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Abstract

Purpose: This study investigates the effect of climate change on economic growth in Kenya using multivariate time-series data spanning the period 2004 to 2023.

Materials and Methods: Adopting a quantitative, non-experimental research design, the analysis employed a multivariate time-series regression model to estimate the impact of temperature variability on real GDP.

Findings: The results reveal a statistically significant, negative relationship between climate change and economic growth (β = –0.634, p = 0.047), signifying that a unit increase in mean annual temperature results in a 0.634-unit decline in GDP. The model explains 40.2% of the variation in GDP. These results affirm that rising temperatures, intensified by recurrent droughts and floods, are constraining Kenya's economic performance, particularly through adverse effects on agriculture, water resources, infrastructure, and tourism.

Unique Contribution to Theory, Practice and Policy: Accordingly, it recommends the institutionalization of climate-resilient policies through adaptive infrastructure planning, disaster early warning systems, and climate-smart agriculture. Further, the Ministry of Environment, Climate Change and Forestry should strengthen public-private partnerships and resource mobilization frameworks to finance mitigation and adaptation efforts. Integrating climate risk into national economic planning and investment strategies is essential to safeguarding GDP growth and ensuring sustainable development.

Keywords: *Climate Change, Climate Policy, Economic Growth, Temperature anomaly, Gross Domestic Product, Climate Variability, Sustainable development, climate-smart Agriculture, Economic Vulnerability*

1.0 INTRODUCTION

Economic growth refers to the sustained increase in an economy's productive capacity, typically measured by the rise in real Gross Domestic Product (GDP) (Hess, 2016). It shows how well an economy can produce more goods and services over time, raising living standards and national income. Higher household consumption, higher per capita incomes, and more public and private investment in vital areas like infrastructure, healthcare, and education are all made possible by expanding economic output, and these factors taken together improve social welfare and human development (Ding, 2021). However, because it disrupts productivity in important sectors, raises operational and adaptation costs, and reduces long-term growth prospects, climate change poses a serious threat to economic development. Particularly in climate-sensitive economies, the heightened frequency and severity of climate-related shocks, like heatwaves, floods, and droughts, complicate economic planning, put a strain on public resources, and worsen structural vulnerabilities (Obasanmi & Akhamie, 2025).

Although localized agricultural opportunities may arise as a result of climate change, especially in higher elevations where rising temperatures may increase crop productivity, these benefits are sparse and unequally distributed (Hertel & Lobell, 2014). The majority of the projected increases in average yields are limited to areas where agronomic potential and climatic shifts coincide. Extreme weather events, which disproportionately impact subsistence farming and staple crops like maize -a vital component of Kenya's food system that is extremely sensitive to heat stress-pose serious risks to the sector (Du & Xiong, 2024). Underlying structural vulnerabilities, such as fast population growth, susceptibility to global price shocks, particularly in the food and energy markets, and ongoing budgetary constraints, further exacerbate these climate risks (Detelinova et al., 2023).

India's GDP is expected to decline by 35% as a result of climate change, while Southeast Asian economies like Malaysia and the Philippines could experience losses of up to 45% (Ruamsuke, et al., 2015). The United States and Europe are predicted to experience comparatively smaller losses of 10% to 11%, while China is predicted to experience a 24% drop in output (Dua & Garg, 2024). These differences draw attention to Asian nations' increased susceptibility to climate-related hazards, as they frequently have lower adaptive capacities. Therefore, with potentially irreversible effects, climate change presents a serious threat to the region's long-term development, food security, and economic growth (Swiss Re Institute, 2021).

The tropical and subtropical regions especially Sub-Saharan African nations are more susceptible to the effects of rising temperatures, which can result in the destruction of crops as well as an increased need for water (Kotir, 2011). It results in famines and floods, which in turn causes a country's socioeconomic standing to deteriorate (Samatar, 2023). The amount of direct water available to crops may vary due to variations in the frequency and intensity of rainfall brought on by climate change, the severity of drought on crops, the health of livestock, the availability of forage, and the efficacy of irrigation systems (Shankar & Shikha, 2019). Furthermore, according to Samatar, (2024), sub-Saharan Africa is subjected to a disproportionate impact of climate change as a result of its significant reliance on agriculture, which is dependent on rainfall. As a consequence, the region is unable to adequately foresee and mitigate the far-reaching implications of such catastrophes.

