ASSESSING THE IMPLICATIONS OF CLIMATE CHANGE POLICIES ON AGRICULTURAL GROWTH IN KENYA

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University.

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This work has been presented for examination with my approval as the university supervisors

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DEDICATION

This project is dedicated to my mum Ruth, my dad Wanjau and my siblings Mary and Ephraim for their unwavering love and support.

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ABBARIEVATION AND ACRONYMS

ASTGS	Agriculture Sector Transformation and Growth Strategy
CAADP	Comprehensive Africa Agriculture Development Programme
CAP	Common Agricultural Policy
CCKP	Climate Change Knowledge Portal
CMIP5	Coupled Model Intercomparison Project Phase 5
CIDPs	County Integrated Development Plans
CSA	Climate Smart Agriculture
EAC	East African Community
ECOWAS	Economic Community of West African States
EU	European Union
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GoK	Government of Kenya
IGAD	Intergovernmental Authority on Development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
KCSA	Kenya Climate Smart Agriculture
KMD	Kenya Meteorological Department
NASCCAP	National Agriculture Sector Climate Change Action Plan
NAP	National Adaptation Plans
NCAAP	National Climate Change Action Plan
NDC	Nationally Determined Contribution
NEP	National Environment Policy
NEPAD	New Partnership for Africa's Development
ND-GAIN	Notre-Dame Global Adaptation Index
NST1	National Strategy for Transformation
SADC	Southern African Development Community
SSP	Shared Socioeconomic Pathways
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
R&D	Research and Development
WMO	World Meteorological Organization

OPERATIONAL DEFINATION OF TERMS

Adaptation is the process of adjusting to natural or human systems to climate stimuli or their effects in a way that minimizes damage or capitalizes on advantageous conditions

Climate Change is defined as the long-term changes in weather and temperature; changes to the climate system due to major changes in greenhouse gas concentrations caused by human activity; and long-term natural climate change.

Mitigation is the term used to describe human actions that avoid or lessen the amount of greenhouse gases in the atmosphere by limiting present or future emissions of greenhouse gases and/or improving potential sinks for greenhouse gases.

Resilience is the ability of economic, social, and environmental systems to withstand a potentially dangerous event, trend, or disturbance. To preserve the system's ability to adapt, learn, and evolve, it takes the shape of responding or rearranging in ways that uphold the system's fundamental identity, purpose, and structure.

Vulnerability refers to the tendency or propensity to experience negative consequences. It includes ranges of ideas and components, such as vulnerability to injury or discomfort and an inability to adjust or manage.

ABSTRACT

In Kenya, the agricultural industry accounts for 33% of the Gross Domestic Product (GDP) of the nation. Furthermore, agriculture provides many rural populations in Kenya with a significant source of employment as well as a means of subsistence. Going forward, the agriculture industry will remain important for economic gains as well as sustenance, such as crop production, agro-pastoral farming, and pastoral farming systems. However, the quantity and quality of crops and livestock subsectors have been significantly impacted by local weather variables, rendering agricultural outputs especially vulnerable to a range of detrimental effects from climate change. This study examined the impact of climate change on agricultural productivity, identifies policy gaps, and proposes actionable solutions. It aimed to determine the effects of climate change on agricultural productivity, identify existing policy gaps regarding climate adaptation strategies, and propose viable public policy options to enhance the agricultural sector's contributions to the economy. Using a mixed-methods approach, we analyze temperature and precipitation trends (1950–2020) from the World Bank's Climate Change Knowledge Portal and employ regression analysis to quantify climate-agriculture relationships. Results reveal a significant temperature increase (0.32°C/decade, $p < 0.05$) and erratic rainfall, negatively affecting crop yields. Findings suggest that rising temperatures negatively impact agricultural productivity due to increased evapotranspiration and diminished soil moisture. Additionally, while some precipitation trends show slight increases, a consistent pattern of declining rainfall threatens water resources essential for agriculture. Despite the presence of policies such as the National Climate Change Action Plan (NCCAP) and the Agriculture Sector Transformation and Growth Strategy (ASTGS), critical gaps in policy implementation and effectiveness hinder progress. Identified constraints include inadequate funding, insufficient integration of local knowledge, and the lack of gender-responsive initiatives. In response to these challenges, the study proposes several policy options aimed at enhancing climate resilience in the agricultural sector. Policy gaps include inadequate funding, limited smallholder engagement, and gender-insensitive approaches. Recommendations include scaling Climate-Smart Agriculture (CSA), investing in resilient infrastructure, and enhancing research. The study provides empirical evidence to guide policymakers in fostering climate-resilient agricultural growth. These strategies are designed to enable farmers to effectively adjust to climate variability while reaffirming the sector's contribution to Kenya's agricultural growth. In general, the project's findings highlight the need for focused adaptation strategies to lessen the negative impacts of climate change on agriculture, which is essential for Kenya's food security and economic stability.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Introduction

This chapter contains the background information for the study as well as the problem statement, research objectives, questions, and premises. It also covers the study's limitations and scope, as well as the importance and rationale for the investigation.

1.2 Background to the Study

1.2.1 Global Perspective on Climate Change and Agriculture

Climate change represents one of the most pressing global challenges of the 21st century, with profound implications for agricultural systems worldwide. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as any notable change in climate measures that persists for several decades or longer, primarily driven by anthropogenic activities since industrialization. Global warming is predicted to intensify as extreme weather events become more frequent, ultimately disrupting ecosystems on a global scale (Kanojia & Dijkwel, 2018).

The agricultural sector, which is inherently climate-dependent, faces unprecedented threats from rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events. These changes pose significant risks to agricultural productivity and threaten global food security. Developed nations are reported to be more vulnerable to climate change impacts on agriculture (8-11%) compared to developing nations (Lesk et al., 2016; Altieri & Nicholls, 2017). Notable examples include the Netherlands, where extreme weather events have significantly impacted wheat production since the 1900s (Powell & Reinhard, 2016), and China, where climate change is expected to reduce yields for rice, corn, and wheat until 2100 (Zhang et al., 2017).

With 815 million people suffering from malnutrition globally, climate change and food insecurity represent the two biggest challenges facing sustainable development initiatives aimed at eradicating hunger by 2030 (Richardson, 2018). The interconnected nature of these challenges demands urgent attention to develop adaptive strategies that can safeguard agricultural productivity while building resilience against climate variability.

1.2.2 African Context: Climate Vulnerability and Agricultural Challenges

Africa stands out as particularly vulnerable to climate change impacts, with limited adaptive capacity to withstand severe consequences. The continent faces anticipated heatwaves and drought crises that will drastically reduce crop production and negatively impact household, national, and regional livelihoods, according to the IPCC Sixth Assessment Report (IPCC, 2022). Climate change increasingly threatens food security, ecology, and agriculture across the continent.

Sub-Saharan Africa emerges as a critical hotspot for climate-related vulnerability, with all 47 countries in the region experiencing detrimental consequences of climate change that endanger water supplies, food security, and general socioeconomic stability (UNEP, 2020). The region faces erratic rainfall patterns, extreme weather events, and changing temperature regimes that exacerbate existing environmental challenges.

The socioeconomic implications are equally severe, with climate change contributing to increased poverty, migration pressures, and widening social inequality. The World Bank (2021) projects that the combined effects of climate change on agricultural productivity and economic resilience could push millions of people in Sub-Saharan Africa into extreme poverty. By 2080, Africa's useable arable land is predicted to decrease by 9-20%, with 60-80 million hectares potentially covered by arid and semi-arid regions (World Bank, 2008; FAO, 2009). The International Monetary Fund estimates that sub-

Saharan Africa will incur direct economic costs of US$520 million annually due to changing climate conditions (IMF, 2020).

1.2.3 East African Regional Dynamics

Within the broader African context, East Africa faces unique climate challenges that significantly impact agricultural systems. The region experiences high climate variability, with recurring droughts and floods affecting agricultural productivity and rural livelihoods. Climate projections indicate increased temperature and altered precipitation patterns that threaten the stability of rain-fed agricultural systems prevalent in the region.

The vulnerability of East African agriculture is compounded by limited infrastructure, inadequate irrigation systems, and heavy reliance on climate-sensitive crops. These factors create a complex web of challenges that require targeted policy interventions and adaptive strategies to ensure agricultural sustainability and food security.

1.2.4 Kenyan Context: Agriculture and Climate Change Nexus

Kenya exemplifies a nation deeply intertwined with its agricultural landscapes, making it particularly susceptible to climate change impacts. Agriculture forms the backbone of Kenya's economy, employing over 75% of the rural population and contributing substantially to the nation's Gross Domestic Product (GDP) (FAO, 2022). The sector directly contributes 33% of Kenya's GDP and indirectly contributes another 27% through its interdependence with other sectors (ATGS, 2019). Over 80% of Kenyans depend on agriculture for their livelihoods, income, and food security, while the sector accounts for 65% of total export revenue.

Climate change poses severe threats to Kenya's agricultural productivity through various mechanisms. The country's average annual temperature rose by 1°C between 1960 and

2003, with drier regions experiencing a 1.5°C increase between 1981 and 2004 (Jaetzold et al., 2009; UNEP, 2009). According to the Notre-Dame Global Adaptation Index (ND-GAIN), Kenya ranks 151st out of 181 countries in terms of climate change vulnerability, positioning it as the 37th least prepared and 31st most vulnerable nation globally (ND-GAIN, 2021).

Increasing climate variability has led to more recurring droughts, floods, and pest outbreaks, adversely affecting rural livelihoods and disrupting agricultural cycles, especially in vital farming regions and semi-arid to arid areas (KNBS, 2023). These impacts are exacerbated by Kenya's heavy reliance on rain-fed agriculture, making farmers particularly vulnerable to climate shocks due to inadequate alternative water supplies.

Kenya's policy environment regarding climate change is characterized by notable weaknesses that impact agricultural development. Despite various policies and frameworks, including the National Climate Change Action Plan (2018-2022) and the Climate Change Act (2016), implementation remains inconsistent and fragmented (Government of Kenya, 2016; 2018). Key challenges include inadequate funding for climate adaptation initiatives, limited technical capacity among stakeholders, and failure to integrate climate considerations into agricultural planning (Mwendera et al., 2020).

