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The Impact of Climate Change on the Tourism Sector in Kenya

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List of Acronyms

ADF- Augmented Dickey Fuller test

ARDL- Autoregressive Distributed Lag Model

GDP- Gross Domestic Product

KES-Kenyan Shilling

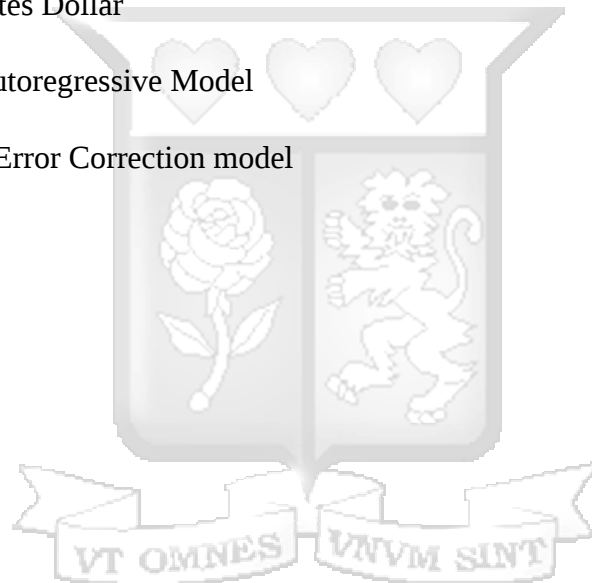
KNBS-Kenya National Bureau of Statistics

KWS- Kenya Wildlife Services

USD-United States Dollar

VAR- Vector Autoregressive Model

VECM- Vector Error Correction model



ABSTRACT

This research investigates the impact of climate change on Kenya's tourism sector, analyzing how key variables such as rainfall, temperature, and economic factors influence revenue generation within the industry. The study hypothesizes that climatic variability significantly affects tourism revenue and employs an explanatory research design with time series data spanning 2002–2022. Using an Autoregressive Distributed Lag (ARDL) model, the analysis reveals that temperature, precipitation, per capita income and exchange rate demonstrates a significant influence on the tourism sector. . Descriptive statistics indicate high variability in precipitation and exchange rates, reflecting broader economic and climatic instability. Despite these challenges, the tourism sector contributes significantly to Kenya's GDP, averaging KES 12 billion annually. The findings emphasize the sector's vulnerability to climatic shifts and underscore the need for adaptive strategies, such as sustainable water management, coastal preservation, and reforestation initiatives. The study also highlights the importance of stakeholder collaboration, policy interventions, and international partnerships to enhance resilience. These findings provide critical insights for policymakers and stakeholders aiming to sustain Kenya's tourism industry amidst evolving climate dynamics.

CHAPTER ONE: INTRODUCTION

1. Background Information

1.1 Climate Change and Its Impact on the Tourism Sector

Climate change is anticipated to have adverse impacts on the tourism industry because climate is one of the key resources for tourism that shapes and drives its success (Hall et al, 2015). The tourism industry is one of the largest and fastest growing global industries, contributing to both national and local economies globally. However, the relationship between climate change and tourism is complicated because climate change is both an essential resource that should be used and a significant limiting factor that creates hazards that should be controlled by both travelers and the tourism sector. Climate has a significant impact on travel planning and the whole travel experience and it affects all tourism sites and providers to some extent. (Scott & Lemieux, 2010).

There are numerous ways that climate change may affect tourism in a country. The industry needs to adopt measures to mitigate climate change because it relies heavily on stable and predictable weather patterns, natural attractions, wildlife, and health and safety concerns. This in turn creates a profound change in the country's economy.

Climate change brings about changes in weather patterns over time, which directly affects tourism. Climate change is expected to influence tourism since weather patterns help determine where and when people travel (Wilkins & Weiskittel, 2017). Seasonality in tourism is widely viewed as a concern for most of the world's most popular places, especially when considering sustainability. (Duro & Turrion-Prats, 2019). Warmer temperatures and altered precipitation patterns can shift the traditional tourism seasons, which alters the peak tourist period by shortening or lengthening it.

Warmer temperatures increased tourism spending in the summer and fall but had more varying results in the winter (Wilkins & Weiskittel, 2017). Warmer winters may reduce

the attractiveness of winter sports destinations while hotter summers make regions with extreme temperatures unattractive to tourists.

1.2 The Effects of Climate Change on Different Aspects

1.2.1 Natural Attractions

Climate change presents a great danger to natural attractions such as beaches, mountains, and coral reefs, which are the epitome of tourism. Some of these heritage sites found in Kenya include coastal sites, such as Fort Jesus and Vasco da Gama pillar, which attract tourists beyond the nation's borders. Fort Jesus is one of the historical sites in Kenya that has been threatened by intense winds and high tides from the Indian ocean which has slowly been eroding the rock foundation (Wanyonyi ,2023). A rise in sea levels and increase in extreme weather conditions may lead to erosion of our beach, as well as damage the coastal infrastructure and historical sites along the coast.

Glacier retreats in mountainous regions also lead to these destinations losing their attractive aspects. Several mitigations should be made and adopted to ensure that the natural attractions are well maintained. However, Because of the increasing number of coastal populations and the high value of coastal assets, poorly thought-out adaptation strategies could have disastrous consequences, even doing more harm than "doing nothing." (Hoggart et al., 2014).

1.2.2 Wildlife and Biodiversity

Wildlife being the major component of tourism in major regions, such as Kenya, may also be affected by climate change. A change in climatic conditions can disrupt wildlife habitats and migration patterns, which makes the viewing experience for tourists deteriorate. Kenya is home to various wild animals, such as “The Big Five.” These wild animals are known to be the epitome of tourist attraction in Kenya. Climatic change may lead to severe cases, such as drought and floods, which may affect the habitat and vegetation for wildlife. In addition, the distribution and behavior of wildlife species including migration, reproduction cycle, forging, habitat selection, reproductive success, and nesting activities, are influenced by vegetation alteration. Determining how climate

change affects animal and forest resources is therefore crucial because it sheds light on the several ways in which biodiversity resources are impacted by these factors. Moreover, it will also help with developing a suitable plan for the preservation and management of wildlife and forest resources. (Rajpar et al., 2022).

1.2.3 Health and Safety Concerns

Tourists' health and safety is also at risk due to changes in climatic conditions. Increased temperature and frequencies may lead to heatwaves, wildfires, and the spread of diseases such as malaria, which make a destination less attractive for tourists. Temperature also affects adverse nutritional outcomes (via crop production and food insecurity). Furthermore, temperature and humidity are associated with various skin diseases and allergies. Studies suggest an association between temperature and diabetes, impaired sleep, cataracts, heat stress, heat exhaustion and renal diseases, albeit some health outcomes being less frequently studied (Rocque et al,2021)

1.2.4 An Overview of the Kenyan Tourism Sector

The economic implication of climate change on tourism is greatly felt by regions that greatly depend on tourism. In 2023, tourist arrivals in Kenya exhibited an increase from 1,483,752 in 2022 to 1,951,185, which is a 31.5% increment. August recorded the highest number of tourist arrivals in 2023, as the growth from July to August was attributed to the wildebeest migration that occurs in Maasai mara around the same time. 45% of the total tourist arrivals were purely for holiday and leisure activities. The arrivals generated 352.54 billion Kenya shillings, which represents a growth of 31.5%. Kenya also recorded a 38% increase in terms of visits made in Kenya Wildlife Service-managed parks, reserves, and national wildlife sanctuaries.

Unfavorable weather conditions and damaged infrastructure can lead to a decrease in tourist arrivals in the country, reducing the income generated by tourists. Therefore, this creates the need to bring up strategies and mitigations to safeguard the economic benefits obtained from tourism. Kenya is famous for its diverse ecosystems, such as the savanna, the coastal area, as well as the lakes. The nation also boasts a cultural heritage, such as

Maasai cultural artifacts, which brings tourist from abroad and overseas. Strategies need to be made and integrated into the tourism system for Kenya to ensure that the industry remains consistent throughout the seasons. This means that stakeholders must understand the concepts involved in a climatic change process and how altering them will affect tourism in Kenya.

To that extent, the stakeholders should undertake actions that lead to positive climatic and environmental change to contribute positively to the tourism sector. For example, participating in afforestation and reafforestation creates a positive shift in weather and climate conditions, thus reducing the extreme heat surge in the country and erratic weather patterns. These shifts create a conducive environment for tourism in Kenya.