In recent years, the socio-economic impacts of climate change in Kenya have become increasingly severe, undermining key sectors such as agriculture, water resources, public health, and infrastructure (Mwambire, 2020; Erickson, 2024). Extreme weather events like droughts and floods, exacerbated by climate change, disrupt agricultural production, leading to food insecurity and losses in key export crops like tea and horticulture. Water scarcity and reduced agricultural yields can trigger price increases for food and fuel, disproportionately affecting vulnerable populations. Furthermore, damage to infrastructure from floods and droughts can lead to long-term fiscal liabilities and hinder economic growth (Mwatu, et, at. (2020). Data from the World Bank (2021) indicate that Kenya has experienced an average of 2.8 meteorological, hydrological, and climatological disasters annually since 2000, a dramatic increase from 0.5 events per year recorded between 1964 and 1999. Severe droughts typically occur every decade, while moderate droughts or floods now occur approximately every three years.

The 2008–2011 drought, for example, led to an estimated 2.8% decline in GDP growth, illustrating the macroeconomic consequences of prolonged climate stress (World Bank, 2021). In 2017, drought displaced more than 300,000 people, followed by additional displacements in 2018 due to widespread flooding. In 2020, prolonged heavy rainfall resulted in floods that affected over 800,000 people, causing fatalities, destruction of property, and significant population displacement (ReliefWeb, 2021). Concurrently, unusually wet conditions triggered one of the worst desert locust outbreaks in decades across Eastern Africa, with Kenya's arid and semi-arid counties severely affected. These swarms devastated crops and pastures, exacerbating food insecurity, disrupting livelihoods, and heightening tensions among pastoral and farming communities (FAO, 2021; UNEP, 2023).

1.1 Problem Statement

Kenya's economic growth faces several significant challenges. These include high levels of poverty, rising public debt, political instability, and the impacts of climate change. Additionally, corruption, a lack of transparency, and weak private sector investment hinder progress. These factors collectively contribute to an environment where economic development is constrained and vulnerable to both internal and external shocks. Nearly 70% of Kenyan households live in chronic vulnerability as a result of food insecurity, preventable diseases, and malnutrition, highlighting the stark gap between the rich and the poor in Kenya (Nyakundi, 2024). The majority of Kenyans still live in poverty, despite a small elite enjoying advantages in terms of resources, labor, and economic opportunities. Furthermore, over time, Kenya's GDP growth has varied. For example, GDP growth was 5.1% in 2019, fell to -0.3% in 2020 as a result of external shocks, then increased to 7.5% in 2021 before falling to 4.8% in 2022. According to Detelinova et al. (2023) addressing climate change, particularly temperature increases, can significantly bolster economic growth in Kenya by fostering climate-resilient agriculture, improving water management, promoting renewable energy, and enhancing competitiveness in international markets. Investing in these areas can reduce the negative impacts of climate change on key sectors like agriculture and tourism, while also creating new economic opportunities. Thus, this study aimed to ascertain the impact of climate change and its implications for Kenya's economic growth against this backdrop.

1.2 Objectives of the Study

The objective of the study was to determine the effect of climate change on economic growth in Kenya

1.3 Hypothesis of the Study

$H_0 1$: there is no statistically significant effect of climate change on economic growth in Kenya

1.4 Significance of the Study

In the face of growing climate risks, Kenya, like many developing economies, faces formidable obstacles to attaining sustainable economic growth. Climate-related shocks like droughts, floods, and temperature fluctuations are making the nation's infrastructure, means of subsistence, and productive sectors, especially agriculture, more susceptible. These disturbances worsen poverty, food insecurity, and income inequality in addition to undermining national development goals. Because it offers empirical insights into the connection between climate change and economic growth in Kenya, this study is critically important and timely. Its goal is to inform adaptive economic strategies and targeted policy responses.

