. Consequently, while some countries maintain moderate debt levels, others may face substantial debt servicing obligations. The skewness of 2.90 illustrates a strong positive skew in the data, meaning that the distribution of debt service values is right-skewed. Most countries have debt service values below the mean, although a few nations with extremely high debt servicing elevate the mean. Furthermore, the kurtosis of 12.87 far exceeds the normal distribution's kurtosis value of 3, signifying a leptokurtic distribution. This indicates that the data possesses heavy tails and a sharp peak, with frequent values clustering around the mean alongside significant outliers in the higher range of debt service.

Population: The average population across these ten countries is approximately 60.4 million. The smallest population in this sample is around 15.9 million, highlighting a considerable range between the smallest and largest populations in the dataset. Conversely, the largest population is approximately 219 million, indicating that at least one country has a significantly larger population, likely skews the average upward. With a standard deviation of 43.8 million, the sampled countries have substantial variability in population sizes. This variability may stem from a mix of more and less populous nations, leading to a wide dispersion around the mean. The skewness value of 1.65 further reveals a right-skewed distribution, meaning the population data is asymmetrical, with a tail extending toward the higher values. This suggests that a few countries possess very large populations compared to others, thus elevating the mean. The kurtosis of 5.31, which exceeds 3, indicates a leptokurtic distribution. This finding is significant as it implies a higher-than-expected number of countries with populations that deviate significantly from the mean (both high and low), underscoring the unique demographic landscape of the sampled nations.

4.2 Correlation Analysis

Table 4.2: Correlation Analysis

	GDPR	FDI	ODA	ATE	ARA	EDS	POP
GDPR	1.0000						
FDI	0.0401	1.0000					
ODA	0.2016	0.1665	1.0000				
ATE	0.1143	-0.1395	0.2133	1.0000			
ARA	0.1534	-0.2462	0.1480	0.5025	1.0000		
EDS	-0.2950	0.3622	0.0362	-0.4049	-0.2144	1.0000	
POP	0.1154	0.2982	0.5218	0.3888	0.1244	0.0762	1.0000

The correlation matrix offers valuable insights into the interrelations among various economic, environmental, and demographic variables. The results presented in this matrix generally suggest weak relationships between the variables, with the strongest correlation observed between Official Development Assistance (ODA) and population (POP), registering at 0.5218.

The results indicate that the independent variables—Foreign Direct Investment (FDI), Official Development Assistance (ODA), Annual Temperature (ATE), and Annual Rainfall (ARA)—can be effectively used in a regression model without significant concerns about multicollinearity. This allows for more reliable interpretations of each variable's impact on the dependent variable, GDP growth (GDPR).

4.3 Empirical Results

The F-statistic is 4597.1600 with a p-value of 0.0000, indicating that the model is overall statistically significant. The AR (2) result is insignificant (p = 0.4310), suggesting no autocorrelation issues are present. Additionally, the Sargan test yields a value of 62.9400 with a p-value of 0.2160. This result is also insignificant, which implies that the instruments used in the model are valid and that the model is not over identified.

Foreign Direct Investment (FDI, 3.0077, p=0.056): FDI positively correlates with GDP growth, showing that increased FDI inflows support economic activity. This result is significant at the 10%

level, aligning with expectations that foreign investment boosts economic growth. Foreign Direct Investment (FDI) is a significant driver of economic growth, as it infuses capital, advanced technology, and managerial expertise into host countries. This influx enhances productivity and fosters industrial growth, increasing gross domestic product (GDP). The overall economic landscape improves as various sectors, including manufacturing, services, and agriculture, become more efficient and capable. Furthermore, foreign investment contributes to job creation, wage increases, and elevated disposable incomes, stimulating demand and promoting further GDP growth. The study's findings are similar to those of Saibu et al. (2022) but contradict those of Afoakwa (2016), who found that FDI significantly negatively affects economic growth.