1.3 Problem Statement

Climate change has affected the tourism industry in Kenya significantly and created a lot of challenges. Some of these challenges include unpredicted rainfall, change in weather patterns, prolonged periods of drought, which may lead to water shortage, as well as habitat degradation for wildlife. The change in weather patterns has led to floods experienced in various parts of the country, which damage infrastructure, making roads inaccessible, disrupting travel plans for tourists as well as posing a great safety hazard for tourists.

Rotich (2019) conducted research on climate change effects on natural resources available, and tourism sustainability in Maasai Mara National Game Reserve in Kenya. The researcher concluded that climate change affects natural resources positively, and in turn natural resources influence tourism sustainability positively. However, the study only gives us perception at a point in time (2019) due to the use of primary data such as questionnaires. This study cannot be applied to years past 2019. The study on effects of climate change on tourism development around lake Nakuru National Park in Kenya is another study where the researcher found out that swift changes in rainfall patterns, incidences of rising temperature and human activities such as illegal logging affect the tourism development in that area (Rotich, 2015). However, the study has geographical

limitations because it was applied in a specific area of the country and the results obtained cannot be applied to other climatic and environmental regions.

This research seeks to identify and analyze the effect of climate change on the tourism sector in Kenya. By examining the current impact of climate change, the vulnerability of the tourism sector will be brought to light as well as proposals for adaptive measures for the tourism industry. This study aims to boost the sustainability and resilience of the tourism industry by creating a comprehensive view of the effects of climate change on tourism in Kenya, the results will then be used to set strategies in place to aid the sector.

1.4 Research Objectives

1.4.1 General Objective

The primary goal in this research is to investigate the impact of climate change on Tourism sector in Kenya.

1.4.2 Specific Objectives

This research aims at:

- I. Assessing the impact of changing rainfall patterns on the tourism sector GDP in Kenya.
- II. To analyze the effects of rising temperatures on the tourism sector GDP in Kenya.

1.4.3 Research Questions

- I. What is the impact of changing rainfall patterns on the tourism sector's GDP in Kenya?
- II. What is the impact of changes in temperatures on the tourism sector's GDP in Kenya?

1.5 Significance of the research

This study is important because it exhibits the relationship between climate conditions and tourism, which are two critical areas for Kenya's economy and development. Various

beneficiaries will be able to use the results from this study in several ways since it provides a detailed analysis on how climate change affects the tourism industry in Kenya. The beneficiaries of this study include tourism stakeholders, policy makers, and tourism organizations. The tourism stakeholders, which include the hotel owners and wildlife conservationists, will gain important insights into how climate change affects their operation and create adaptive business models and measures to ensure sustainability has been acquired.

Policymakers, such as the ministry of Wildlife and Tourism, Kenya Tourist Development Corporation, and the Kenya Wildlife Services, will get to acquire insight on the impacts of climate change on Tourism sector in Kenya. This in turn will enable police makers to formulate appropriate policies that support climate change adaptation, such as creation of supportive programs, which promote sustainable tourism practices. This study will allow organizations, such as the United Nations World Tourism Organization, to learn ways on how to support initiatives and programs in Kenya and other similar regions.

Other beneficiaries include the local communities whose livelihood depends on tourism and benefit from sustainable tourism practices and policies. The tourism sector has created fantastic job opportunities to Kenyans. Businesses and various hotel owners can use the results from this research to plan and make new operation strategies that will effectively help in maintaining the business. The results will also lead to better strategies being set in place which in turn leads to an increase in job opportunities in the country. Researchers and academics can use this study as well to contribute to their academic literature as a basis for a future research study. Researchers can build onto this study and obtain better results using new and developed techniques.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter explores existing knowledge and theories that support the study of the relationship between climate change and Tourism sector in Kenya. The theoretical framework will examine the current theories on the cause and effects of climate change, perceptions of these changes, and establish the connections between these theories.

The empirical framework will synthesize findings from empirical studies to provide an overview of what is known on the link between climatic conditions and tourism.

2.2 THEORETICAL FRAMEWORK

A theory is an idea that has not been proved, whereas a scientific theory is an idea that has been observed and widely accepted (Gould, 2013). This theoretical framework will examine the current theories on the cause and effects of climate change, in addition to perceptions of these changes and to establish the connections between these theories. These theories include the greenhouse theory and push and pull theory.

2.2.1 Push and Pull Theory.

Crompton's theory of push and pull factors in tourism was proposed by Dennis J. Crompton in the paper "Motivations for pleasure vacation," which was published in 1979. Crompton's theory of push and pull factors in tourism proposes that there are two distinct levels of socio-psychological motivations that influence people to travel. In this theory, there are various levels of motivation. The first one is the desire to travel, which in turn initiates the decision for a trip. It is then followed by the decision for destination. There are numerous factors that come into play when one is making the selection of a destination.

Crompton proposes two groups of motives that motivate a tourist to travel to a certain destination. These motives primarily serve as a push or a pull. A push factor is an internal factor that encourages people to leave their current locations such as the need for escape, adventure, or relaxation. Pull factors are exterior attractions that draw people towards a particular destination such as scenic beauty, cultural attractions, or recreational

opportunities. These factors work hand in hand when it comes to shaping people's travel behaviors and their destination of choice.

There are various assumptions present in Crompton's theory that make the theory viable. Some of these assumptions include differentiation of factors, where Crompton's assumes that push and pull factors are distinct and can be clearly identified separately when it comes to influencing a travel decision. The theory also assumes that the push and pull factors are universal and hence can be applied across the world despite the presence of diverse cultures. The theory also assumes that the motivation for travelling can be completely grouped into a push factor or pull factor.

However, the theory has various limitations such as Simplification of Motivations whereby the theory tends to oversimplify the complexity of individuals' motivations to travel into two aspects a push or pull factor. The theory does not factor in complex matters such as cultural background, personal experience and economic states that may influence the travel destination selection process. Crompton's theory also does not incorporate the factor that travelling motivations are dynamic and may evolve over time based on interests and external factors hence this model may not capture this dynamic nature.

This theory fits into the research in that it evaluates the factors that push tourists from their countries and pull them into Kenya. For example, tourists in European nations experience push factors such as extreme snow conditions during the winter and the desire to experience warmer climate. In return, Kenya pulls them using its tourism products such as warm weather, sandy beaches, and beautiful sceneries to compel the European tourists to consider the nation as a destination.

The push and pull theory seeks to explain how changes in climatic conditions push tourists to consider travelling to other nations, and how nations use their tourist attraction products and services to pull them into selecting a viable destination that suits their push factors.

2.2.2 Green House Effect

The greenhouse effect was proposed and supported by various scientists over the years. The greenhouse theory suggests that climate change can be caused when radiation from

the sun is absorbed by greenhouse gases, mainly carbon dioxide and chlorofluorocarbons, in the atmosphere and hence this radiation is not reflected into space. This tends to function as a blanket and hence prevents our earth surface from cooling down (Denchak,2023).

There are various causes of the greenhouse effect, such as burning fossil fuels, deforestation, and industrial waste. Burning fossil fuels is the leading source of carbon dioxide production since most people around the world as well as companies burn fossil fuels to generate heat. Deforestation involves the cutting down of forests to create land for agricultural practices as well as obtaining wood for fuel. The intensity of absorption of carbon dioxide in the atmosphere reduces because of forest destruction, hence increasing the greenhouse effect (Audi et al., 2020).

The main effect of greenhouse effect is that it leads to an increase in temperature, severe storms, as well as rising ocean levels (El Zein & Chehayeb, 2015). Over the years, the earth has been getting warmer, with other countries such as India, Italy, Spain, and Mali experiencing extreme heat waves and having temperatures soar past 40 degrees Celsius. Elevated temperature has also led to wildfires in various countries such as Australia, Canada, and the United States.

Elevated temperatures have also caused severe storms throughout the world. Some of these storms include hurricanes, cyclones, and typhoons, which have been prevalent in regions across the Atlantic, Pacific, and Indian Ocean. The increase in temperature has led to melting of the ice sheets at the north pole because of the greenhouse effect, leading to an increase in ocean levels (Denchak,2023). This creates a great threat to regions along the coastal areas.

Various researchers over the years concluded that greenhouse gases play a fundamental role in terms of climate change and hence the rising levels of the same could affect the future. This theory is relevant to this study since Kenya is blessed with a great coastline that has various historical sites and sandy beaches, which play a huge role in tourism. The

coastal line can be affected by the rising sea levels and in the long run affect the level of tourism in the country.