The findings of this research will be valuable to policymakers and development planners by offering evidence-based recommendations on climate-resilient economic interventions, infrastructure planning, and sectoral investment priorities. Moreover, the study will contribute to the growing body of empirical literature on climate-economy linkages in sub-Saharan Africa, providing a contextual foundation for comparative research and future modelling efforts.

Students, researchers, and academic institutions focusing on climate economics, sustainable development, and public policy will also benefit from this work. It offers a framework for further scholarly inquiry, supports data-driven decision-making, and enhances understanding of the socio-economic consequences of climate variability in a developing country context.

2.0 LITERATURE REVIEW

2.1. Theoretical Review

This study is anchored on two principal economic theories: The endogenous growth theory and the theory of comparative advantage. These frameworks provide the analytical lens through which the relationship between climate change and economic growth is examined.

2.1.1 Endogenous Growth Theory

Endogenous growth theory was primarily developed by economists Romer (1980). It emerged as an alternative to neoclassical growth theory, emphasizing that long-term economic growth is driven by factors within the economy, particularly technological progress, rather than being solely determined by factors outside the economic system. The theory argues that economic growth is generated from within a system as a direct result of internal processes. More specifically, the theory notes that the enhancement of a nation's human capital will lead to economic growth by means of the development of new forms of technology and efficient and effective means of production.

Endogenous growth economists believe that improvements in productivity can be tied directly to faster innovation and more investments in human capital. As such, they advocate for government and private sector institutions to nurture innovation initiatives and offer incentives for individuals and businesses to be more creative, such as research and development (R&D) funding and intellectual property rights (Roberts, & Setterfield, 2007).

Endogenous growth theory, which emphasizes the role of internal factors like innovation and human capital in driving long-term economic growth, can be applied to understand the complex relationship between climate change and economic growth. It suggests that climate change can impact growth through various channels, including reduced investment, slower technological progress, and shifts in savings behavior. Conversely, economic growth can influence climate change through increased emissions and resource consumption.

2.1.2 Comparative Advantage Theory

The Theory of Comparative Advantage, originally articulated by David Ricardo in 1817posits that countries can achieve mutual economic gains by specializing in the production of goods and services for which they have the lowest opportunity cost relative to others. Ricardo's classical model of trade operates under several assumptions, including immobility of factors of production across countries, the use of labour as the sole input, and constant labour productivity. While Ricardo acknowledged the restrictive nature of these assumptions, the core insight of the theory -that international trade is beneficial even when one country is less efficient in absolute terms- remains foundational in modern trade economics.

The Ricardian model has been expanded to evaluate how climate variability affects agricultural productivity and, consequently, comparative advantage in food production in the context of climate change. This method, which is frequently called the '*Ricardian climate model,*' assesses how regional differences in temperature, precipitation, and other agro-climatic factors impact the net value of agricultural land. By using this model in a variety of geographical contexts to estimate the effect of climate change on land value, groundbreaking studies by Mano and Nhemachena (2007), Mendelsohn (2008), and Passel (2012) demonstrated that land productivity -and thus comparative advantage- is sensitive to climatic conditions.

According to the Ricardian model, the present value of anticipated future net farm output revenues is reflected in the per-hectare value of arable land (V). Therefore, a nation's comparative advantage in agricultural production can be drastically shifted by climatic changes that affect yield potential, pest prevalence, or input efficiency. According to empirical research (e.g., Nkonde, 2014; Bozzola, 2014), areas that experience anomalies in rainfall or temperature frequently see a decline in land values and a decrease in their ability to compete in international agricultural markets.

The Ricardian model, while useful for analyzing the impact of climate change on agriculture, has significant limitations when applied to non-agricultural sectors like manufacturing and tourism. In manufacturing and tourism, land value is not the primary driver of economic activity or the primary way climate change impacts these sectors. These sectors are more affected by factors like infrastructure damage, changes in consumer behavior, and disruptions to supply chains, which the model doesn't directly address.