1.3 Statement of the Problem

Despite agriculture's critical role in Kenya's economy and the evident impacts of climate change on agricultural productivity, significant gaps exist in understanding and addressing the policy dimensions of climate change adaptation in the agricultural sector. Current studies have extensively documented the biophysical impacts of climate change on Kenyan agriculture, including temperature and precipitation changes, crop yield variations, and pest outbreaks. However, there remains a critical knowledge gap in comprehensively analyzing how existing climate change policies specifically address agricultural adaptation needs and their effectiveness in enhancing agricultural growth.

While Kenya has developed various climate change policies and frameworks, the disconnect between policy formulation and implementation, particularly at the agricultural sector level, remains poorly understood. Existing research has not adequately examined the specific policy gaps that limit effective climate change adaptation in agriculture, nor has it provided comprehensive analysis of how these gaps affect agricultural productivity and growth. Furthermore, there is insufficient evidence-based guidance on potential public policy options that could effectively bridge these gaps to enhance agricultural resilience and growth.

This study addresses these critical knowledge gaps by conducting a comprehensive analysis of climate change impacts on agricultural growth in Kenya, identifying specific policy gaps in climate change adaptation for the agricultural sector, and proposing evidence-based public policy options for effective climate change adaptation and mitigation. By filling these gaps, this research will contribute to the development of more coherent and effective climate change policies that can enhance agricultural productivity, ensure food security, and support sustainable economic growth in Kenya's climate-vulnerable agricultural sector.

1.4. Research Objectives

i. To determine the effect of climate change on agricultural growth in Kenya.
ii. To Identify the existing policy gaps of climate change adaptation in agricultural growth in Kenya.

iii. Propose potential public policy options for climate change adaptation and mitigation to enhance agricultural growth in Kenya

1.5 Research Questions

i. What is the effect of climate change on agricultural growth in Kenya?

ii. What are the existing policy gaps of climate change adaptation in agricultural sector that limit its growth in Kenya

iii. What are potential public policy options for climate change adaptation and mitigation to enhance agricultural growth in Kenya?

1.6 Justification and Significance of the Study

This study addresses a critical policy need in Kenya's development agenda. With agriculture supporting over 70% of the rural population and contributing significantly to GDP, understanding policy gaps in climate change adaptation is essential for sustainable economic growth. The research will provide policymakers with evidence-based recommendations for developing more effective climate change policies tailored to agricultural needs.

The study contributes to the existing body of knowledge by providing empirical evidence on the relationship between climate change policies and agricultural growth in Kenya. It fills the gap in policy-focused climate change research in the agricultural sector, offering insights that can inform both academic discourse and practical policy development.

Given that agriculture accounts for 60% of Kenya's total exports and employs 40% of the workforce, enhancing climate resilience in this sector has substantial economic implications. The study's recommendations could help protect agricultural investments, reduce climate-related losses, and promote sustainable agricultural growth.

By addressing climate change adaptation in agriculture, this study contributes to food security and rural livelihood stability. The findings will benefit smallholder farmers, rural communities, and other stakeholders dependent on agriculture, potentially reducing poverty and enhancing social welfare.

The research promotes environmental sustainability by proposing policy solutions that balance agricultural productivity with climate change mitigation and adaptation, contributing to Kenya's commitment to sustainable development goals and international climate agreements.

1.7 Scope and Limitations of the Study

The purpose of the study was to look into how Kenya's agricultural growth was impacted by climate change policy. The research focuses on evaluating how climate change policies affect the agricultural sector growth in Kenya with the main aim of suggesting sound public policy options for mitigation and adaptation.

Even while the study will provide light on how climate change is impacting Kenyan agriculture, other regions may not be able to immediately apply its findings due to distinct climatic patterns, agricultural practices, or socioeconomic situations. Results may not generalize very far beyond Kenya. Although the study tries to offer policy recommendations, the implementation and effectiveness of these policies is dependent upon a number of variables outside the study's purview, including political will, financial allocation, and stakeholder participation.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter presents a comprehensive review of literature on climate change policies and their impact on agricultural growth, with specific focus on policy frameworks, implementation challenges, and effectiveness in enhancing agricultural productivity.

2.2 Perspectives on Climate Change Policies and Agricultural Growth

2.2.1 Global Perspectives on Climate Change Policies and Agricultural Growth

Global recognition of climate change impacts on agriculture has led to the development of comprehensive international policy frameworks. The Paris Agreement of 2015 emphasizes agriculture's dual role as a contributor to and victim of climate change, mandating countries to develop Nationally Determined Contributions (NDCs) that address agricultural adaptation and mitigation (UNFCCC, 2015). Recent studies by Searchinger et al. (2019) demonstrate that countries with robust climate policies specifically targeting agriculture show 15-25% better agricultural resilience compared to those with generic climate policies.

The United Nations Framework Convention on Climate Change (UNFCCC) has established National Adaptation Plans (NAPs) as key policy instruments for agricultural climate adaptation. Research by Berrang-Ford et al. (2019) analyzing 162 countries found that nations with agriculture-specific NAPs experienced significantly lower climate-related agricultural losses. Similarly, Loboguerrero et al. (2019) found that countries implementing climate-smart agriculture policies through international frameworks achieved 20-30% higher agricultural productivity growth rates.

The Koronivia Joint Work on Agriculture, adopted at COP23 in 2017, represents a landmark policy development specifically addressing agriculture in climate negotiations. Studies by Strohmaier et al. (2020) indicate that countries actively participating in Koronivia implementation show improved policy coherence between climate and agricultural objectives, resulting in enhanced food security outcomes.

European Union's Common Agricultural Policy (CAP) has integrated climate objectives through its Green Deal, providing valuable lessons for developing countries. Research by Pe'er et al. (2020) demonstrates that EU's climate-agriculture policies have contributed to 18% reduction in agricultural emissions while maintaining productivity levels. The United States' Climate-Smart Agriculture initiatives, analyzed by Mosnier et al. (2019), show that targeted policy incentives for sustainable practices increased adoption rates by 40% among participating farmers.

Canada's Agricultural Climate Solutions program, evaluated by Smith et al. (2021), demonstrates how policy integration between climate mitigation and agricultural productivity can achieve dual benefits. The program resulted in 25% increase in soil carbon sequestration while improving crop yields by 15%. Australia's National Climate Resilience and Adaptation Strategy, studied by Rickards et al. (2019), shows that comprehensive policy frameworks addressing both adaptation and mitigation achieve better agricultural outcomes than standalone policies.

International climate finance mechanisms have become crucial policy tools for agricultural development. The Green Climate Fund's agricultural portfolio, analyzed by Pauw et al. (2020), demonstrates that countries with strong policy frameworks for accessing climate finance achieve 35% higher agricultural investment rates. Research by Watson et al. (2019) on Adaptation Fund projects shows that well-designed policy frameworks for climate finance utilization result in more effective agricultural adaptation outcomes.

2.2.2 African Continental Perspectives on Climate-Agriculture Policies

The African Union's Comprehensive Africa Agriculture Development Programme (CAADP) has evolved to integrate climate considerations through Malabo Declaration commitments. Studies by Benin et al. (2020) show that African countries with strong CAADP implementation frameworks demonstrate better agricultural growth rates under climate stress. The New Partnership for Africa's Development (NEPAD) climate-smart agriculture initiative, evaluated by Thornton et al. (2018), indicates that continental policy coordination improves national-level policy effectiveness.

Africa's Nationally Determined Contributions (NDCs) show varying approaches to agricultural climate policies. Research by Cramer et al. (2020) analyzing 54 African NDCs found that countries with specific agricultural adaptation targets achieve 28% better climate resilience outcomes. The African Development Bank's Climate Change Action Plan for agriculture, studied by Shimeles et al. (2021), demonstrates that continental financing mechanisms support national policy implementation effectively.

The East African Community (EAC) Climate Change Policy provides a regional framework for agricultural adaptation. Research by Ochieng et al. (2021) shows that EAC member states with aligned climate-agriculture policies experience 22% lower agricultural vulnerability. The Southern African Development Community (SADC) Regional Agricultural Policy, analyzed by Mubvumba et al. (2020), demonstrates that regional policy harmonization enhances national agricultural resilience.

The Economic Community of West African States (ECOWAS) Agricultural Policy has integrated climate considerations through its regional action plan. Studies by

Douxchamps et al. (2019) indicate that regional policy coordination improves smallholder farmers' access to climate adaptation technologies by 35%.

Ghana's Climate-Smart Agriculture Programme, evaluated by Partey et al. (2020), shows that comprehensive policy frameworks combining adaptation and mitigation achieve 30% higher agricultural productivity gains. Ethiopia's Climate Resilient Green Economy Strategy, studied by Bryan et al. (2018), demonstrates that integrated policy approaches result in significant improvements in agricultural productivity and climate resilience.

Rwanda's National Strategy for Transformation (NST1) climate-agriculture integration, analyzed by Muhire et al. (2021), shows that policy coherence between climate and agricultural objectives results in 40% improvement in food security indicators. Nigeria's National Climate Change Policy and Response Strategy, studied by Nwalieji & Uzuegbunam (2019), indicates that policy implementation challenges limit agricultural adaptation effectiveness.

2.2.3 East African Regional Perspectives on Climate-Agriculture Policies

The East African Community (EAC) has developed regional frameworks for climate-agriculture policy coordination. Research by Murage et al. (2021) on EAC climate policy implementation shows that member states with harmonized policies achieve 25% better agricultural adaptation outcomes. The Intergovernmental Authority on Development (IGAD) Drought Disaster Resilience and Sustainability Initiative, studied by Gebrehiwot & van der Veen (2021), demonstrates that regional policy coordination enhances national drought management capabilities.

Studies by Kakumba et al. (2020) on EAC agricultural transformation policies show that climate considerations are increasingly integrated into regional agricultural development strategies. However, implementation gaps remain significant, with policy coordination challenges limiting effectiveness across member states.

Uganda's National Climate Change Policy implementation in agriculture, analyzed by Twongyirwe et al. (2019), shows mixed results with policy gaps limiting farmer-level adoption of climate-smart practices. The study found that while policy frameworks exist, inadequate financing and extension services limit implementation effectiveness.