Kenya has also been affected by severe changes in weather where the country has experienced flood in various parts of the country. Early 2021, the country experienced floods in most parts of our country, which rendered most places inaccessible, various roads became impassable, and various hotels had to close due to the floods. For example, in Narok County in Kenya, the River Talek broke its banks affecting several people, including tourists in Maasai Mara and 12 camps (Koech,2024). This is attributed to the change in climate over the years due to the greenhouse effect.

2.3 EMPIRICAL FRAMEWORK REVIEW

The study on the effects of climate change on Tourism sector has been done by various scholars over the years and in various parts of the world.

2.3.1 Effects of Climate Change on Tourism Sector in Developed Countries

(R. Steiger et al,2017) conducted a critical review of climate change on ski tourism in 27 countries some of them being part of the European Union, Austria, Australia, Switzerland, United States, and Canada. The researchers obtained literature published from 1996 up to April 2017 on the effects of climate change on ski tourism, analyzed their results, and found out that tourism - especially sport tourism - directly depend on climate change .It has been consistently noted that ski area managers are hesitant to recognize climate change as a threat to their businesses or to participate in climate change research vulnerability.

Similarly, (Shijin et al., 2022) conducted a study on the review of the Impacts of Climate Change on Tourism in the Arid Areas: A Case Study of Xinjiang Uygur Autonomous Region in China. In this research, the impact of climate change on tourism was assessed from various aspects: tourist's behavior, tourist routes and destinations, and tourism climate comfort. Both quantitative and qualitative data was used where qualitative data was obtained from mainstream newspapers, network news websites, central and local government websites, and other channels.

Meanwhile, quantitative data on weather and climate data of daily precipitation and temperature were provided by the National Climate Center, China Meteorological Administration (CMA). The researchers selected 77 literature studies related to climate change and tourism in Xinjiang as basic data and found out that the impacts of climate change on tourism are long-term. The impact of climate change on tourism sector in arid areas is omnidirectional and tourism needs to be optimized and adjusted in advance.

Moreover, Steiger (2023) later conducted research on climate and carbon risk of tourism in Europe. The researcher obtained literature written on climate change and weather on European countries as well as Azerbaijan, Armenia, Georgia, Kazakhstan, Russia, and Turkey, from this, a total of 423 articles were reviewed. The main purpose was to evaluate climate and carbon risks for the European tourism industry. The findings were that truly climate and carbon risk greatly affect tourism in Europe and that tourism in Europe must urgently prepare for various climate and carbon risks while simultaneously intensifying efforts to lower tourism-related greenhouse gas emissions.

Wilkins and Home (2024) reviewed the effects and perceptions of weather, climate and climate change on outdoor recreation and nature-based tourism in the United States. The researchers looked for articles that were written across multiple years that had various words, such as “climate” and “weather” in their title. The authors worked with articles from 2000 to 2022 and discovered that extreme weather events and changes in climate can negatively impact infrastructure access and safety, which in turn affects outdoor recreation. These results support the results obtained by Steiger (2023), (R. Steiger et al,2017), and Shijin, Xinggang, and Jia (2022).

2.3.2 Effects of Climate Change on Tourism in Developing Countries

Rotich (2015) conducted research titled, “The Perceived Effects of Climate Change on Tourism Development Around Lake Nakuru National Park in Kenya.” The researcher’s study incorporated the use of primary and secondary data, where the author issued surveys and obtained data from books and journals. This research was conducted in 2015 and the researcher found out that swift alterations in rainfall patterns and instances of increasing

temperature, and human activities, such as illegal logging, affect tourism development in that area.

(Jurema et al,2018) conducted research on the impacts, possibilities, and challenges of tourism under global climate change scenarios in Brazil. The research was conducted from January to May 2015 where various Brazilian universities were selected to take part in the research. Interviews and questionnaires were used to obtain data from the participants and later analyzed. The key findings in this research showed that tourism is extremely sensitive to climate change.

Correspondingly, Rotich (2019) conducted research on climate change effects on natural resources available and tourism sustainability in Maasai Mara National Game Reserve in Kenya. His sample size was comprised of 507 respondents: 399 households, 90 tourists and 18 experts selected by simple random sampling. Rotich utilized interviews to collect data from climate change experts and tourists and later analyzed qualitatively using content analysis. The researcher concluded that Climate change affects natural resources positively, and in turn natural resources influence tourism sustainability positively. This study emphasized the need for tourism operators to adopt mitigation and adoption strategies to address the challenges posed by climate change.

Similarly, Lucia (2021) conducted a study on the effect of climate change on sustainable tourism in Uganda. The researcher issued questionnaires to obtain information for 100 individuals who were the industries' major stakeholders. The author had various questions, such as "What are the causes of climate change in Uganda?" "What effects of climate change has one experienced?" and "How has that experience affected business and other operations?" From the various responses, the researcher was able to analyze the information and concluded that effect of climate change on tourism in Uganda was widely felt across the country and must be identified and studied to mitigate measures to curb the causes of climate change.

Finally, Njeri (2023) conducted research on the impact of flooding caused by climate change on tourism investments and local livelihoods in the Samburu Region in Kenya.

The author used primary data by issuing questionnaires to 40 respondents from three tent camps and 2 lodges. The researcher analyzed the responses and concluded that climate change induced flooding disrupted tourism business operations, causing losses of approximately 11 billion dollars as well as damages tourism investments, loss of property, employment, and household income.

2.4 Research Gap

The study done on the impact of flooding resulting from climate change on tourism investments and local livelihoods in the Samburu Region in Kenya (Njeri, 2023) has a limitation since it only gives a perception at a given point in time (2023) and the conclusions drawn from this research cannot be applied to subsequent years. Similarly, the research done on the effect of climate change on sustainable tourism in Uganda (Lucia, 2021) has limitations since the use of interviews taken in 2021 would give information at a point in time and hence the result may not be used for other years. The same limitation can be applied to the research on climate change effects on natural resources available and tourism sustainability in Maasai Mara National Game Reserve in Kenya (Rotich, 2019) and the impacts, possibilities, and challenges of tourism under global climate change scenarios in Brazil study (Jurema et al., 2018).

Moreover, there are several research that have a geographical limitation such as the study on the impact of climate change induced flooding on tourism investments and local livelihoods in the Samburu Region in Kenya (Njeri, 2023) and the study on effects of climate change on tourism development around lake Nakuru National Park in Kenya (Rotich, 2015). In this case the two research were only applied to specific areas of the country, and the results obtained cannot be applied to other climatic and environmental regions. Moreover, the study on the effects and perceptions of weather, climate and climate change on outdoor recreation and nature-based tourism in the United States (Wilkins & Home, 2024) and the study on climate and carbon risk of tourism in Europe (Steiger, 2023) have the same limitation since the conclusions obtained cannot be applied in other countries such as Kenya.

This study will therefore look at the effects of climate change on the tourism industry in Kenya. It will incorporate climatic and economic factors, which will be part of the model needed to identify the causal mechanism and predict the future economic implications of climate change in the country's tourism sector. From the results obtained from this study various stakeholders will be able to understand the challenges faced by the tourism industry, especially when it comes to matters to do with climate.

2.5 Conceptual Framework.

The conceptual framework gives an outline of the relationship between variables of interest when it comes to studying the effect of climate change on Tourism sector in Kenya. The variables of interest would be revenue generated by tourism activities within the country, temperature, rainfall, exchange rate, per capita income in the country, interest rate, and rule of law indicator. Revenue generated from the tourism sector will be the dependent variable while temperature, rainfall, exchange rate, per capita income in the country, interest rate, and rule of law indicator are the independent variables.

Revenue generated in the tourism sector- This will be the gross domestic product generated by both domestic and international tourism.

Temperature - Temperature has an influence on destinations that are mostly considered by tourists. In this study, the expectation will be that there is a direct correlation between temperature and the revenue generated from tourism.

Rainfall - Rainfall has a negative effect on tourism since many tourists would consider better weather for them to take part in outdoor activities. Therefore, in this study, the expectation will be an inverse relationship between rainfall and revenue generated from tourism.

Exchange rate - The exchange rate refers to the relation of one currency to another. In this study, the expectation will be an inverse relationship between exchange rates and revenue generated from tourism. The USD/KES exchange rate will be used for this study.

Per capita income in the country -This is the measure of the amount of money earned per person in a country. The more per capita income, the more disposable income a person has. This in turn allows individuals to take part in tourism activities, which would increase the GDP generated from tourism. Hence the expectation will be a direct correlation between per capita income and the GDP.