Therefore, by changing the resource endowments that support comparative advantage, climate change has the potential to reshape patterns of international trade. While some nations in more temperate regions or higher elevations may benefit, others may lose their competitive advantage in some agricultural exports as a result of increased climate volatility or declining productivity. These changes may have significant effects on trade policy, economic growth, and food security in Kenya, where agriculture accounts for a large portion of GDP and export revenue.

2.2 Empirical Studies

Farajzadeh, Ghorbanian, and Tarazkar (2023) used a panel dataset of Asian nations spanning the years 1994–2017 to investigate how climate change affects economic growth. Key macroeconomic variables, including GDP per capita, labor force, capital formation, financial development, trade openness, and foreign aid, were included in the study along with climate data based on annual mean temperatures and CMIP6 projections to 2100. The Generalized Method of Moments (GMM) was used for dynamic panel estimation. Physical and environmental capital were the main drivers of output per worker, according to the analysis, which was based on a Constant Elasticity of Substitution (CES) framework and then a Cobb-Douglas production function. However, the impact of trade-related variables was negligible, highlighting the predominance of environmental factors in determining economic productivity in climate-vulnerable areas.

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Farajzadeh, Ghorbanian, and Tarazkar (2022) focused on the shocks of climate change on economic growth in developing economies: evidence from Iran. The present study implements a dynamic integrated assessment model to evaluate the potential impact of climate change on per capita output, per capita consumption, capital per worker, input prices, and welfare over the current century. Two classes of climate change scenarios from CMIP3 (A2 and A1B) and CMIP5 (RCP 4.5, RCP 6.0, and RCP 8.5) under two assumptions of damage function known as "W-damage" and "DS-damage" were examined. In addition, three channels of damage – current production, productivity growth, and capital depreciation–were investigated. In general, the simulation results revealed a significant effect on the selected variables. Nevertheless, the effects were strongly dependent on climatic scenarios and assumptions about the damage function.

Aslan, Altinoz and Atay Polat (2021) focused on the nexus among climate change, economic growth, foreign direct investments, and financial development: New evidence from N-11 countries. The aim of this article was to investigate the relationship between air pollution, economic growth, energy use, trade openness, foreign direct investment, and financial development in N-11 countries data period from 1980 to 2018. For this purpose, it is adopted the Panel Vector Autoregression (PVAR) model for the estimation of the long and short-run effects. The results suggest that although energy consumption and financial development have a negative impact on CO_2 emissions, foreign direct investment leads to an increase in pollution. In addition, there is bidirectional causality between financial development and CO_2 emissions and energy use, carbon dioxide emissions and energy consumption, foreign direct investments and energy consumption, and financial development and energy consumption. In addition, there is unidirectional causality from carbon dioxide emissions to GDP, from energy consumption to GDP, from foreign direct investments to CO_2 emissions and GDP, from financial development to GDP. Finally, impulse-response functions indicate the validity of the EKC hypothesis in these countries.

Using annual time-series data from 1990 to 2023 and an ex-post facto research design, Obasanmi and Akhamie (2025) examined the effect of climate change on Nigeria's economic growth. Along with rigorous econometric analysis, including unit root and cointegration tests, and post-estimation diagnostics like Breusch–Godfrey, heteroskedasticity, ARCH, and CUSUM stability tests, the study used a Cobb–Douglas production function framework. At a 5% significance level, the short- and long-term impacts of climate variables, specifically rainfall, on economic growth were estimated using an Autoregressive Distributed Lag (ARDL) model. Although rainfall was positively correlated with economic growth, the results showed that this relationship was statistically insignificant over the short and long terms, indicating that while rainfall may have an impact on agricultural productivity, its wider impact on GDP remains limited without complementary adaptive measures.

Tagwi (2022) focused on the impacts of climate change, carbon dioxide emissions (CO2) and renewable energy consumption on agricultural economic growth in South Africa: ARDL approach. The main objective of this study was to evaluate the impact of carbon dioxide emissions (CO_2), renewable energy usage, and climate change on South Africa's agricultural sector from 1972 to 2021. The nexus was estimated using an Auto Regressive-Distributed Lag (ARDL) Bounds test econometric technique. In the short run, findings indicated that climate change reduces agricultural economic growth and carbon dioxide emissions increase as agricultural economic growth increases. The use of renewable energy was insignificant in the short and long run. Carbon dioxide emissions granger causes temperature and renewable energy unilateral. An ARDL analysis was performed to evaluate the short and long-term relationship between agricultural economic growth, climate change, carbon dioxide emissions and renew able energy usage. The study adds new knowledge on the effects of climate change and carbon emissions on the agricultural economy alongside the use of renewable energy which can be used to inform economic policy on climate change and the energy nexus in the agricultural sector.