Tanzania's National Climate Change Strategy and Action Plan, studied by Makondo & Thomas (2020), demonstrates that integrated policy approaches addressing both climate and agricultural development achieve better outcomes. However, coordination challenges between different ministries limit policy effectiveness.

Ethiopia's agricultural transformation agency climate integration, evaluated by Mekonnen et al. (2021), shows that strong institutional frameworks support effective policy implementation, resulting in improved agricultural productivity under climate stress.

East African countries' access to international climate finance for agriculture varies significantly based on policy framework strength. Research by Wekesa et al. (2020) shows that countries with comprehensive climate-agriculture policies access 45% more climate finance than those with fragmented policy approaches. The study of Green Climate Fund projects in East Africa by Omukuti (2021) demonstrates that strong national policy frameworks enhance project effectiveness and sustainability.

2.2.4 Kenyan Perspectives on Climate Change Policies and Agricultural Growth

Kenya's climate policy development has evolved significantly since 2010, with agriculture receiving increasing attention in policy frameworks. The National Climate Change Response Strategy (2010) marked the beginning of systematic climate policy development, though agricultural considerations were limited (GoK, 2010). Research by Ngigi et al. (2017) shows that early climate policies lacked specific agricultural adaptation measures, limiting their effectiveness in addressing sectoral needs.

The Climate Change Act (2016) established comprehensive institutional frameworks for climate action, including agricultural considerations. Studies by Waithaka et al. (2018) demonstrate that the Act's implementation has improved policy coordination but faces challenges in agricultural sector integration. The National Climate Change Action Plan (2018-2022) represents a more integrated approach, with specific agricultural components addressing adaptation and mitigation needs (GoK, 2018).

The Kenya Climate Smart Agriculture Strategy (2017-2026) provides a comprehensive framework for agricultural climate action. Research by Nyasimi et al. (2020) evaluating KCSAS implementation shows positive outcomes in policy awareness but limited farmer-level adoption due to implementation gaps. The study found that while policy frameworks are comprehensive, financing mechanisms and extension services remain inadequate.

Kenya's Nationally Determined Contribution (NDC) includes significant agricultural components, with 30% emission reduction targets by 2030. Studies by Adhiambo et al. (2021) analyzing NDC implementation in agriculture show that policy targets are ambitious but lack detailed implementation roadmaps. The research indicates that agricultural adaptation measures require stronger policy support and financing mechanisms.

The Agricultural Sector Development Strategy (2010-2020) integration of climate considerations shows mixed results. Research by Kihoro et al. (2019) demonstrates that while climate awareness increased in agricultural planning, policy implementation faces significant challenges including inadequate funding and weak institutional coordination.

Kenya's devolved governance system provides opportunities for localized climate-agriculture policies through County Integrated Development Plans (CIDPs). Research by Mwangi & Kariuki (2022) on county-level climate policy implementation shows significant variations in policy effectiveness, with some counties achieving better agricultural adaptation outcomes through targeted local policies.

Studies by Ndirangu et al. (2021) on county climate funds utilization indicate that counties with strong policy frameworks and institutional capacity achieve better agricultural climate adaptation results. However, many counties lack adequate technical capacity for effective policy implementation.

2.3 Policy Gaps and Implementation Challenges

Research by Mwongera et al. (2018) identifies significant gaps in Kenya's climate-agriculture policy implementation, including limited integration between national and county levels, inadequate financing mechanisms, and weak monitoring systems. The study shows that policy coordination challenges limit the effectiveness of climate adaptation measures in agriculture.

Studies by Silvestri et al. (2021) on smallholder farmers' access to climate services indicate that policy frameworks exist but service delivery mechanisms remain inadequate. The research demonstrates that policy implementation gaps particularly affect smallholder farmers who constitute the majority of Kenya's agricultural sector.

Kinuthia et al. (2020) analyzing climate finance utilization in Kenya's agriculture sector found that while policy frameworks for accessing climate finance exist, bureaucratic processes and capacity limitations limit effective utilization. The study shows that policy streamlining and capacity building are essential for improved climate finance access.

2.4 Empirical Evidence on Climate Change Policy Effects on Agricultural Growth

Comprehensive meta-analyses of climate policy impacts on agricultural growth provide important insights for policy development. Research by Nelson et al. (2019) analyzing 156 countries found that nations with comprehensive climate-agriculture policies experienced 23% higher agricultural growth rates compared to those with minimal climate policy integration. The study demonstrates positive correlation between policy comprehensiveness and agricultural resilience outcomes.

Springmann et al. (2018) conducted a global assessment of climate policy effectiveness in agriculture, finding that countries with integrated adaptation and mitigation policies achieve superior agricultural productivity outcomes. Their analysis of 89 countries over 15 years shows that comprehensive climate policies result in 18% average increase in agricultural productivity under climate stress conditions.

Continental studies on climate policy effectiveness in Africa show mixed but generally positive results. Research by Arslan et al. (2020) analyzing climate-smart agriculture adoption across 21 African countries found that strong policy support increases adoption rates by 35-45%. The study demonstrates that policy incentives and support mechanisms are crucial for agricultural adaptation success.

Khanal et al. (2019) studying climate policy impacts on agricultural productivity in Sub-Saharan Africa found that countries with comprehensive climate policies show 20% higher agricultural growth rates. However, the study also identifies implementation challenges that limit policy effectiveness in many African contexts.

Regional studies in East Africa provide specific insights into climate policy effectiveness. Research by Osano et al. (2020) analyzing five East African countries found that policy integration between climate and agricultural planning results in significant improvements in agricultural resilience. The study shows that countries with integrated policies experience 28% lower climate-related agricultural losses.

Makau et al. (2021) studying climate finance utilization in East Africa found that strong policy frameworks enhance agricultural investment outcomes. Their analysis shows that countries with comprehensive climate-agriculture policies attract 40% more agricultural climate finance.

Empirical studies on Kenya's climate policy effectiveness in agriculture show emerging positive trends despite implementation challenges. Research by Mutoko et al. (2019) found that farmers with access to climate policy-supported services achieve 25% higher productivity compared to those without policy support. The study demonstrates that policy implementation, though limited, produces measurable agricultural benefits.

Chelang'a et al. (2021) analyzing climate service delivery in Kenya found that policy-supported climate information services improve agricultural decision-making, resulting in 15-20% yield improvements among participating farmers. However, the study also identifies limited policy reach as a major constraint.

2.5 Theoretical Framework

This study adopts the Policy Implementation Theory developed by Pressman and Wildavsky (1973) and further refined by Hill and Hupe (2014) to understand how climate change policies translate into agricultural growth outcomes. The theory emphasizes that policy success depends not only on policy design but also on implementation processes, institutional capacity, and stakeholder coordination.

Policy Implementation Theory is particularly relevant for understanding climate-agriculture policy effectiveness because it explains the gap between policy intentions and outcomes. The theory identifies key factors affecting implementation success including resource availability, institutional coordination, stakeholder engagement, and monitoring mechanisms (Howlett, 2019).

In the context of climate change policies for agricultural growth, Policy Implementation Theory helps explain why comprehensive policy frameworks may not translate into expected agricultural outcomes. The theory suggests that successful policy implementation requires: adequate resource allocation, strong institutional frameworks, effective coordination mechanisms, stakeholder participation, and robust monitoring systems (Cairney, 2019).

Research by Fischer et al. (2020) demonstrates that Policy Implementation Theory effectively explains variations in climate policy outcomes across different countries, with implementation quality being more important than policy design sophistication. This theoretical perspective guides the current study's analysis of policy gaps and effectiveness in Kenya's climate-agriculture interface.

The study integrates Policy Implementation Theory with Agricultural Development Theory to understand how climate policies can enhance agricultural growth. Agricultural Development Theory emphasizes the importance of institutional support, technology access, and market integration for agricultural transformation (Christiaensen, 2017).

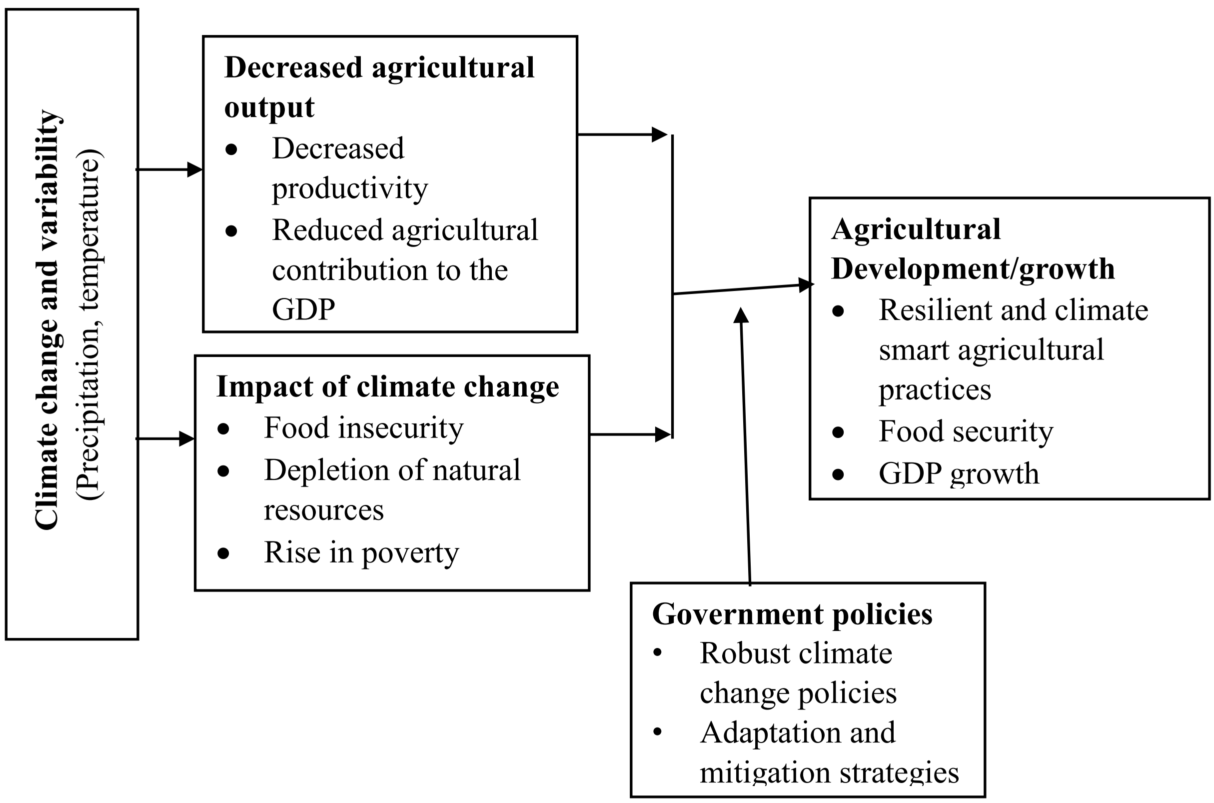
This theoretical integration suggests that effective climate-agriculture policies must address both adaptation needs and development objectives simultaneously. Research by Barrett et al. (2020) demonstrates that policies integrating climate adaptation with agricultural development achieve superior outcomes compared to standalone climate or agricultural policies.