Interest rate -The interest rate for a country may affect the amount paid by borrowers, which may either reduce or increase their disposable income. Therefore, in this study, the expectation will be a negative correlation between interest rate and revenue generated from tourism.

Rule of law - This captures perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, and the courts as well as the likelihood of crime and violence. Therefore, the expectation will be positive in relation to revenue generated from tourism.

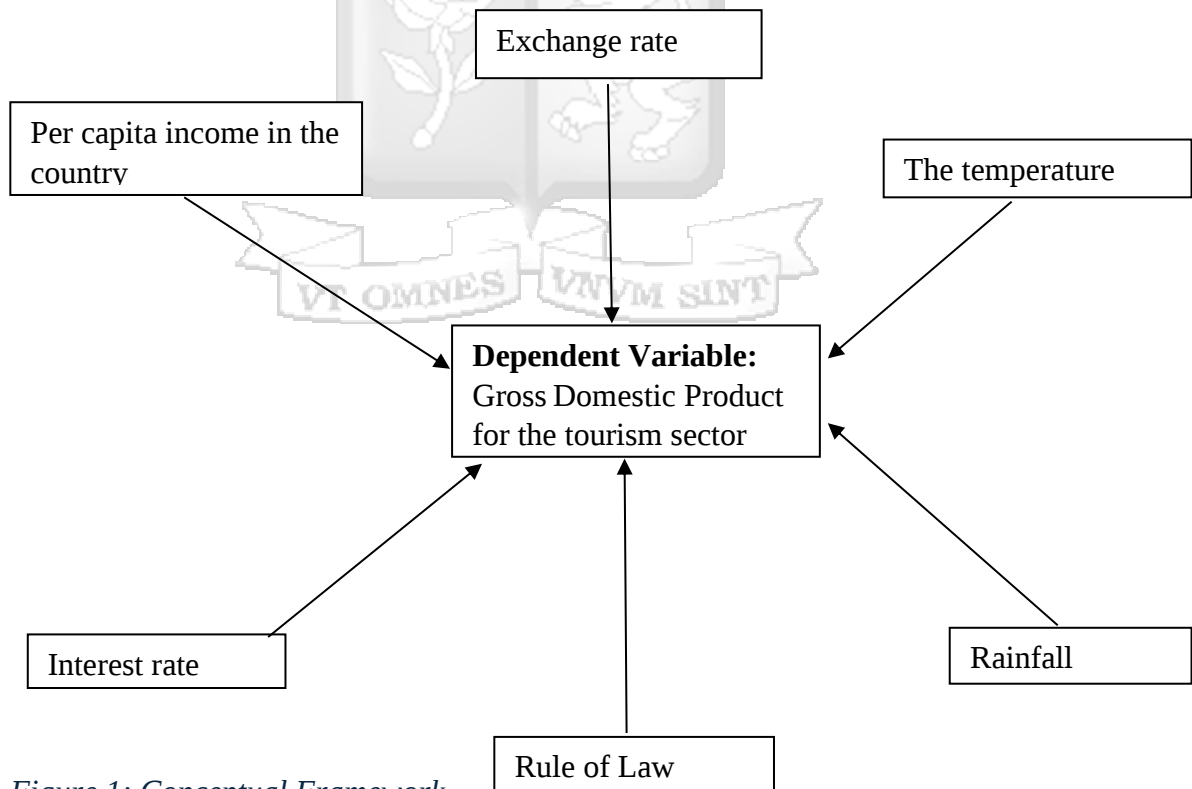


Figure 1: Conceptual Framework

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The main aim of this study is to find out the relationship between climate change and the Tourism sector in Kenya by carrying out a time series analysis. This study utilizes quantitative methodology and hence a positive approach is expected. The research design, sample to be used and a step-by-step process on how the data will be analyzed is given in this chapter. In addition, this chapter also states the sources for data used in this study.

3.2 Research Design

This paper utilizes the explanatory research design to assess the effects of climate change on Tourism sector in Kenya. The explanatory research design is used to connect ideas as well as understand the cause and effect between the independent and dependent variables. This design provides a clear picture and an in depth understanding of the effect of the independent variables (rainfall, temperature, interest rate, exchange rate, rule of law, per capita income) on the dependent variables (Gross domestic Product in the tourism sector). This design enables the analysis of patterns and trends in data that will yield results that provide a better understanding on the impact of climate change (temperature and rainfall) on the tourism sector in Kenya.

3.3 Population and sampling

Population refers to a set of objects or data that has specific characteristics and a researcher would like to draw conclusions about the data. When it comes to the study on the effect of climate change on the tourism industry in Kenya, sampling is most appropriate since data available for variables such as quarterly Gross domestics product cover up to 2002. This then reinforces the use of a sample from 2002 to 2022 for this study.

Sampling refers to the process of selecting a subset of data from a larger population or dataset to analyze or make inferences about the entire population (Muhammad, 2023). This study on the effects of climate change on Tourism sector in Kenya utilizes samples obtained from various departments and stakeholders in Kenya and the world bank.

3.3.1 representativeness of sample

This study will use data from various departments and stakeholders, such as the Kenya National Bureau of Statistics and the World Bank. This study ensures representativeness of samples is achieved by ensuring that a sufficient sample is obtained for the analysis. The study's data ranges from 2002 to 2022, which is divided into quarters, makes the sample a total of 84 observations. The results obtained on the effect of climate change on Tourism sector will then be accurate, comprehensive, and adequately representative. Due to the lack of data for variables, such as quarterly Gross Domestic Product before 2002, this research will use data from 2002 to 2022.

3.4 Data collection and sources

This study utilizes secondary data because of the nature of the study. Nevertheless, the data will be quarterly time series data since the focus is on Kenya. Secondary data is a better fit compared to primary data since it is easily accessible as the data is available online. The data will be obtained from various departments and stakeholders in Kenya and the World Bank, from 2002 to 2022. Other sources of data include, Climate change Knowledge Portal, the Kenya National Bureau of Statistics, Central Bank of Kenya, and the World Bank. The data obtained for this study is dependable since it is obtained from well-known and trusted organizations.

Table 1: Description of Variables and Units of Measurement

Variable	Definition	Sources
Gross Domestic Product	This is the revenue generated by the tourism sector	Kenya National Bureau of Statistics
Temperature	Temperature indicates how hot or cold an object or environment is. Temperature is typically measured in degrees Celsius (°C) or degrees Fahrenheit (°F).	Climate change Knowledge Portal
Rainfall	Rain is liquid water in the form of droplets that have condensed from atmospheric water vapor. Rainfall is measured in Millimeters.	Climate change Knowledge Portal
Interest rate	The percentage of interest that a bank or financial institution charges when one borrows money, or the percentage it pays when one deposit money into an account.	Central Bank of Kenya
Exchange rate	is a relative price of one currency expressed in terms of another currency.	Central Bank of Kenya
Rule of Law	These captures perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, and the courts as well as the likelihood of crime and violence.	The World Bank
Per capita Income	measure of the amount of money earned per person in a nation or geographic region.	Kenya National Bureau of Statistics

3.5 Data Analysis

This involves the application of statistical and logical techniques to data to obtain accurate and comprehensive results. Statistical tests provide a clear picture of the data's properties.

This study employs the multiple linear regression model that contains the dependent variable (Gross Domestic Production from tourism) and the independent variables, which are temperature, rainfall, exchange rate, interest rate, per capita income, and rule of law. The economic variables, such as exchange rate, interest rate, and per capita income, are control variables that entail the other variables that affect tourism revenue, apart from temperature and rainfall.

3.5.1 Model Specification

This model will use time series data to generate coefficients that help in establishing the quantitative effect of climate change on Tourism sector revenue in Kenya. The model is as follows:

$$GDP = B_0 + B_1Temp_t + B_2Rain_t + B_3int_t + B_4Exchange_t + B_5Rule_t + B_6capita_t + \varepsilon_t$$

$B_0 = \text{Intercept}$

$GDP = \text{natural log of Gross Domestic Product of the tourism sector}$

$Temp = \text{temperature}$

$Rain = \text{Rainfall}$

$Int = \text{interest rate}$

$Exchange = \text{exchange rate}$

$Rule = \text{Rule of law}$

$capita = \text{natural log of per capita income}$

$\varepsilon_t = \text{error term}$

$B_1, B_2, B_3, B_4, B_5, B_6 = \text{coefficients}$ that shows the relationship between independent variables and dependent variables.