Sebukeera, Mukisa and Bbaale (2023) focused on the effects of climate variability on economic growth in Uganda. Thus, using the endogenous economic growth framework, this study estimated the long-term and short-term direct and indirect-sectoral effects of climate change on Uganda's economic growth using the vector error correction model and Johansen cointegration econometric analysis methods. The results show that climate change (precipitation) affects agriculture and industry sectoral output growth in a positive direction, and service sectoral output growth in a negative direction. Further, climate change (temperature) affects agriculture and industry sectoral output growth in a negative direction, and service sectoral output growth in a positive direction.

Mammo (2022) focused on climate change and its impact on agricultural GDP Growth in Ethiopia: A Time Series Analysis. This study uses time-series annual data from 1992/93to 2017/18 and, an effort is made to identify the long run and short-run impact of climate change in Ethiopia using an autoregressive distributed lag (ARDL) and error correction methods. The results of the study provide evidence that climate change and variability affect real agricultural gross domestic product growth negatively in the long run. The coefficient of the error term that captures the speed of adjustment toward the long-run equilibrium is found with the correct sign and magnitude.

Ali (2022) focused on the impact of climate change on the economic growth of Kenya. The concept of climate change has piqued the interests of researchers in the current business environment since it impacts not only human lives but also the trade relations between countries. Therefore, this research aims to analyze the impact of climate change on the economic growth in case Kenya. For this purpose, the thesis study has developed research objectives that will be addressed in this study. The effects of climate change on economic growth and development have been investigated and evaluated. Although there is no relationship between the selected variables in the long run, significant CO_2 has a negative effect on economic growth in the short run.

Mbotela (2018) did an analysis of the quantitative impact of climate change on national level economic growth: a Kenyan case study. That being the case, this paper seeks to analyze the empirical linkage between economic growth and climate change in Kenya from a quantitative point of view. Using data from two climate variables, temperature and precipitation, and employing time series analysis techniques, the paper tries to estimate both the short-run and long-run effects of climate change on growth. The paper establishes that an increase in temperature significantly reduces economic performance in Kenya. This takes the form of reducing agricultural output, industrial output, and aggregate investment, and increasing political instability. Some policy options have arisen from this study all in all. First and most importantly, mainstreaming climate change adaptation into National Development Strategy and budgets could promote proactive engagement on the formulation and implementation of climate change adaptation strategy

2.3 Research Gaps

Farajzadeh et al. (2023); Farajzadeh et al. (2023) studies were done in Asia, Farajzadeh, et al. (2022) study was done in Iran, Akhamie (2025) study was done in Nigeria, Tagwi (2022) was done in South Africa, Sebukeera et al (2023) stud was done in Uganda, Mammo (2022) study was done in Ethiopia thus showing a contextual gap. The current study was done in Kenya.

Farajzadeh at al. (2022) adopted a desktop research design, Akhamie (2025) adopted an ex post facto research design and thus the studies presented a methodological research design. The current study adopted a non-experimental approach.

2.4 Conceptual Framework

Sachdeva (2023) appreciates that conceptual framework is an important part or section of any study. That is because it outlines the standards defining study question(s) and discovers right, meaningful responses for the same. The dependent variable was economic growth while the independent variable was climate change.