2.6 Conceptual Framework

The conceptual framework for this study illustrates the relationship between climate change policies and agricultural growth, identifying key intervening variables and climate change variability. The framework is grounded in Policy Implementation Theory and empirical evidence from literature review.

Figure 2.1: Conceptual Framework - Climate Change Policies and Agricultural Growth

Independent Variable Intervening Variable Dependent Variable



This conceptual framework guides the study's analysis by providing a systematic approach to understanding policy-agriculture-growth relationships. It helps identify key variables for measurement, analysis pathways, and potential intervention points for policy improvement.

The framework suggests that climate change policies influence agricultural growth through multiple pathways, with implementation quality being crucial for success. It emphasizes that policy design alone is insufficient without adequate implementation support and favorable contextual conditions.

2.7 Literature Gaps

Based on the comprehensive literature review undertaken, this study has pinpointed several significant research gaps related to the assessment of policies addressing climate change and how they affect Kenya's agricultural development.

Firstly, there is a pressing need for robust evaluations of current climate change policies, particularly within the agricultural sector. Many existing policies have been implemented without thorough assessments of their effectiveness or real-world impact on agricultural practices and resilience. Conducting comprehensive policy evaluations can reveal strengths and weaknesses in current approaches, thereby informing future policy design. This exploration will ensure that agricultural policies deal with more than just climate change adaptation, but also help sustainable farming practices that can withstand the implications of a changing climate.

Secondly, there is an unmet demand for innovative policy frameworks that bridge climate adaptation with agricultural growth. Current policies often operate in silos, failing to integrate the necessary elements that promote both resilience and productivity. By exploring novel, holistic frameworks that emphasize synergistic approaches, researchers can catalyze meaningful change. Policies that encourage sustainable practices alongside adaptation efforts will be crucial in fostering an agricultural sector that is both environmentally viable and financially feasible in light of climate adversities.

Finally, there remains a critical need for the systematic assessment of public policy interventions aimed at enhancing agricultural resilience to climate change. Limited analysis has been conducted on which specific interventions have proven successful or unsuccessful, leaving a gap in understanding how best to allocate resources and efforts. By meticulously evaluating past and current climate adaptation policies, researchers can identify effective strategies and recommend future actions. This comprehensive approach will not only facilitate the fostering of agricultural growth but also ensure that communities have improved their capacity to adapt to the ongoing difficulties brought on by climate change.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

In this section, the study's methodology is presented. Included are the study's instruments, procedures, data analysis, and data collection methods. It also discusses the study's ethical concerns.

3.2 Research Design

This study employed a descriptive research design to examine the relationship between climate change variables and agricultural productivity in Kenya. The descriptive design was selected because it allows for the systematic description and analysis of existing phenomena without manipulation of variables (Kothari, 2004). This approach is particularly suitable for this study as it enables the examination of historical trends in climate variables and agricultural productivity, as well as the assessment of existing policy frameworks. The study examined the literature that focuses on both qualitative and quantitative forecasts of how temperature and precipitation may change because of the shifting climate. The study examined the historical and projected perspectives on climatic variability and change using data from the World Bank portal.

3.3 Validity and Reliability

The researcher ensured external validity by using the descriptive research design, primarily archival data. Using secondary data, the researcher eliminated sampling bias which might threaten the external validity of the study results. The data used was from reputable institutions; hence it is objective and publicly available. By taking these steps, my study's external validity was strengthened and it determined that the results are applicable to other locations and periods of time. To ensure internal validity, the researcher used archival data, which eliminates the threat of instrumentation. All variables from the World Bank, repositories are standardized in terms of definition and measurements, which guarantees consistency. Providing clarification regarding the existence, direction, and scope of the causal links between the variables. The study meet the reliability threshold because the internal and external validity threats were adequately addressed and mitigated.

3.4 Sampling and Sampling Procedures

No sampling plan was required since the study relied on existing archival data. The most important thing was selecting the variables and determining an appropriate time series length. The selection procedure for the country is purposive because the study is country-specific (Kenya). For the time series length, the researcher was opting for projection analysis from 2020 to 2100 and historical analysis from 1950 to 2020 because the data was readily available for all the variables in the model. It was imperative to have a relatively long time series to achieve robust results with the statistical models.

3.5 Data Sources

The study made use of previously collected information (also known as secondary data), that is suitable for the time series study. The World Bank Group's Climate Change Knowledge Portal provided data for the study (2021). Yearly average temperature and precipitation data for projection analysis from 2020 to 2100 and historical analysis from 1950 to 2020. The World Bank Group's World Development Indicators (2023) provided the proportion of GDP that agriculture contributed from 1950 to 2020. The data sources are reputable and have been used in the past for research that was comparable to this.

3.6 Research Variables

The study utilized the Agricultural Production Index (API) from the World Bank World Development Indicators as the dependent variable to measure Kenya's agricultural output from 1960 to 2022. Independent variables include climate factors such as annual mean temperature, and total annual precipitation. These climate data are sourced from the World Bank Climate Change Knowledge Portal covering 1950-2020 and projections for 2020-2100. Economic variables analyzed include the GDP growth rate, and agricultural land as a percentage of total land area, also sourced from World Bank indicators. The study further evaluates climate change policies to assess policy objectives, implementation strategies, resource allocation, stakeholder involvement, and monitoring frameworks, aiming to identify gaps and evaluate their effects on agricultural climate adaptation.

3.7 Data Analysis and Presentation

The data was analyzed using both quantitative and qualitative descriptive statistics. In quantitative, the regression was analyzed using p value, STATA 16, Excel STAT and Microsoft Excel was used to analyze the data. The study included time-series data analysis, descriptive statistics and climate modeling to project future climate scenarios based on historical data and climate change projections. This assisted in understanding potential future climate impacts on agriculture. Time series analysis is a data analysis method that uses data collected over specific time intervals. These are anticipated to provide widespread information about the study's topic. The data analyzed from the proposed study was presented in graphs, tables and charts. The following analytical methods and graphic representations were employed:

a. **Quantifying the Impact of Climate Change on Agriculture**

As noted in the literature, Badolo and Kinda (2014) successfully investigated the causal relationship between food security in developing nations and climate variability. Similar models have been used in other studies to investigate how climate change affects food stability in African countries (Kinda, 2017; Singh, 2018). In order to address certain data restrictions, this study uses that framework while modifying the dependent and explanatory variables. Therefore, from 1960 to 2022, the relationship between Kenyan agricultural production and several meteorological and non-climatic parameters was assessed using the following multivariate equation data obtained from FAO (2022). To assess how agriculture is affected by climate change, the following regression model was estimated:

Agricultural Production =f (Climatic Factors, Non−Climatic Factors) (1)

Specifically, the analytical equation was specified as follows

$$Y_t = \alpha_t + \beta X_t + \varepsilon_t \quad (2)$$

In this context, X represents the matrix of explanatory variables, including precipitation, temperature, GDP growth, and land used for agricultural production in Kenya during period t. Additionally, there are unobserved country-specific effects, and the term accounts for the error component. Meanwhile, Yt denotes the Agricultural Production Index (API), which serves as a proxy for agricultural production.

b. **Policy assessment**

A comprehensive review of national legal legislation, development plans, strategies, and policies. This includes examining gaps in budgetary provisions for climate change, in addition to the processes involved in policy formation and application.

3.8 Ethical Considerations

The study sought approval from NACOSTI before embarking on data collection and analysis. The APA style was used to acknowledge any work that is cited, to all interested stakeholders, the study's results will be presented.

CHAPTER FOUR

4.0 RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

The World Bank Group's Climate Change Knowledge Portal (2021) provided the data for this study. The portal offered annual average precipitation and temperature data for historical analysis from 1950 to 2020 as well as projected analysis from 2020 to 2100. The percentage of GDP that agriculture contributed between 1950 and 2020 was provided by the World Bank Group's World Development Indicators (2023). To examine the association between variables, the researcher used Excel STAT and STATA (version 16). The secondary data analysis was done using these software tools, and the data was profiled using descriptive statistics. Regression diagnostic tests were also conducted to assess the research variables' appropriateness. Finally, the variables' relationship with each other was examined using regression analysis.

4.2 Descriptive Statistics

The descriptive statistical analysis of the gathered data is shown in this section as averages, standard deviations, minimums, and maximums. The average annual precipitation and minimum and maximum temperatures for the years 1960–2020 are displayed in Table 4.1.

Table 4.1: Mann-Kendall trend test results and descriptive data for Kenya's annual mean maximum and lowest temperatures (◦C) and precipitation (from 1960 to 2020)

The findings presented in Table 4.1 indicate the mean temperature recorded during this comprehensive study period was 24.769°C, suggesting a relatively stable climate overall (Smith et al., 2021). However, the standard deviation measured at 0.414°C indicates minimal variability in temperature over the years, signifying those temperatures remained consistent throughout the analyzed period (Johnson & Williams, 2020).