The dependent variable

The dependent variable is the gross domestic product in the tourism sector. This is majorly measured by the quarterly earnings made by the tourism sector.

Independent variable

The independent variable majorly used in this study is the rainfall and temperature. The two variables effectively show the effect of climate change on Tourism sector GDP.

Control variables

The following control variables have been included in the model to factor in other elements that would influence the tourism sector.

- **The interest rate** - The interest rate for a country may affect the amount paid by borrowers, which may either reduce or increase the disposable income.
- **Rule of law** - This captures perceptions of the extent to which agents have confidence in and abide by the rules of society and in particular the quality of contract enforcement, property rights, the police, and the courts as well as the likelihood of crime and violence.
- **Per capita income in the country** - This is the measure of the amount of money earned per person in a country. The per capita income influences the disposable income a person has, hence affecting the amount spent on leisure activities in the long run.
- **Exchange rate** - The exchange rate refers to the relation of one currency to another. The USD/KES will be used in this study because it is widely used and is more stable, compared to other currencies.

3.5.2 Descriptive Statistics

The descriptive statistics in this study aims to summarize and describe the features and characteristics of the data to be used. This offers a summary and understanding of the data about the central tendencies by computing the mean and median for the sample data. The dispersion of the data about the mean is obtained by computing the variance and standard

deviation. The distribution will also be looked at by having the skewness and kurtosis. These descriptive statistics are done for all variables to gain understanding on the trend and variation of the data.

3.5.3 Unit root tests

Unit root test is important when determining the stationarity of the times series data. Variables have constant mean and variance over time when they are said to be stationary. This means that the results obtained from the Ordinary Least Square Estimator are accurate and can be used for future planning. Variables are said to be non-stationary when they do not revert to the mean or have a volatility that changes over time. In this case, the results obtained would be misleading. Hence, to receive consistent and relevant results, non-stationary variables will be converted to stationary data by differencing.

This study will utilize the Augmented Dickey Fuller (ADF) test. In this test, the null hypothesis is that the variables are non-stationary. This test helps in attaining the p value, which upon evaluation, if the value is less than significance level, the null hypothesis is rejected. Otherwise, the null hypothesis is not rejected. If the null hypothesis is rejected, then the variables are stationary. On the other hand, if the null hypothesis is not rejected then the variables are non-stationary.

3.5.4. Johansen Cointegration Test

Economists relied on linear regressions to find the relationship between several time series processes. However, Granger and Newbold argued that linear regression was an incorrect approach for analyzing time series due to the possibility of producing a spurious correlation. The use of linear regression to analyze the relationship between several time series variables becomes detrending and it would not solve the issue of spurious correlation. Instead, a recommendation was made to check for cointegration of the non-stationary time series. This brought about the importance of conducting cointegration tests. There are numerous ways of conducting cointegration tests, namely the Engle-Granger test, and the Johansen test.

The Johansen Cointegration test is a statistical test that is used to show if there is a long run relationship between the variables. If the variables are found to be non-stationary, then the next thing would be to evaluate for cointegration test. Compared to the Engle-Granger test, the Johansen test allows for more than one cointegrating relationship making it the best for this study since there are multiple variables.

3.5.5 Autoregressive Distributed Lag Model

An autoregressive distributed lag (ARDL) model is an ordinary least square (OLS) based model which is applicable for both non-stationary time series as well as for times series with mixed order of integration. This model estimates the relationship between the independent variable and the dependent variable while including both current and lagged values in the model. The lag length is chosen, and the model is estimated to ensure accurate and valid data is obtained. This model has various advantages, such as flexibility when dealing with mixed order integrations, which makes it a better option for carrying out the study.

3.5.6 Diagnostic test

The next thing, after estimating the model, is performing diagnostic tests. Various diagnostic tests, such as multicollinearity and heteroscedasticity, will be done to ensure that the model is robust, valid, and reliable. Heteroscedasticity helps estimate if the variance of the error term is constant over time. This test is done by conducting the Breusch-pagan or white test. The results obtained from the regression and the statistical tests will be interpreted and conclusions drawn.

CHAPTER FOUR: EMPIRICAL RESULTS AND ANALYSIS

4.1 Introduction

The main purpose of this chapter is to present the findings on the effects of climate change on the tourism industry in Kenya. The analysis is structured around the research objectives and aims to provide an inclusive overview of how climate change affects the tourism industry in Kenya. The analysis entails the descriptive statistics, test for stationarity, and the Autoregressive distributed lagged model as well as various diagnostic tests.

4.2 Descriptive statistics

In this sector, the descriptive statistics - such as the number of observations, the mean, the standard deviation, the minimum, maximum, range, skewness and kurtosis - will be presented. A summary of the findings is as follows:

Table 2: Descriptive Statistics

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum	Range
Tourism Sector in billion Kenya Shillings	84	12.278	11.021	2.064	46.859	44.795
Per capita income in Kenya Shillings	84	23,195.000	17,365.929	6,311.000	53,123.000	46,812.000
Temperature (degrees Celsius)	84	25.520	0.901	23.960	27.530	3.570
Precipitation (Millimeters)	84	56.910	28.686	12.000	149.970	137.970
Rule of law	84	-0.711	0.242	-1.020	-0.320	0.700
Central Bank Rate (%)	84	14.630	2.298	11.880	20.210	8.330
Exchange rate (USD/KES)	84	88.680	14.573	62.650	121.950	59.300

Table 2 includes a summary of key metrics, such as the mean, standard deviation, maximum, minimum, and range. The analysis was conducted using 84 observations. The tourism sector had an average of KES 12.278 billion between 2002 to 2022. The sector has seen great variation in its revenue, as shown by the high standard deviation of KES 11.021 billion within the same timeframe. This suggests that there has been growth and decline between the year 2002 and 2022 with values ranging from a low of 2.064 billion in the second quarter of 2003 and a high of 46.859 billion in the last quarter of 2021, creating a wide range of 44.795 billion.

Environmental variables, such as temperature and precipitation show contrasting patterns. The temperature on average is 25.53 Degrees Celsius between 2002 and 2022. The variation in temperature has been minimal over the same timeframe, as indicated by a standard deviation of 0.9004 Degrees Celsius. This means that the temperature has been stable since it ranges between 23.96 degrees Celsius and 27.53 Degrees Celsius. However, precipitation demonstrates great fluctuation with an average of 56.91mm and a high standard deviation of 28.686mm, suggesting periods of both drought and heavy rainfall. This reflects a broader shift in climate.

Per capita income reflects a large disparity as indicated by a mean of KES 23,195 and a high standard deviation of KES 17,365.92, suggesting considerable income inequality. The range from KES 6,311 in the second quarter of 2002 to KES 53,123 in the last quarter of 2022 indicates a wide economic division, which implies a mix of affluence and poverty in the population.

The exchange rate displays substantial volatility, with a mean of KES 88.68 per USD and a significant standard deviation of KES 14. 573per USD. The exchange rate ranges from KES 62.65 per USD to KES 121.95 per USD resulting in a range of 59.30, indicating significant swings in the Kenyan shilling against the US dollar, which could be attributed to external economic pressure, such as inflation, trade balance, or international market forces. In terms of monetary conditions, the Central Bank interest rate averages 14.63%, with a moderate standard deviation of 2.297%, reflecting some level of fluctuation in borrowing costs, influenced by shifts in monetary policy or economic conditions. The

range between the lowest central bank interest rate of 11.88% in the third quarter of 2020 and the highest of 20.21% in the second quarter of 2012 indicates that the central bank interest rates have seen notable changes but within a controlled band.