Independent Variable **Dependent Variable**

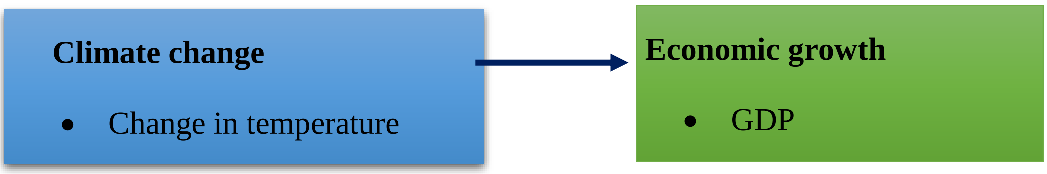

Figure 1: Conceptual Framework

3.0 MATERIALS AND METHODS

3.1 Research Design

Research design helps in identifying the choice of a research methodology in relation to research problem and objectives and provides a strategy for testing the hypothesis in the research study (Berman et al., 2020). The study adopted a quantitative and non-experimental approach. The data that was used to investigate the interrelationship among the variables was time-series data collected in the time period 2004 to 2023.

3.2 Target Population

The entire set of units, people, or observations from which study-relevant data is gathered is referred to as the target population in research (Willie, 2024). With data initially available for the years 1994 - 2023, this study used a time-series framework with a focus on Kenya. However, the study limited its analysis to a 20-year timeframe, yielding 20 annual observations, in order to maintain analytical consistency and data quality. No sampling was done because of the small dataset and the nature of time-series analysis; instead, empirical estimation was done using all of the available data points.

3.3 Description of Data Analysis Procedures

Processing of data in this study involves filtering and screening of data for accuracy, missing values and removal of outliers before entering in the EViews version 10 software package for analysis. The mean, minimum, maximum and standard deviation was used in descriptive statistics. Correlation and regression coefficients were considered in the inferential analysis. Pearson correlation was used to determine the strength of the relationship between the variable. Correlation coefficient measures the strength of linear association between variables. The

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coefficient, denoted by r is obtained by standardizing the covariance which gives values lying between -1 and +1. A coefficient of +1 indicates that the variables are perfectly positively correlated. Conversely, a coefficient of −1 indicates a perfect negative relationship. A coefficient of zero indicates no linear relationship at all. Multivariate time series regression, as advocated by Black et al. (1996) was used to regress test portfolio returns on explanatory variables across time to obtain the regression coefficients or factor loadings which was interpreted as sensitivities of test portfolios to the risk factors. The study adopted a multivariate time series regression technique for analysis of relationships among the study variables. The model equation for the study is as specified in the ensuing sections.

The main effects model specified in equation 3.1 was used to test the amount of variation in the dependent variable accounted for by the independent variable

$$Y_t = \beta_0 + \beta_1 X_{t-1} + \varepsilon_t \qquad \ldots\ldots\ldots\ldots 3.1$$

Where

Y is economic growth and

X is climate change.

X_{t-1} denotes the lagged value of the climate change variable (e.g., temperature anomaly), and

ε_t is the stochastic error term.

This model specification enables the assessment of how changes in climate conditions influence economic growth over time, accounting for temporal dynamics.

Two time series properties were tested which included unit root test and Co-integration test. Unit root test was used to test for the stationary or non-stationary of the series used in the study. Stationary variable is one with a mean and variance over time is constant, this is necessary to ensure that spurious results are not obtained which is a common case with non-stationary variables. The study used Augmented Dickey Fuller (ADF) to carry out stationary test. Co-integration test was carried out to show the relationship among the variables used in the study. The study adopted Johansen Co-integration test to show long-run relationship among variables. It was preferred over other methods since it was used on variable irrespective of the order of integration. Normality and heteroskedasticity tests were also conducted.

4.0 FINDINGS

4.1 Descriptive Statistics

Descriptive analysis is one of the critical phases of statistical data analysis. It provides a clear conclusion on the distribution of data which help in detecting errors and outliers. The study used the four common measures of descriptive statistics; minimum, maximum, mean and standard deviation to present the data patterns. Descriptive results are presented in Table 4.1.