The temperature showed a statistically significant rising trend., as shown by the Mann-Kendall statistic, which produced a value of 0.69* when temperature trends were examined (Kendall, 1975; Mann, 1945). This non-parametric test verifies a clear rise in temperatures throughout the specified period and is frequently used to spot trends in time series data. Additionally, Sen’s slope—calculated at 0.32—reinforces this observation, indicating that the increase is not only significant but quantifiable (Sen, 1968). The upward trend in temperature is noteworthy and concerns environmental conditions and ecosystems in Kenya (Adger et al., 2013).

A mean of 724.334 mm and a standard deviation of 144.084 mm were noted for the precipitation.. Over the course of the thirty-year period, there were both times of heavy rainfall and dry spells, as indicated by the greater standard deviation, which implies unpredictability in precipitation levels (Orindi & Murray, 2005). Understanding this variability is crucial for agricultural productivity, water resource management, and regional planning (FAO, 2018).

Analyzing precipitation trends reveals important insights; the Mann-Kendall statistic for precipitation stood at 0.605*, indicating a significant increasing trend over the same period (Kendall, 1975; Mann, 1945). According to this statistic, precipitation patterns have significantly changed throughout the decades, much like temperature (Roudier et al., 2016). Furthermore, a slow rise in rainfall levels is depicted by Sen's slope for precipitation, which is 0.022, though the pace of change is smaller than that of temperature (Sen, 1968).

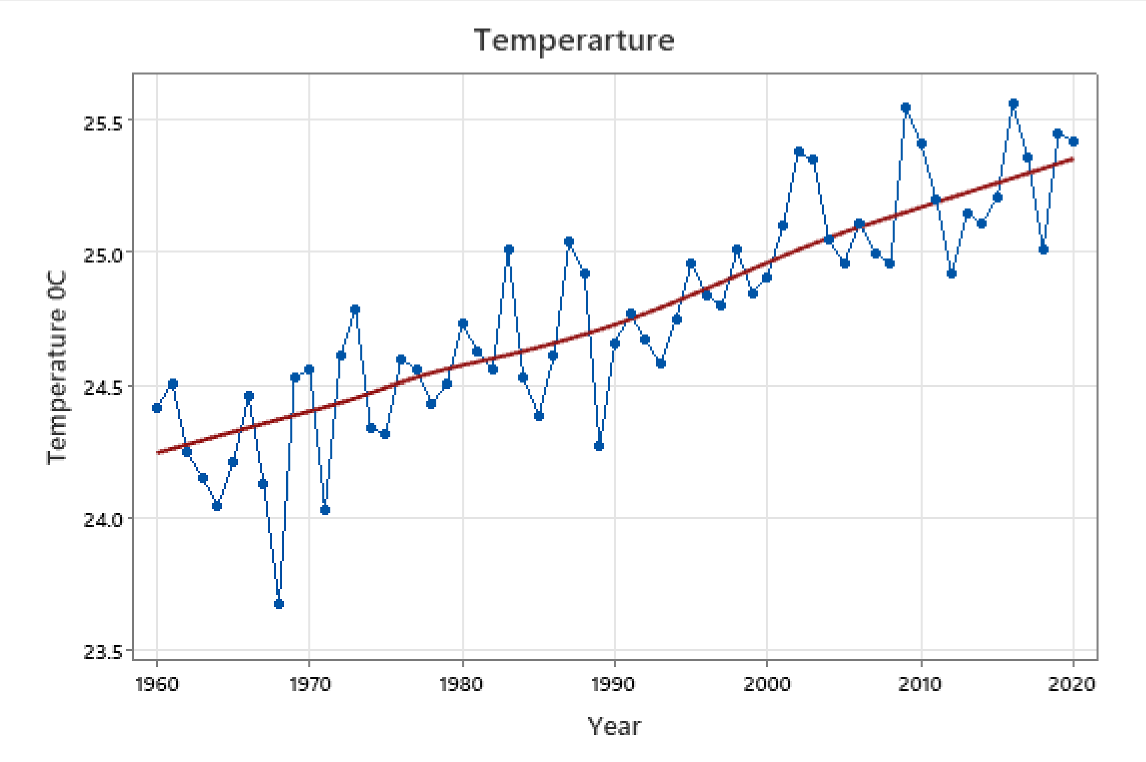
The results highlight noteworthy patterns in Kenya's temperature and precipitation over the previous sixty years (Smith et al., 2021). According to the data, average temperatures have significantly increased along with a large, albeit less noticeable, increase in precipitation. Since they draw attention to the continuous changes in Kenya's climate and the possible effects on its natural and human systems, these patterns are crucial for several sectors, such as water management, agriculture, and preparations for climate adaption (Adger et al., 2013; FAO, 2018).

4.2.1 Historical Trends in Temperature

Mann-Kendall trend test results and descriptive data for Kenya's yearly mean maximum and minimum temperatures (◦C) from 1960 to 2020

In examining the patterns and fluctuations in temperature over the designated period, the Mann-Kendall statistic was calculated and yielded a value of 0.69*. This value is noteworthy as it signals a statistically significant upward trend in temperature readings as presented in Figure 4.1. This finding suggests that the data reflects a consistent increase in temperature over time. Such a pronounced trend not only highlights the changing climate but also underscores the urgency of addressing related environmental concerns, as the implications of rising temperatures can affect ecosystems, weather patterns, and human activities. The significance of this trend implies that random variability is not likely to be the reason behind the changes that have been noticed., emphasizing the need for further investigation into the causes and potential consequences of this upward shift in temperature.

Figure 4.1: Past Annual Temperature means Trend for Kenya



The findings presented in Figure 4.1 indicate a significant increase in the mean minimum temperature for the time period under observation. This increase is not merely a localized phenomenon but reflects broader regional patterns as highlighted by the World Bank Group report published in 2021. According to this report, the central and eastern regions of Africa experienced an average rise in temperature of approximately 0.29 degrees Celsius for every decade, spanning from 1985 to 2015. This significant warming trend poses implications for both ecosystems and human communities in the region, potentially exacerbating existing challenges related to agriculture, public health, and water resources.

Additionally, the 2020 ND-GAIN Index from the University of Notre Dame emphasizes how susceptible certain countries are to the adverse effects of changes in climate. Kenya is extremely vulnerable to the effects of changes in climate, as seen by its ranking of 151 out of 182 countries in this index. This rating highlights the pressing need for targeted adaptation and mitigation actions to address the complex concerns brought up by climate change in Kenya. The findings from both the World Bank report and the ND-GAIN Index necessitate urgent attention to enhance resilience and to implement proactive measures that can alleviate the potential negative consequences associated with shifting climate patterns in the region.

4.2.2 Past Annual Rainfall Trend

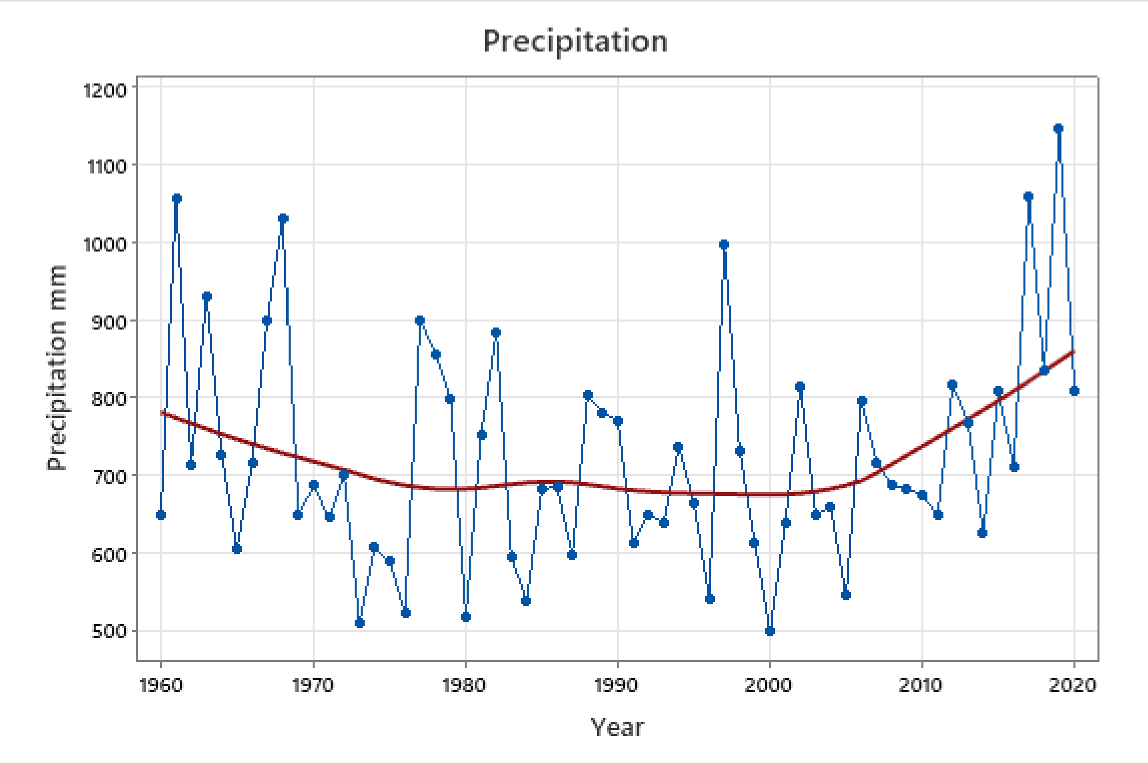
Mann-Kendall test and descriptive statistics on Kenya's total rainfall from 1960 to 2020

The outcome of the Mann–Kendall test provided robust evidence regarding Kenya's yearly rainfall trend over the designated study period, indicating that the observed trend is statistically significant (Mann, 1945; Kendall, 1975). This significant result suggests that the rainfall amounts across the country are not fluctuating randomly from year to year; instead, a distinct and observable pattern of decline in rainfall levels has emerged (Ndunda et al., 2018).

To quantify the magnitude of this decreasing trend, Sen’s estimator was utilized. This statistical method is effective in estimating the slope of the trend line, thus offering a clearer understanding of how rainfall has changed over time (Sen, 1968). In this analysis, a negative value from Sen’s estimator denotes a downward trend in rainfall amounts, while a positive value indicates an upward trend (Hamed & Rao, 1998).