Table 3: Skewness and Kurtosis

Variable	Number of observations	Skewness	Kurtosis
Tourism Sector in billion Kenya shillings	84	1.272	0.752
Per capita income in Kenya Shillings	84	0.395	-1.598
Temperature (degrees Celsius)	84	0.251	-0.935
Precipitation (Millimeters)	84	0.936	0.770
Rule of law	84	0.209	-1.683
Central Bank Rate (%)	84	0.784	-0.565
Exchange rate (USD/KES)	84	0.304	-1.051

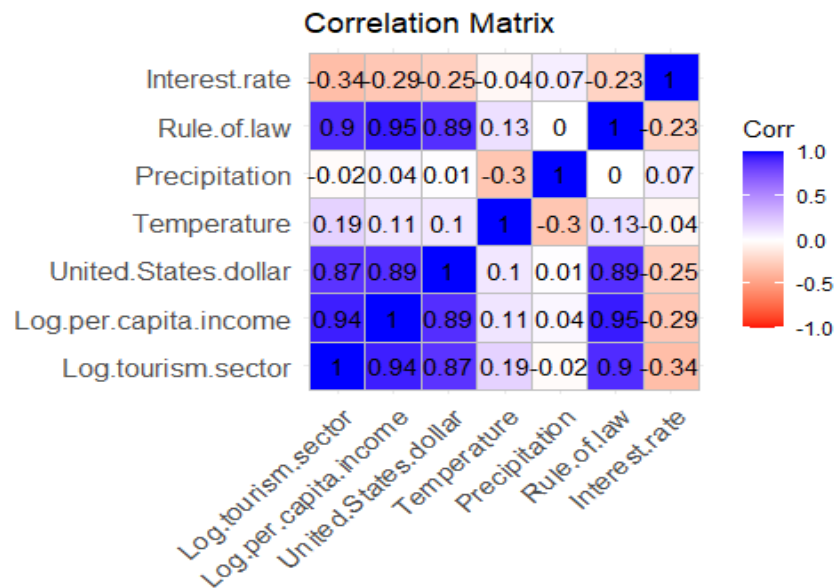
Skewness and kurtosis are important because it gives insight into the distribution of each variable. Understanding the data's skewness and kurtosis ensures that the research study is dependable, relevant, trustworthy, and consistent with the assumptions of the statistical techniques employed. It assists in spotting potential problems with the data and guaranteeing reliable results.

The tourism sector is seen to have a positive skew of 1.272, indicating that the data has lower values with some exceedingly high values, pulling the distribution to the right. Its kurtosis of 0.752 is less than 3, suggesting a platykurtic distribution, which indicates fewer outliers and a lighter tail than a normal distribution. Similarly, temperature and precipitation have positive skewness of 0.251 and 0.936 respectively, which give similar

indications about its data. In addition, the kurtosis for temperature and precipitation are below 3, indicating few outliers and lighter tails than a normal distribution.

Moreover, per capita income, exchange rate, interest rate, and rule of law have positive skews of 0.395, 0.304, 0.784, and 0.209, respectively. This indicates that the data has lower values, with extremely high values pulling the distribution to the right. The Kurtosis of -1.598, -1.051, -0.565, and -1.683 are all below 3, meaning the data has few extreme values. Overall, the variables show generally that the data has few extreme outliers and more uniform data distributions.

4.3. Correlation Matrix



A weak positive correlation (0.19) between temperature and log of tourism sector indicates that greater temperatures may have a minor impact on tourism. The weak correlations between precipitation and the log of the tourism sector (-0.02) imply that rainfall patterns have very little direct impact on the tourism sector. Additionally, there is a high positive association between the log of tourism sector and rule of law (0.90) and the exchange rate (0.87). This suggests improved governance or institutional quality and a stronger US dollar, due to exchange rate effects, are positively correlated with the performance of the tourism industry. Nevertheless, the substantial positive connections between log of per

capita income and the US dollar (0.89) and rule of law (0.95) further support the concept that good governance and economic growth are related. The strong correlation between the per capita income, US dollar and the rule of law has led to the rule of law being dropped due to the presents of multicollinearity. The rule of law was chosen because the two variables (per capita income and exchange rate) are greatly linked to the tourism sector.

4.4 Stationarity Test

The Augmented Dickey-Fuller (ADF) test was employed to assess the stationarity of the variables.

Table 4: Stationarity test

Variable	P-value	Significance level	Stationarity at levels
Natural log Tourism Sector	0.035	0.05	Stationary
Natural log Per capita income	0.549	0.05	Non-Stationary
Temperature (Degrees Celsius)	0.010	0.05	Stationary
Precipitation (Millimeters)	0.010	0.05	Stationary
Central bank rate	0.402	0.05	Non-stationary
Exchange rate (USD/KES)	0.549	0.05	Non-stationary

The Augmented Dickey-Fuller (ADF) checks for stationarity in a time series. In this case, stationarity means that the statistical properties of the series (mean, variance, and autocorrelation) do not change over time. The null hypothesis means that the variable is stationary and hence the p-value is less than the level of significance. On the other hand, the alternative hypothesis means that the variable is non-stationary hence the p-value is greater than the level of significance. The null hypothesis is rejected if the P-value is

greater than the level of significance and in this case the variable is said to be non-stationary else the null hypothesis is not rejected.

The Augmented Dickey-Fuller (ADF) test's results indicate a mixture of stationarity across the variables. For example, precipitation, natural log of the tourism sector, and temperature are stationary variables with p-values of 0.010, 0.035, and 0.010 respectively, making their statistical properties consistent and suitable for time-series analysis without additional alterations.

On the other hand, variables such as the interest rate, tourism sector, per capita income, and the exchange rate are non-stationary variables with p-values that exceed 0.05, meaning that their statistical properties vary with time. Interest rates, natural log of tourism sector, natural log of per capita income and exchange rate become stationary after differencing the variables once.

4.5 Lag selection criteria

The ideal lag length must be chosen in time series analysis to create precise and dependable models. The Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ), Schwarz Criterion (SC), and Final Prediction Error (FPE) are a few examples of lag selection criteria that are frequently used to assess model performance at various lag lengths. With lower values signifying higher model performance, these criteria strike a balance between model fitness and complexity. Lag 6 was chosen as the best model by three criteria after the metrics were calculated for lag lengths ranging from 1 to 6. The lowest values of AIC, SC and FPE at lag 6 indicate that this represents the optimal trade-off between model accuracy and parsimony.

Table 5: Lag selection criteria

Lag length	AIC(n)	HQ(n)	SC(n)	FPE(n)
1	7.047	7.072	7.109	1149.579
2	6.591	6.628*	6.684	728.433
3	6.577	6.627	6.702	719.010
4	6.601	6.663	6.757	735.922
5	6.625	6.670	6.812	753.968
6	6.521*	6.607	6.738*	679.329*

4.6 The Autoregressive Distributed Lag Model

A statistical method for examining the relationship between a dependent variable and one or more independent variables is the Autoregressive Distributed Lag (ARDL) model. This method is especially useful when dealing with time-dependent data sets. This model's output provides approximations of the connection between the tourism industry (using dependent variables transformed into their natural log forms) and independent variables such as exchange rates (USD), per capita income, precipitation, temperature and interest rate – along with their lagged values. The following results were obtained from the model.

Table 6: Short run effect

Variables and lags	Coefficient	P value
Intercept	5.790	0.117
1 st L (log of the tourism sector)	0.472	0.007 ***
2 nd L (log of the tourism sector)	-0.084	0.695
3 rd L (log of the tourism sector)	-0.227	0.114
4 th L (log of the tourism sector)	0.380	0.022 **
5 th L (log of the tourism sector)	-0.373	0.055*
6 th L (log of the tourism sector)	0.4117	0.054*
Log of per capita income	1.209	0.000
1 st L (Log of per capita income)	-0.574	0.159
2 nd L (Log of per capita income)	0.660	0.171

3 rd L (Log of per capita income)	-0.152	0.709
4 th L (Log of per capita income)	-0.653	0.179
5 th L (Log of per capita income)	0.151	0.721
6 th L (Log of per capita income)	-0.028	0.935
Exchange rate	-0.015	0.051*
1 st L (Exchange rate)	0.021	0.054*
2 nd L (Exchange rate)	-0.002	0.836
3 rd L (Exchange rate)	-0.007	0.479
4 th L (Exchange rate)	0.017	0.114
5 th L (Exchange rate)	-0.013	0.228
6 th L (Exchange rate)	-0.001	0.987
Temperature	-0.018	0.724
1 st L(Temperature)	0.058	0.298
2 nd L (Temperature)	-0.096	0.130
3 rd L (Temperature)	-0.029	0.597
4 th L (Temperature)	0.005	0.936
5 th L (Temperature)	-0.125	0.060*
6 th L (Temperature)	0.058	0.362
Precipitation	0.000	0.598
1 st L(Precipitation)	-0.001	0.218
2 nd L (Precipitation)	-0.001	0.041**
3 rd L (Precipitation)	-0.001	0.078*
4 th L (Precipitation)	0.000	0.825
5 th L (Precipitation)	-0.002	0.173
6 th L (Precipitation)	-0.001	0.225
Interest rate	-0.027	0.244
1 st L (Interest rate)	0.013	0.780
2 nd L (Interest rate)	-0.009	0.850
3 rd L (Interest rate)	0.015	0.765
4 th L (Interest rate)	-0.013	0.839
5 th L (Interest rate)	0.007	0.918

6 th L (Interest rate)	-0.021	0.489
***, ** & *denote 1%,5% & 10% level of significance respectively		

Where L represents the lag of a variable

The regression results, including their lagged values, offer comprehensive insights into the connections between independent and dependent variables. The intercept is 5.791, with a p-value of 0.102. This suggests that when all predictors are zero, the baseline value of the dependent variable is 5.791, but the p-value indicates that the intercept is not statistically significant at the 5% level of significance.