Table 1: Descriptive Results

	N	Minimum	Maximum	Mean	Std. Deviation
GDP in billion $	20	16.095	114.449	65.0942	31.8706
Change in Temp	20	-0.36	0.58	0.016	0.26033

The results showed that the mean of GDP in billion $ between 2004 and 2023 was 65.0942, minimum GDP was 16.095 billion $ while the maximum GDP billion $ was 114.449. The standard deviation was 31.8706

The results showed that the mean of change in temperature between 2004 and 2023 was 0.016, minimum change in temperature was -0.36 while the change in temperature was 0.58. The standard deviation was 0.26033

4.2 Diagnostic Tests

According to Shevlin and Miles (2010), data analysis requires a number of tests to be carried out before the actual process begins. The assumptions are basically on the response variable distribution and that of the residual's distribution of residuals. These assumptions were varied based on the study.

4.2.1 Unit Root Test

This study adopted Levin-Lin Chu test to check for presence of unit roots. Table 4.8 presents the results.

Table 2: Unit Root Test

	t-Statistic	At Levels	Comment
GDP	-2.5044	0.0264	Stationary
Change in Temperature	-4.3763	0.0018	Stationary

Source: Researcher (2025)

From table 2, the significance level for this test at 0.05 for each variable. Alternative hypothesis that data lacks a unit root (stationary) was chosen over the null hypothesis because all of the variables used in the study had P-values below 0.05.

4.2.2 Co-Integration Test

The study utilized the Johansen ML estimator to test for unit roots. Table 3 presents the results.

Table 3: Johansen Cointegration Test

	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
GDP	0.3102	6.6849	3.8415	0.0097
temperature change	0.6333	18.0583	3.8415	0.0000

The result of the linear cointegration test presented in table 3 indicates that there exists long run relationship among the study variables. Hence the null hypothesis of no cointegration was rejected, indicating that long-run relationships existed relationship between climate change and economic growth

4.2.3 Normality Test

The study tested for normality through jarque-bera tests. Results were presented in Table 4.

Table 4: Normality Test

	GDP	Temperature change
Jarque-Bera	1.9035	1.4478
Probability	0.3861	0.4849

The results showed that all the p values were higher than 0.05 for all the jarque bera of all the variables. Therefore, the study failed to reject the null hypothesis. This suggests that the data do not deviate significantly from a normal distribution.

4.2.5 Heteroskedasticity Test

Glejser and Breusch-Pagan-Godfrey tests were used to test Heteroskedasticity Test. The F-statistics results were used to show whether or not the time data series are homoscedastic with a constant difference. Results are presented in Table 5.

Table 5: Glejser and Breusch-Pagan-Godfrey Tests

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	14.4081	Prob. F (2,17)	0.1232
Obs*R-squared	12.5791	Prob. Chi-Square (2)	0.1945
Scaled explained SS	18.1645	Prob. Chi-Square (2)	0.8081

The results showed that the F statistic was 14.4081 and the p value was 0.1232which was above 0.05. This infers that the data was did not have Heteroskedasticity. Therefore, the time data series was homoscedastic with a constant difference.

4.3 Inferential Analysis

The inferential analysis was undertaken after subjecting the data to various tests (Kothari, 2004). Inferential statistics helped in measuring the relationship among variables this included correlation analysis and regression analysis. Therefore, this section contained the correlation and the regression results.

4.3.1 Correlation Analysis

Correlation is usually used to test the relationship between the dependent and the independent variable. The correlation ranges from perfect negative correlation (-1) to perfect positive correlation (+1). Any value close to -1 or +1 indicates that the variables were strongly negatively correlated and strongly positively correlated. A correlation value close to zero (0) indicates weak correlation between variables.

Table 6: Correlation Analysis

		Economic growth	**Climate change**
Economic growth	Pearson Correlation	1	
	Sig. (2-tailed)		
Climate change	Pearson Correlation	-.449*	1
	Sig. (2-tailed)	0.047	

Correlation results showed that climate change had a negative and significant correlation on economic growth in Kenya (r=-0.449, p=0.047). This infers that climate change poses a significant threat to Kenya's economic development,

4.3.2 Regression Analysis

Regression analysis helps to establish the relationship between the variables by presenting the coefficients (coef) and P values. Results were presented in Table 7.