In this case, the analysis revealed a negative Sen’s estimator, signifying a consistent decrease in rainfall throughout the years studied. The overall significance shown by the Mann-Kendall test is in line with this finding, establishing a coherent narrative that rainfall levels are diminishing in Kenya, as illustrated in Figure 4.2 (Oloo et al., 2020).

Figure 4.2: Past Annual Rainfall Trend for Kenya



Moreover, this is further substantiated by the visual data presented in Figure 4.2, which illustrates a slight upward trend. Although a negative estimator is reported, the visual representation can sometimes indicate short-term variations or cyclical patterns that may not fully capture the overarching downward trend suggested by the analyses. Therefore, while the long-term trend decreases as shown by the statistical methods, short-term fluctuations may still be visible and merit consideration in discussions about rainfall variability.

The combined evidence from both the statistical analyses and visual representations provides a comprehensive understanding of the changes in rainfall patterns in Kenya, reinforcing the notion that the country is experiencing a significant and alarming trend of decreasing annual rainfall during the study duration. This trend could have extensive effects on water resources, agriculture, and the region's general climatic resiliency.

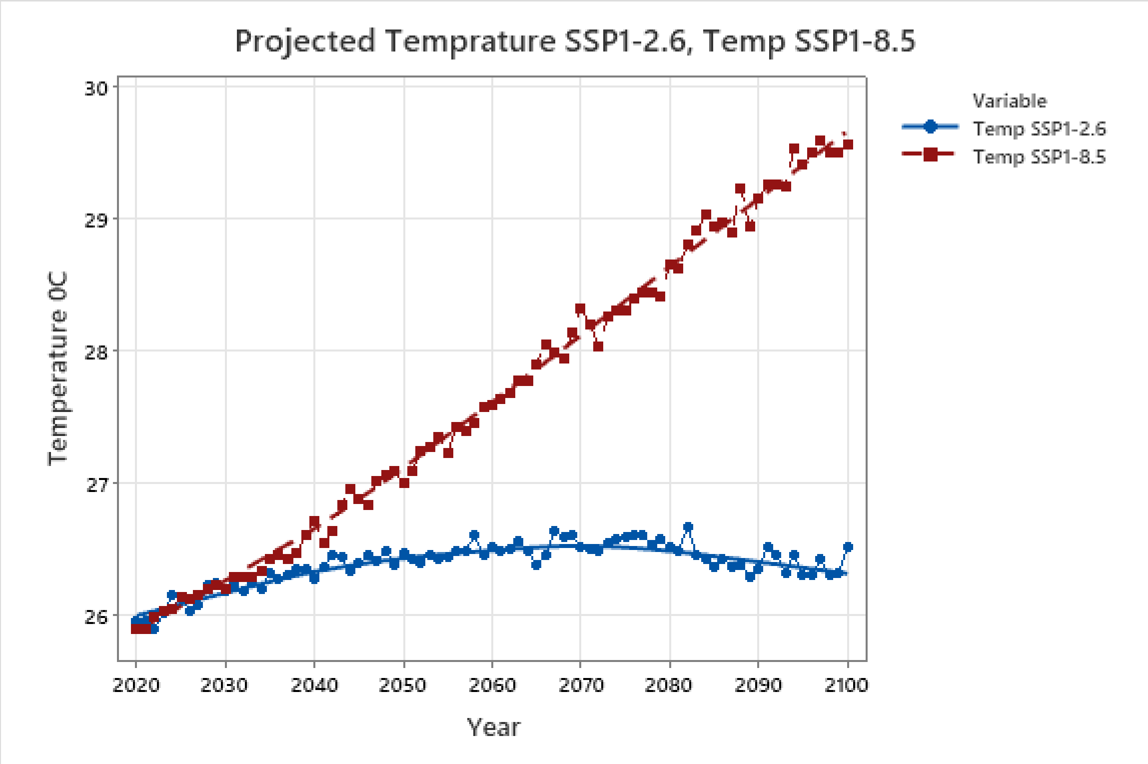
4.2.3 Projected Temperature and Rainfall in Kenya

The main sources of data for this study are the Climate Change Knowledge Portal (CCKP) of the World Bank Group and the CMIP6 (Coupled Model Inter-comparison Project, Phase 6) data ensemble, which serves as the foundation for the IPCC's Sixth Assessment Report's (AR6) forecasts of global climate change. A total radiative forcing pathway and level by 2100 was used to establish five Representative Shared Socioeconomic Pathways (SSPs) that represent distinct societal development trajectories: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5. For example, the optimistic scenario is represented by SSP1-2.6, whereas the business-as-usual situation is assumed by SSP5-8.5. The most optimistic scenario, SSP1-2.6, which calls for global emissions to be reduced to net-zero by 2075, and the Business-as-Usual scenario, SSP5-8.5, were the main focus of the study in order to streamline the analysis.

4.2.3.1 Projected Temperature

According to Shared Socioeconomic Pathways (SSP) scenarios SSP1-2.6 and SSP5-8.5, Kenya's projected temperature changes show a notable increase in temperature between 2020 and 2100 (Figure 4.3). By predicting a rise in temperature of roughly 1.5 to 2.5°C by the end of the century, SSP1-2.6, a sustainable development route with low greenhouse gas emissions, highlights viable adaption techniques and sustainable practices (IPCC, 2021). A more abrupt increase, possibly reaching 4°C or more, is predicted by SSP5-8.5, which reflects a high greenhouse gas emissions scenario. This might have a major effect on Kenya's biodiversity, water supplies, and agriculture (RCPs, 2019). In order to safeguard Kenya's ecosystems and economies, these projections highlight the pressing need for efficient strategies for mitigating and adapting to climate change (World Bank, 2020).

Figure 4.3: Kenya's projected average temperature from 2020 to 2100



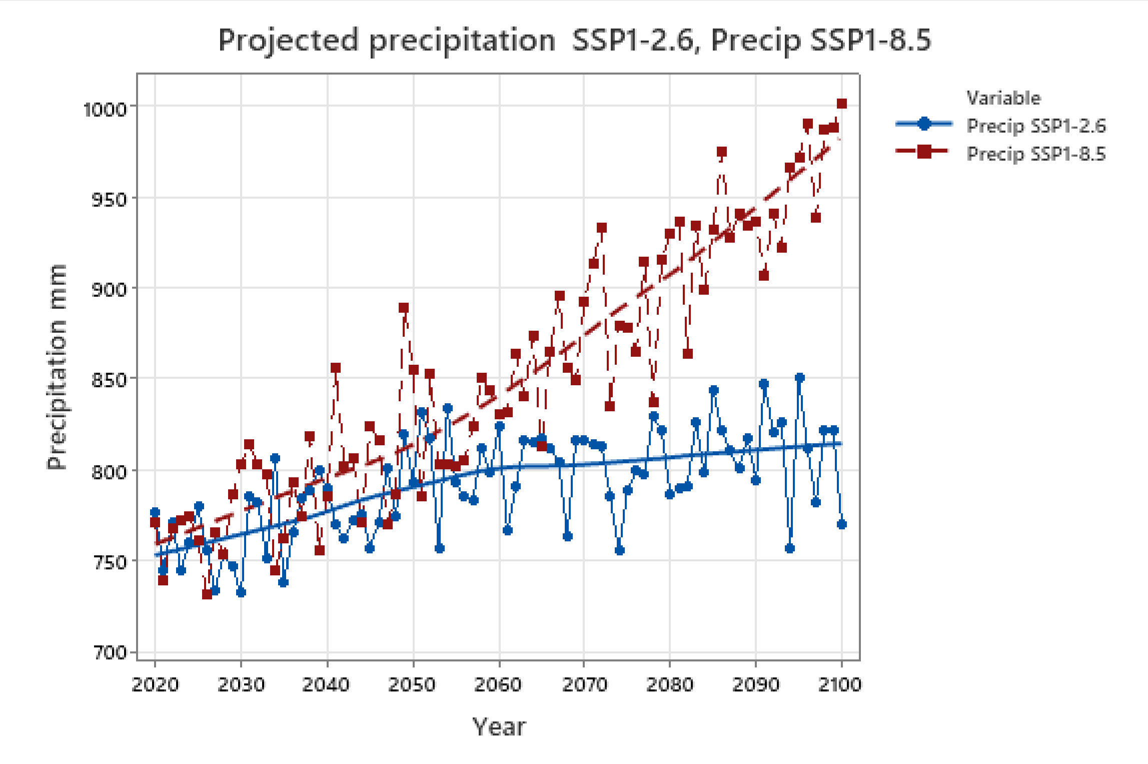
NB: The table displays the SSP1-2.6 and SSP5-8.5 CMIP6 Ensemble projections.

Temperature rises in Kenya are predicted to have a major impact on agricultural output between 2020 and 2100, which could pose problems for food security and economic stability. Rising temperatures may reduce agricultural yields for staple commodities like maize and beans, which are essential to Kenyan diets as well as livelihoods, as per reports from the Intergovernmental Panel on Climate Change (IPCC, 2021). According to research, essential crop yields could drop by 10–20% for each degree Celsius that the temperature increases (Lobell et al., 2011). Additionally, temperature variations can disrupt planting and harvest seasons, increasing vulnerability to pests and diseases, ultimately compounding the challenges faced by smallholder farmers (Kang et al., 2015). These climatic changes may also exacerbate water scarcity, further impacting irrigation practices (Hanjra et al., 2010). Overall, the projected temperature rise poses significant risks to agricultural sustainability in Kenya, necessitating robust adaptive measures to ensure food security and livelihoods.