The first lag of the log of the tourism sector is statistically significant and has a coefficient of 0.472 and a p-value of 0.007. This indicates that a 1% increase in the tourism sector (lagged by one period) is associated with a 0.472% increase in the dependent variable. The second and third lags are seen to be statistically insignificant since the p values of 0.695 and 0.114 respectively are greater than the 5% level of significance. The fourth lag has a coefficient of 0.380, with a p-value of 0.022. This suggests a statistically significant positive relationship between the tourism sector (lagged by four periods) and the dependent variable, indicating a 0.380% increase in the dependent variable for a 1% increase in the tourism sector's fourth lag.

The fifth lag has a coefficient of -0.373 and a p-value of 0.055. The coefficient is statistically significant at the 10% level. This indicates that a 1% increase in the tourism sector (lagged by five periods) is associated with a 0.373% increase in the dependent variable at a 10% level of significance. Moreover, the sixth lag has a coefficient of 0.4117 with a p-value of 0.054. The coefficient is statistically significant at the 10% level. This indicates that a 1% increase in the tourism sector (lagged by six periods) is associated with a 0.4117% increase in the dependent variable at a 10% significance level.

The current log of per capita income has a coefficient of 1.209 and a p value of 0.000 which is highly significant at the 5% level of significance. This indicates that per capita income has a strong positive effect on the tourism sector hence a 1% increase in the log of per capita income is associated with a 1.209% increase in the log of the tourism sector

.This implies that the current level of per capita income in Kenya affects the tourism sector. Since the p-values are more than 0.05, none of the log of per capita income lags are statistically significant. This implies that the contemporary tourism industry is not greatly impacted by historical per capita income values.

The current exchange rate has a coefficient of -0.015 and a p value of 0.051, which is statistically significant at the 10% level. This suggests that a 1 KES per USD increase in the exchange rate leads to a reduction in the tourism sector revenue by -1.5%. Similarly, the first lag of the exchange rate has a coefficient of 0.021 and a p value of 0.054, which is significant at the 10% level of significance. This suggests that a 1 KES per USD increase in the exchange rate leads to an increase in the tourism sector's revenue by 2.1%. The second to the sixth lag is not statistically significant, indicating no meaningful relationship between historical exchange rate values, past the first lag, and the tourism sector.

The current temperature and the first to fourth lag are statistically insignificant, as their p-values exceed 0.05. The fifth lag of temperature with a p value of 0.060 is statistically significant at the 10% level, with a coefficient of -0.125, indicating that a 1 degree increase in temperature five periods ago may have negatively impacted tourism sector revenue by -12.5%. This could be due to extreme weather conditions discouraging travel. Additionally, the sixth lag is statistically insignificant since the p value of 0.362 is greater than the 5% level of significance. This statistic indicates that the current temperature levels have no significant effect on the tourism sector while the fifth lag has a significant impact on the tourism sector.

The current precipitation as well as the first lag are statistically insignificant, as their p-values exceed 0.05. This implies that the current precipitation levels do not affect the tourism sector significantly. However, the second lag has a coefficient of -0.001 and p-value of 0.041 making this lag statistically significant at the 5% level of significance. Therefore, a 1-millimeter increase in precipitation is associated with a 0.1% decrease in the log of the tourism sector. This indicates a small but significant negative effect of precipitation two periods ago on the current tourism sector. The third lag has a p value of 0.078 and is significant at the 10% level with a coefficient of -0.001. This implies that a

1-millimeter increase in precipitation is associated with a 0.1% decrease in the tourism sector, further supporting the idea that excessive rainfall in previous periods can have a dampening effect on tourism. The fourth lag to the sixth lag are statistically insignificant since the p values are greater than the 5% level of significance.

When it comes to the interest rate the coefficients for the current period and all the lags are statistically insignificant, as all p-values exceed 0.05. This indicates that interest rates - whether current or lagged - do not have a significant effect on the tourism sector. The model has a 94.70% R squared value, which indicates that 94.70% of the variation in the tourism sector revenue is explained by the model. The P value of the model is less than 0.05 which means that the model is statistically significant.

4.7 Bound Test

A reliable technique for assessing whether a long-term link between a dependent variable and its explanatory factors exists in an autoregressive distributed lag (ARDL) framework is the Pesaran, Shin, and Smith (2001) cointegration test, commonly referred to as the Bounds Test. The test yielded an F-statistic of 3.235, which is compared to the critical value boundaries for the 5% critical level. The critical values of the 5% level of significance are 3.61 for the lower bound and 4.43 for the upper bound. The F statistics is seen to be less than the lower bound of the 5% critical level, showing that there is no long run relationship between the variables.

4.8 Diagnostic test

4.8.1 Heteroskedasticity test

Heteroscedasticity, which happens when the variance of the residuals varies between observations, is identified using the Breusch-Pagan test. The test yielded a p-value of 0.796, thus fail to reject the null hypothesis of homoscedasticity because the p-value is significantly higher than the usual significance level of 0.05. This implies that there is no sign of heteroscedasticity and that the variance of the ARDL model's residuals is constant. This finding validates the model's estimated coefficients given that heteroscedasticity can result in biased standard errors and ineffective estimators.

4.8.2 Normality test

The residuals' conformity to a normal distribution is assessed using the Shapiro-Wilk test. The p-value of 0.426 shows that we are unable to rule out the null hypothesis of normalcy. This suggests that the ARDL model's residuals have a normal distribution.



CHAPTER FIVE: DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This study's main goal was to investigate the connection between climate change and tourism in Kenya. To facilitate more successful policy interventions, the investigation sought to improve understanding of the connections between climate change and tourism. The Autoregressive Distributed Lag Model was used in the study to accomplish this. Furthermore, macroeconomic time series data covering the years 2002-2022 were examined, which included exchange rate, per capita income in the country, interest rate, rule of law indicator as well as environmental factors such as temperature and rainfall. This chapter also links the findings from this study to previous findings by other researchers as well as previous theories.

5.2. Discussions

This section covers the summary of this study's findings. Chapter four provides the results obtained from conducting various tests.

5.2.1 Descriptive and Correlation Analysis

Kenya's tourism sector experienced revenue fluctuations (2002–2022), averaging KES 12 billion with high variability, implying the sector has experienced varying extents of growth and decline. Moreover, temperature is stable, averaging 25.53°C with a narrow range (23.96°C–27.53°C) and minimal variation. However, this contradicts Precipitation's high variability (56.91mm average, large standard deviation), reflecting alternating periods of drought and heavy rainfall, and an overall shift in climatic conditions.

In addition, Kenya's per Capita Income averages at KES 23,000, highlighting income inequality within the nation's population (ranging from KES 6,311 to KES 53,123). Nevertheless, the nation has a volatile exchange rate, ranging from KES 62.65 to KES 121.95, indicating the presence of external economic influences. These descriptive analyses indicate that the nation is generating substantial income from tourism, despite the industry – and country– not being in the ideal conditions regarding economic performance or climate conditions.

In addition to the descriptive analysis, the research employs a correlation matrix, which displays the correlation coefficients between various variables. A weak positive correlation between temperature and log of tourism sector indicates that greater temperatures may have a minor impact on tourism. The weak correlations between precipitation and the log of tourism sector imply that rainfall patterns have very little direct impact on the tourism sector, which is in line with Laban Rotich's research, whose correlation analysis indicated a positive link between rainfall and tourism (Rotich, 2015).

Consequently, Emily Wilkins and Lydia Horne's research discovered that there is a significant link between weather conditions and tourism (Wilkins & Horne, 2024). For instance, their correlation matrix discovered that more than half of their respondents highlighted the importance of weather in their destination picking process.

5.2.2 The Autoregressive Distributed Lag (ARDL) Model

The research examines the relationship between the tourism industry variables (in their natural log form) and independent variables such as per capita income, exchange rates, temperature, precipitation, and interest rate, including their lagged values using the Autoregressive Distributed Lag Model (ARDL).