Table 4.3: Empirical Results

Variables	**Coefficient**	**P-Value**
Constant	568.8406	0.027
GDPR(-1)	-1.25275**	0.0360
FDI	3.0077*	0.0560
ODA	-9.7954**	0.0320
ATE	-3.1313**	0.0290
ARE	21.1798***	0.0090
POP	-20.1732	0.1870
EDS	-5.3829***	0.0040
F-Statistic/Wald Statistics	4597.1600***	0.0000
AR (1)	-1.7200*	0.0860
AR (2)	-0.7900	0.4310
Sargan Test	62.9400	0.2160

Source: Authors' computation (2024)

Statistical significance levels at 0.10*, 0.05 **, and 0.01 ***

Official Development Assistance (ODA) significantly negatively affects GDP growth, as evidenced by a p-value of 0.0320. With a 5% significance level, this finding suggests challenges in translating aid into tangible economic growth. Official Development Assistance (ODA) can sometimes be misallocated, meaning that funds do not always reach their intended targets due to

corruption or inefficient bureaucracy. This misallocation limits the impact of ODA on productivity and growth. Additionally, aid flows are often inconsistent, which makes it challenging for recipient countries to plan long-term development projects. This inconsistency can disrupt economic planning, ultimately affecting investment and growth. The study's findings align with those of Yiew and Lau (2018) but contradict those of Saibu et al. (2022), who found that ODA has a significant positive effect on economic growth.

Mean Annual Temperature (ATE, -3.1313, p=0.0290): Elevated average temperatures have a detrimental and statistically significant effect on GDP growth, with significance at the 5% level. High temperatures can negatively impact crop yields by causing plant heat stress, reducing water availability, and increasing the incidence of pests and diseases. Given the importance of agriculture for GDP in many African countries, adverse effects on this sector translate to lower overall economic growth. Moreover, higher temperatures can cause health issues (e.g., heat strokes and malaria in warmer regions) that affect worker productivity, particularly in labour-intensive sectors such as agriculture and construction. The study's findings align with those of Duan et al. (2022) but contradict those of Aigbedo and Aigbovo (2023), who found an insignificant relationship between temperature and economic growth.

Mean Annual Rainfall (ARE, 21.1798, p=0.0090): Rainfall is positively correlated with GDP growth, significant at the 1% level. In many African countries, rainfall supports agriculture, a crucial driver of GDP in these regions. Agriculture is crucial to the GDP in many African countries, with a significant portion of the population depending on it. Sufficient rainfall enhances crop yields, increasing agricultural productivity, improved food security, and higher exports. Furthermore, greater agricultural productivity resulting from favourable rain reduces the need for food imports, helping to improve trade balances and potentially stimulating other sectors of the economy. The study's findings are similar to those of Duan et al. (2022) but contradict those of Talib et al. (2021), who found an insignificant relationship between rainfall and economic growth.

5.0 Conclusions and Recommendations

The study examined the impact of developmental finance and climate change on economic growth. The sample included ten African countries from 1999 to 2022. Developmental finance was assessed through foreign direct investment (FDI) and net official development assistance (ODA), while the mean annual temperature and rainfall represented climate change. Economic growth was measured by the annual gross domestic product (GDP) growth rate. The system Generalized Method of Moments (GMM) estimation technique was employed to analyse the relationship between the independent and dependent variables. The findings indicated that foreign direct investment and mean annual rainfall significantly improve economic growth. Conversely, net official development assistance and mean annual temperature negatively impact economic growth. Based on these findings, governments should foster favorable conditions for foreign direct investment (FDI) by implementing tax incentives, streamlining registration processes, and establishing regulations encouraging investment. Examples of such strategies could include the creation of special economic zones, lowering tariffs, and strengthening protections for intellectual property rights. Given that many African economies rely heavily on agriculture, policies promoting effective water management, advanced irrigation systems, and the development of drought-resistant crops can optimize rainfall utilization and enhance GDP growth. Additionally, considering the significant effects of aid dependency on sustainable development, policymakers must take proactive steps to encourage financial self-reliance. Expanding tax bases and minimizing tax evasion can enhance domestic resource mobilization and support enduring economic growth. With rising temperatures threatening productivity, particularly in agriculture, investing in climate-resilient crops, innovative irrigation techniques, and infrastructure designed to withstand climate challenges to mitigate the adverse effects of increasing temperatures is crucial.

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