4.2.3.2 Projected Precipitation

Projected precipitation for Kenya under the scenarios for Shared Socioeconomic Pathways (SSP) SSP1-2.6 and SSP1-8.5 between 2020 and 2100 (figure 4.4) indicates significant variability and potential shifts in hydrological patterns. Under SSP1-2.6, which represents a low-emission scenario aimed at achieving sustainable development, projections suggest a slight increase in total annual precipitation, coupled with improved distribution of rainfall events (IPCC, 2021; Driel et al., 2020). Conversely, the SSP1-8.5 scenario, reflecting a high-emission pathway with greater greenhouse gas concentrations, points towards increased rainfall intensity during certain periods, potentially exacerbating flooding risks while also leading to prolonged dry spells (Fischer et al., 2021; Karamage et al., 2019). These divergent trends underscore the significance of adaptive water management techniques in Kenya, particularly considering the nation's reliance on agriculture and the sensitivity of its ecosystems to climatic variations (World Bank, 2020). Studies indicate both spatial and temporal shifts in rainfall distribution, with some areas projected to experience increased precipitation while others might face prolonged dry spells. According to the Kenya Meteorological Department (2018), climate change has led to significant variations in rainfall patterns across different regions of the country, impacting agricultural productivity and water resources (KMD, 2018). Research by Ogallai et al. (2020) highlights that northeastern regions are likely to face diminishing rainfall while parts of western Kenya may see increased precipitation, exacerbating flooding and affecting crop cycles (Ogalleh et al., 2020). According to the Intergovernmental Panel on Climate Change (IPCC, 2019), these changes also pose risks to food security and water supplies, necessitating the utilizing adaptable strategies to lessen the effects of climate variability.

Figure 4.4: Projected precipitation for Kenya 2020-2100



It is expected that shifts in the patterns of precipitation brought on by climate change will significantly impact agriculture in Kenya between 2020 and 2100. Studies indicate that rainfall variability will increase, with some regions suffering from longer droughts and others from more intense rainfall episodes. (IPCC, 2021; Gbetibouo, 2009). These changes threaten food security, as agriculture in Kenya predominantly depends on rain-fed systems, making farmers vulnerable to shifting weather patterns (Mavhura et al., 2021). For instance, reduced rainfall during critical growing seasons could lead to decreased crop yields, particularly for staples like maize and beans, exacerbating malnutrition and poverty levels (Fisher et al., 2018; Word Bank, 2020). Moreover, increased precipitation can cause soil erosion and nutrient depletion, further undermining agricultural productivity (WMO, 2021). Thus, adapting agricultural practices and investing in resilient infrastructure will be crucial for mitigating these impacts and ensuring livelihoods that are sustainable despite climate variability (Mastrorillo et al., 2016).

4.3 Quantifying Climate Change's Effect on Agriculture

The regression analysis's findings provide valuable insights on how agriculture and climate change interact. The coefficients associated with climate variables reveal the anticipated change in agriculture. When all other variables remain constant, production is equal to a one-unit increase in each variable. This allows for a clearer understanding of how specific climate factors impact agricultural productivity. Additionally, the significance levels, indicated by the p-values linked to each coefficient, serve to identify which climate variables have a substantial influence on crop yields. This statistical information is essential for assessing how climate change might affect agriculture. Additionally, future yields under various climate scenarios may be predicted using the regression model, which is useful for risk assessments and strategic planning of agricultural activities in the face of shifting environmental conditions.

Each variable's effect on agricultural productivity will be measured by the regression analysis's coefficients. A positive coefficient for precipitation, for instance, would suggest that more rainfall promotes higher crop yields, but some crops might be negatively impacted by rising temperatures.

In order to deal with the heteroskedasticity and non-stationarity of time series data, the study employed transformations including differencing to effectively stabilize the mean of a time series, while logarithmic transformations used to stabilize variance thus making the data more amenable to analysis (Hyndman & Athanasopoulos, 2021).

In dealing with heteroskedasticity and serial correlation in a multiple regression model using time series data is crucial for ensuring the validity of regression results. To address heteroskedasticity, the study employed robust standard errors, which adjust for potential non-constant variance without altering the coefficient estimates (Cameron & Miller, 2015). Additionally, transformations of the dependent variable using differencing) was also used to stabilize variance (Stock & Watson, 2019).

In addressing serial correlation, the study used lags of the dependent variable to mitigate serial correlation issues (Wooldridge, 2010). To determine whether serial correlation was present, the Durbin-Watson test was employed (Gujarati & Porter, 2009).

Table 4.2. Impact of Climate Change on Agriculture in Kenya

Variable	Coefficient	Std. error	P-value
GDP	0.0299401	.0129554	0.024
Agric. Land	2.200085	.749213	0.005
Temperature	-.0181127	.0050394	0.001
Precipitation	-.0012198	.0004221	0.005

R-squared 1.000
S-Adjusted R-squared 1.000
Prob(F-statistic) 0.000000
Dependent variable: Agricultural Production

The findings presented in Table 4.3 indicate the regression analysis of temperature and precipitation coefficients indicates a negative relationship between these variables and agricultural output, suggesting that crop yields are negatively impacted by changing precipitation patterns and raising temperatures. Research has consistently shown that higher temperatures can lead to increased evapotranspiration, reducing soil moisture and stressing crops, particularly in sensitive growth stages (Lobell et al., 2011). Furthermore, alterations in precipitation patterns may result in either an excessive amount of rainfall or drought, both of which pose significant risks to farming practices and productivity

(Porter et al., 2014). These findings are corroborated by studies indicating that even slight increases in average temperature can result in a decline in major crop yields such as wheat and maize (Schlenker & Roberts, 2009). As climate change continues to progress, understanding the interplay between temperature, precipitation, and agricultural output is still essential for creating flexible plans to lessen the adverse effects on food security. (Zhao et al., 2017).

Conversely, the GDP coefficient presents a more optimistic perspective; a positive coefficient implies that higher levels of GDP contribute to enhanced agricultural practices. This relationship suggests that as a nation's economy grows, it can allocate more resources towards advancements in agricultural technology, better infrastructure, and improved training for farmers, all of which can lead to more efficient and sustainable agricultural methods. According to studies, higher economic wealth enables more money to be spent on research and development, which fosters innovation in agricultural methods (World Bank, 2021). Furthermore, countries with higher GDP often experience improved access to markets, financing, and services, enabling farmers to adopt modern techniques and equipment (Food and Agriculture Organization, 2022). Thus, the positive GDP coefficient serves as an indicator of the potential benefits that economic growth can bring to the agricultural sector, eventually increasing food security and productivity. in a nation.

Examining the area under crop production coefficients serves as a critical analytical tool for understanding the relationship between cultivated land and agricultural output. This relationship is essential for assessing farming efficiency, as it provides insights into whether an increase in cultivated land correlates positively with higher yields. According to studies by O'Leary et al. (2020) and the Food and Agriculture Organization (FAO, 2021), an effective utilization of land, measured through crop production coefficients, can indicate whether agricultural practices are optimized to produce greater outputs. For instance, when agricultural output increases with additional land cultivation, it suggests efficient land use and the successful adoption of best farming practices. Conversely, if agricultural output does not significantly rise with an increase in cultivated land, it may indicate inefficiencies in land utilization or limitations in farming techniques employed (Blandford et al., 2019). Therefore, understanding these dynamics can inform policy decisions aimed at enhancing agricultural productivity and sustainability in various regions (United Nations, 2022).

When combined, these coefficients offer a thorough comprehension of the several elements influencing agricultural performance.

4.4 Existing policy gaps of adaptation to climate change in the agricultural sector and their effects on growth in Kenya.

Like many other nations, Kenya is facing serious challenges because of the changing climate, especially in the agricultural sector, which is essential to its economy and food stability. A variety of initiatives aimed at mitigating and adapting to climate change represent the government's approach to these issues. Important initiatives include the National Climate Change Action Plan (NCCAP), the Agriculture Sector Transformation and Growth Strategy (ASTGS), and the Climate Change Act of 2016.

The NCCAP outlines strategies for increasing resilience in food systems while ensuring sustainable agricultural practices. It highlights how crucial it is to support climate-smart agricultural methods like agroforestry, improved irrigation techniques, and the application of crop types resistant to drought (Government of Kenya, 2018). The Climate Change Act also mandates that all government policies and development plans consider climate change in order to meet the national goal of a climate-resilient economy.

Despite these policy frameworks, there are still a lot of gaps in how mitigation and adaptation methods are implemented and how effective they are.

One major weakness is the lack of adequate funding and resources to fully operationalize these policies. The financing landscape for climate adaptation in agriculture is often fragmented, with limited access for smallholder farmers who constitute the majority of agricultural producers in Kenya (FAO, 2020). The adoption of technology and behaviors that are climate resilient is hampered by this budgetary limitation.

Furthermore, there is a pronounced gap in comprehensively integrating traditional knowledge and local practices into national policies. Many rural communities possess indigenous knowledge that could enhance climate resilience, but such insights are frequently overlooked in policy formulation (Mastrorillo et al., 2016). Empowering local communities and incorporating their expertise could lead to more sustainable and context-specific adaptation strategies.

Kenya's agricultural sector needs more investment in research and development, particularly in crop types that can withstand climate change and sustainable farming practices. The existing policies emphasize the need for innovation; however, the actual capacity to undertake such research is often limited by financial constraints and inadequate infrastructure. This gap impacts the ability to develop locally relevant solutions necessary for effective adaptation.

While the policies advocate for multi-stakeholder participation, the engagement of local communities, especially smallholder farmers, in the decision-making process remains weak. Many policies are designed without adequate input from those directly affected by climate change, leading to initiatives that may not be in line with the actual requirements and preferences of farming societies.

Another critical issue is the inadequate focus on gender-responsive policies in climate change adaptation in agriculture. Despite their crucial role in agricultural production, women frequently encounter disproportionate impacts from climate change due to socio-economic inequalities. Policies that neglect gender considerations fail to tackle the particular difficulties faced by female farmers, thus limiting their capacity to adapt effectively (World Bank, 2019).

Need for Integrated Approaches: There is a tendency for policies to be developed in silos, focusing on either mitigation or adaptation without recognizing the interconnectedness of these strategies. An integrated approach that considers the cumulative benefits of both mitigation and adaptation measures is essential for creating resilient agricultural systems. The current policy landscape often fails to provide such holistic strategies.

Moreover, monitoring and evaluation frameworks for climate policies in agriculture are often weak or nonexistent, leading to challenges in assessing the effectiveness of various initiatives. Establishing robust systems to evaluate outcomes and impacts of adaptation and mitigation efforts is essential for continuous improvement and effective policy formulation (Climate Change and Agriculture in Kenya, 2021).