Table 7: Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
climate change	-0.634	0.297	-2.134	0.047
C	4.989	0.075	66.110	0.000
R-squared	0.402	Mean dependent var		4.979
Adjusted R-squared	0.358	S.D. dependent var		0.367
S.E. of regression	0.337	Akaike info criterion		0.756
Sum squared resid	2.042	Schwarz criterion		0.856
Log likelihood	-5.563	Hannan-Quinn criter.		0.776
F-statistic	4.555	Durbin-Watson stat		1.519
Prob(F-statistic)	0.047			

Optimal Model

$$Y = 4.989 - 0.634X + 1$$

Where

Y is economic growth and

X is climate change.

The results showed that climate change had a negative and significant effect on economic growth in Kenya (β=-0.634, p=0.047). Therefore, a unit increase in temperature would result in decline in economic growth by 0.634.

The results also showed that the R square was 0.402. This infers that climate change explain 40.2% of the variations in the dependent variable which economic growth. The overall model also indicated that the F statistic was 4.555 while the p value was 0.047 which was less than 0.05. The null hypothesis stated that there was no statistically significant effect of climate change on economic growth in Kenya. Since the p value was less than 0.05 the null hypothesis was rejected and the study concluded that there was a statistically significant effect of climate change on economic growth in Kenya.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study offers empirical proof that Kenya's economic growth is negatively impacted by climate change in a statistically significant way. The results of the regression showed that a quantifiable drop in GDP is linked to rising temperatures, which represent climate variability. These results demonstrate how Kenya's economy is already vulnerable, especially in climate-sensitive industries like agriculture, water resources, and tourism, which are made worse by extreme weather events like frequent droughts and floods. These climate-related disruptions have the combined effect of decreasing productivity, raising public spending on disaster relief, and generating long-term fiscal liabilities. Thus, Kenya's socioeconomic development and future growth trajectory are at systemic risk due to climate change.

Kenya has adopted a mainstreaming approach, integrating climate change considerations into development planning, budgeting, and implementation across all sectors and levels of government. In addition, National Climate Change Policy aims to enhance adaptive capacity and build resilience to climate variability and change, while also promoting a low-carbon development pathway, according to the United Nations Development Programme.

5.2 Recommendations

Climate change presents significant and sustained threat on Kenya's economic growth, particularly due to the country's reliance on climate-sensitive sectors like agriculture. Recommendations for policymakers include strengthening climate resilience through improved governance, ecosystems, and social structures, and enhancing adaptive capacity by adjusting behaviors, resources, and technologies. Investing in mitigation and adaptation strategies is crucial to reduce the economic burden of climate change.

Strengthening both national and local adaptive capacities should be a priority. The government must take a comprehensive, multi-sectoral approach to climate resilience and adaptation in light of the study's findings, which demonstrate that climate change has a negative and significant impact on Kenya's economic growth, especially through temperature variability. It is imperative to prioritize strengthening local and national adaptive capacity through resilient social systems, improved governance frameworks, and ecosystem preservation. Since the agriculture and water sectors are the most susceptible to climate variability, it is imperative that climate-smart practices be incorporated into all levels of development planning.

To enable prompt responses to calamities like droughts and floods, the Ministry of Environment, Climate Change, and Forestry should invest in cutting-edge systems for climate monitoring, early warning, and disaster preparedness. The frequency and severity of economic shocks brought on by climate-related disasters will be decreased by the establishment and growth of these systems. The Ministry should also take the lead in creating a thorough resource mobilization plan that includes investigating Public-Private Partnerships (PPPs) and gaining access to global climate finance tools like the Adaptation Fund and the Green Climate Fund. In order to close the large funding gap in the implementation of climate resilience and mitigation strategies, these financial mechanisms are essential.

Furthermore, by implementing forward-thinking engineering and construction standards, the government should guarantee that vital infrastructure, such as transportation, energy, and water systems, is climate-proofed. This would lower long-term maintenance costs linked to climate-related damages and protect public investments. Implementing localized adaptation measures effectively also requires strengthening institutional and technical capacity, especially at the devolved levels of government.

Ultimately, safeguarding Kenya's development gains and promoting equitable, climate-resilient economic growth depend on a concerted national strategy that connects macroeconomic planning with climate change adaptation and mitigation.

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