Tourism Influences

Current tourism performance depends significantly on past performance as indicated by the positive first lag coefficient of 0.472, a p value of 0.007 and a fourth lag coefficient of 0.380, with a p-value of 0.022. Additionally the fifth and sixth lag are seen to be statistically significant at the 10% level. Moreover, the current per capita income has a significant impact on the tourism sector, with a coefficient of 1.209 and a p value of 0.000. Similarly, temperature is seen to have a significant effect on the tourism sector because its fifth lag value is statistically significant at the 10% significance levels. On the other hand, precipitation is seen to have a second lag that is statistically significant and is seen to lead to a 0.1% decrease in the revenue generated by the tourism sector. Rotich's study supports this discovery by emphasizing the influence of climatic factors such as temperature and precipitation. He emphasizes on Kenya's tourism sector's vulnerability to changes in

temperature, precipitation, and humidity, which could lead to higher temperatures in the nation, thereby affecting Kenya's natural landscape and attraction sites negatively. The exchange rate is significant at the 10% level because of its current and first lag values, which indicate statistical significance. Lastly, interest rates have no minimal impact on the tourism sector since both its current and lagged values are insignificant.

The model's R-squared value of 94.70% indicates that it explains most of the variation in tourism sector revenue. Its p-value is less than 0.05, confirming its statistical significance. The Bounds test indicates no long-term relationship between the variables since it is below the critical lower bound at the 5% level, with the F-statistic being 3.235.

This conclusion obtained in this research is in line with findings from Rotich (2015), Jurema et al (2018), Steiger (2023) and Njeri (2023), which highlighted the pivotal role of climatic conditions in the tourism industry in developed and developing countries. These findings support the theories used in this research as well. For example, the research illuminates the inverse nature between precipitation and tourism. This highlights the fact that the push and pull theory is in play.

The extreme precipitation levels in various periods force tourists who have a push to travel into other countries other than Kenya in order to enjoy better weather conditions for outdoor activities, such as the sandy beaches and resorts. This in turn leads to a decrease in the entry of tourists into the country, hence reducing the revenue generated by the tourism sector at that particular time. The greenhouse effect theory is also effective because, as discussed, natural disasters such as severe rainfall and storms, and high sea levels affect the tourism sector. This has been evident on multiple accounts in the Kenyan coastline and inland regions whereby floods have occurred and rendered most places inaccessible. This is a clear indicator that the country is suffering from causes of greenhouse effects such as deforestation and industrial waste.

5.3 Conclusion

This study provides valuable insights into the complex interplay between climate change and tourism in Kenya, highlighting both challenges and opportunities for the sector. The findings emphasize the vulnerability of tourism to climatic variability, particularly in terms of precipitation and its effects on the tourism sector. Moreover, economic factors,

such as per capita income also play a critical role in shaping tourism performance. This means that a country whose populace consists of lower-class citizens being a majority would lead to diminished tourist activities, leading to a decline in the country's tourism sector.

Overall, the study highlights the necessity for adaptive methods and the susceptibility of Kenya's tourism industry to climate fluctuation. The results emphasize the possible drawbacks of unfavorable weather conditions as well as the crucial role that income levels play in promoting tourism. For researchers, industry stakeholders, and governments looking to create resilient and sustainable tourism policies in the face of climate change, these insights are essential.

5.4 Recommendations

The incorporation of climate change considerations into national tourist policy and development plans ought to be a top priority for the Kenyan government. This entails funding studies to learn more about the unique vulnerabilities of popular tourist destinations and putting adaptation strategies into action, like sustainable water management in game reserves and coastal preservation initiatives. To lessen the impact of extreme weather events on tourism infrastructure, policymakers can also improve early warning systems and climate risk assessments. Additionally, tourism operators who implement eco-friendly measures, such as the usage of renewable energy, waste management, and carbon offset programs, could receive incentives like tax reductions or grants.

In line with the inverse effects of precipitation and temperature on the tourism sector, wildlife conservancies and hotels should work with the local community by adopting sustainable tourism practices. To support conservation initiatives like reforestation and wildlife habitat restoration, which improve the long-term viability of tourism resources. Additionally, training programs should be created to inform management and employees about the effects of climate change and the significance of sustainability in tourism operations. This recommendation is based on improving the climatic conditions in the

country, which can be tracked using temperature and precipitation. The former shows the daily – or volatile – shift in temperature levels while the latter shows an overall measurement of humidity in the atmosphere. The two metrics can help track the impacts of reformative actions such as reforestation, allowing the relevant authority to reduce the extreme heat in the nation, thereby attracting more tourists within the country and boost the tourism sector.

Furthermore, seeing that per capita income positively affects the tourism sector, local communities can diversify their sources of income and lessen their reliance on climate-sensitive tourism by being empowered through education and capacity-building programs. For instance, communities could receive assistance in creating less climate-vulnerable alternative revenue streams like crafts or agriculture. To guarantee a fair distribution of tourism earnings, which can then be put back into locally driven conservation and adaptation initiatives, partnerships between local communities and tourism operators should be promoted. Kenya's government should consider this measure because the nation has natural tourist attraction sites such as beautiful scenery, sandy beaches, and wildlife. Since the government is essential in promoting people's livelihoods and revenue generating activities, it could enforce laws that ban or limit cutting down of trees and enforce sustainable measures to take care of the environment.

Lastly when it comes to funding climate adaption initiatives in Kenya's tourism industry, international organizations and development partners are essential. Initiatives like conservation campaigns, capacity-building projects, and the construction of sustainable infrastructure should get financial and technical support from these stakeholders. International partnerships may also encourage the sharing of technology and expertise to improve climate resilience in the travel and tourism industry. This would lead to minimal negative effects of precipitation and temperature on the tourism sector.

5.5 Limitations of the study

This study has a number of limitations that should be noted, even if it offers insightful information about how climate change is affecting Kenya's tourism industry. First, the

study does not incorporate perspectives from key stakeholders in the tourism sector, such as local communities, policymakers, and private sector players. These stakeholders provide valuable insights into the practical challenges and opportunities associated with climate change adaptation and mitigation. Their exclusion is due to limited time that was needed to carry out this research.

Furthermore, the study primarily adopts a quantitative approach, which, while useful for identifying trends and relationships, fails to capture qualitative insights into stakeholder perceptions and experiences. For instance, understanding how tourists perceive the safety and attractiveness of destinations affected by climate change, or how local communities adapt to changing climatic conditions, requires qualitative data that is not included in this study. The omission of such insights limits the depth of the findings and their applicability in designing adaptive strategies that address human and behavioral factors. This limitation is also brought about by limited time given to carry out this research.

The inability to specifically examine regional variations in climate impacts, such as coastline erosion in Mombasa or droughts in the Maasai Mara, restricts the capacity to offer tailored suggestions for tourist destinations. This limitation is brought about by the unavailability of regional specific data for variables such as temperature, rainfall, per capita income and tourism revenue generated in that specific region.

The study's findings are based on data collected between 2002 and 2022, limiting the scope of its temporal relevance. While this 20-year period captures significant trends, climate change is a gradual process whose impacts unfold over longer timeframes. The reliance on a relatively short historical dataset may not fully capture the long-term effects of climate change on the tourism sector. This limitation is present due to the lack of quarterly data for tourism sector revenue and per capita income before 2002.

5.6 Areas for further research

To further understand the regional differences in climate impacts, more localized and detailed assessments might be included in future research on how climate change is affecting Kenya's tourism industry. Future studies might, for example, concentrate on

particular tourist destinations like the Maasai Mara, Amboseli, and the coastal areas, looking at the direct effects of unusual weather phenomena like droughts, floods, or rising sea levels on infrastructure, wildlife habitats, and tourism activities.

Furthermore, longitudinal studies that combine data on tourism and climate projections may offer important insights into how the industry may change over the coming decades. Another crucial topic is investigating the socioeconomic effects of climate change on communities that depend on tourism, as this would highlight the local population's vulnerabilities and adaptability. Additionally, studies might investigate how new tourism trends like eco-tourism and sustainable tourism can help reduce the effects of climate change while fostering environmental preservation. Studies that compare several African nations or other developing areas with comparable climatic and economic circumstances may also provide Kenya with more comprehensive insights and lessons. Future studies should concentrate on examining the regional effects of climate change on certain tourism subsectors and evaluating the efficacy of adaptation strategies to guarantee the sustainability of the industry. Future studies could improve the findings' precision, depth, and application, providing stakeholders and policymakers with more thorough recommendations.



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