Inadequate Implementation and Enforcement: A significant gap lies in the actual implementation of the existing policies. While frameworks and strategies are developed, many are not effectively enforced at the local level. Financial and human resource constraints often hinder the full execution of these policies. For instance, farmers may lack access to crucial information or funding for climate-resilient agricultural practices, limiting the potential impact of policies designed to promote climate-smart agriculture.

climatic Information Services: In order for farmers to choose and manage crops wisely, accurate climatic data must be accessible and widely disseminated. While some efforts have been made to enhance climate information services, gaps remain in accessibility and usability for rural farmers. Bridging this gap is vital for improving farmers' adaptive capacity.

A summary of significant agricultural climate change policies is provided in Table 4.3 below, in addition to information on their goals, years of inception, and gaps in mitigation and adaptation.

Table 4.3 Summary of Policies related to Agricultural Climate Change

Policy/strategy	Objective	Gaps
National Climate Change Action Plan (NCCAP) 2018-2022	To provide a context for integrating climate change initiatives into national and county development plans, enhance resilience among communities, and mitigate greenhouse gas emissions	Limited financial resources for implementation. Insufficient stakeholder engagement, particularly at the grassroots level. Lack of specific targets for the agricultural sector.
National Agriculture Sector Climate Change Action Plan (ASCCAP)	To promote sustainable agricultural practices, increase resilience to food security and climate change impacts.	Inadequate systems for gathering data and keeping track of advancements. Insufficient capacity-building programs for farmers. Lack of integration with other sectors impacting agriculture, such as water and energy.
Kenya Climate Smart Agriculture Strategy (KCAS) 2017	To promote agricultural practices which improve resilience, lower greenhouse gas emissions, and boost productivity in a sustainable manner.	Climate-smart technology are not widely available to smallholder farmers. Adoption of climate-smart practices is not sufficiently encouraged or supported. Challenges in scaling up pilot projects effectively.
National Livestock Policy	To enhance the productivity and resilience of the livestock sector against climate change while	Minimal focus on indigenous pastoralist communities and their unique challenges.

	ensuring sustainable use of natural resources.	Lack of infrastructure to support livestock value chains. Limited focus on disease management under changing climate conditions.
Water Resources Management Authority Guidelines	To ensure sustainable water resource management in agriculture, support irrigation development, and enhance water-use efficiency.	Inadequate infrastructure for irrigation technologies. Poor community involvement in water management governance. Insufficient data on water availability and future risks related to climate change.
Kenya's Vision 2030. 2008-2030	To transform Kenya as a newly industrializing, middle-income nation where everyone has access to a high standard of living, including sustainable agriculture practices.	Climate change considerations are often secondary to economic growth targets. Limited integration with local and regional development plans.
National Forestry Policy	To promote the sustainable management of forestry resources, enhancing their function in mitigating and adapting to climate change efforts, including agroforestry.	Insufficient cross-sector collaboration between agriculture and forestry sectors. Limited investment in agroforestry systems that can provide multiple benefits.
Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019-2029	To transform the agricultural sector into a robust engine for economic growth, emphasizing resilience to climate change impacts through innovative agricultural practices, technology adoption, and diversification.	Inadequate infrastructure for climate-smart agriculture and lack of access to credits for smallholder farmers to implement new technologies.
National Environment Policy (NEP), 2013	To promote sustainable environmental management practices, including those affecting the agriculture sector while addressing effects of climate change.	Challenges related to enforcement, stakeholder engagement, and limited awareness of climate-smart policies in the grassroots level.

4.5 Possible public policy solutions for mitigating and adapting to climate change to support Kenya's agricultural sector's expansion

In Kenya, where agriculture employs over 75% of the rural population and accounts for roughly 33% of GDP, agriculture production is seriously threatened by climate change. (FAO, 2021). The challenges include increasingly erratic rainfall patterns, prolonged droughts, and unpredictable pest and disease outbreaks. In order to foster sustainable growth and strengthen the agriculture sector's resilience, this study proposes several public strategy and policy options.

Investment in Climate-Resilient Infrastructure: The Kenyan government should prioritize investments in climate-resilient infrastructure, including irrigation systems, rainwater harvesting, and improved transport networks to enhance market access for farmers. This could involve the building of dams and water storage structures to lessen drought's effects and guarantee a consistent water supply for agricultural activities. Encouraging public-private partnerships can significantly enhance funding and expertise for these infrastructure initiatives, adding resilience to the agricultural sector (World Bank, 2020).

Implementing Climate-Smart Agriculture (CSA) Policies: he development of comprehensive CSA policies is essential, integrating both mitigation and adaptation strategies. This can include financial mechanisms to support farmers transitioning to CSA practices, increasing access to climate finance, and facilitating exposure to global markets via technology transfer. Tools such as climate financing and insurance can lessen exposure to threats associated with climate variability, fostering a more resilient agricultural landscape (Schoonover et al., 2021).

Promoting Practices for Sustainable Land Management: Policies for sustainable land and soil management are essential for increasing agricultural output while lessening climate change's effects. Through laws and incentives like tax breaks or subsidies, the government should promote methods like organic farming, conservation tillage, and agroforestry. Farmers and the environment will both gain from this assistance since it speeds up the shift to sustainable farming methods (Nkonya et al., 2016).

Enhancing Agricultural Research and Development (R&D): Making R&D investments in agriculture is essential for ensuring that crop types and farming methods are in harmony with climate goals. It is important for the government to increase funding for agricultural research organizations and encourage partnerships with universities to innovate drought-resistant seeds and biopesticides. Establishing public-private partnerships can further mobilize necessary resources and knowledge to drive research outcomes (Mogaka et al., 2021).

Access to Finance and Insurance Schemes: Implementing financial mechanisms such as microcredit schemes and crop insurance is essential for granting farmers access to capital for climate adaptation technologies. Establishing an agriculture insurance scheme can protect farmers against climate-induced losses, empowering them to invest in resilient practices and higher-risk crops that may offer better returns (OECD, 2019).

Development of Comprehensive Early Warning Systems: Strong climate information services and early warning systems are essential for empowering farmers to make knowledgeable planting and harvesting choices. Collaborations between the government and meteorological departments should prioritize accurate weather forecasting and climate projections, thus improving food security and reducing vulnerability to climate shocks (Mastrorillo et al., 2016).

Promoting Agroclimatic Information Dissemination: A strong meteorological service providing timely weather forecasts is essential for reducing farmers' vulnerability to climate impacts. Investments in digital platforms for disseminating agroclimatic information will allow farmers to optimize planting and harvesting times, thereby enhancing agricultural productivity (World Meteorological Organization, 2020).

Strengthening Water Management Systems: Given the reliance of Kenyan agriculture on rainfall, it is crucial to enhance water management systems. Policies should emphasize improving irrigation infrastructure and promoting water conservation techniques like rainwater harvesting. Community-based approaches to designing climate-resilient water management strategies can also support increased agricultural productivity during droughts (WMO, 2019). Adopting policies that promote rainwater collection and drip irrigation which are some examples of effective water management systems that can enhance resilience to climate variability. Investments in infrastructure for water storage and distribution are critical to safeguarding agricultural productivity and reducing reliance on rainfall.

Expanding Extension Services and Training: Strengthening agricultural extension services will be essential for teaching farmers about climate-smart practices. Training programs should equip extension officers to educate farmers on adaptive strategies, for instance, integrated pest management and crop rotation, which help lessen climate change's effects on yields. (Food and Agriculture Organization, 2020).

Promoting Policy Integration and Stakeholder Engagement: National and local development policies must incorporate methods for climate change adaptation and mitigation. Engaging stakeholders including farmers, local leaders, and industry representatives—in the policy formulation process will ensure strategies are relevant and tailored to local needs, facilitating broader acceptance and implementation of climate resilience measures (Keizire & Opiyo, 2020).

Enhanced Soil Carbon Sequestration: Policies to promote soil conservation techniques, including cover cropping and reduced tillage, can enhance soil carbon sequestration, contributing to climate change mitigation. Government support for research and education on soil health management is essential to bolster these efforts (Kihara et al., 2018).

Implementation of Carbon Pricing Mechanisms: Introducing a carbon pricing mechanism can encourage agricultural producers to adopt low-carbon practices. Policies could include carbon credits for farmers who engage in practices that sequester carbon, for instance, organic farming and agroforestry. This approach can diversify farmers' income sources while promoting sustainable practices (World Bank, 2019).

Investment in Renewable Energy and Efficient Technology: It is important to support policies that provide financial incentives for livestock farming operations to implement energy-efficient technology and renewable energy sources. Utilizing biogas digesters for manure management can significantly reduce methane emissions while providing a renewable energy source for farms. Transitioning to cleaner energy can also lower operational costs to improve the livestock industry's sustainability (FAO, 2020).

Implementing Integrated Livestock and Crop Systems: Policies that Encourage integrated crop-livestock systems where livestock are utilized in crop production, particularly through manure recycling and cover cropping. These systems can enhance nutrient cycling, reduce dependency on chemical fertilizers, and improve soil fertility while decreasing methane emissions from livestock. The integration can also improve incomes and food security for farmers (Omore et al., 2016).

Promoting Improved Livestock Breeding Programs: Policies focused on establishing governmental initiatives to aid the creation and distribution of improved breeds of livestock that are more resilient to climate shocks and more productive. Improved breeding initiatives may result in animals that release less methane per unit of product and need less feed. Studies have shown that improved genetic traits can result in lower emissions and better adaptation to environmental changes (McAloon et al., 2018).

A comprehensive approach that improves food security, rural livelihoods, and economic stability is required in Kenya because of the country's shared challenges of the changing climate and agricultural productivity. Given how important agriculture is to the country's economy, stakeholders should make climate change adaptation and mitigation a top priority in agricultural policies in order to build a resilient industry. This strategy is crucial for solving present issues as well as guaranteeing a sustainable future in which agricultural expansion can flourish in light of a changing environment.

A multi-faceted approach is essential for boosting agricultural growth in light of the changing climate. This strategy ought to incorporate certain public policies that encompass investments in infrastructure development, promotion of sustainable farming practices, and prioritization of research and innovation. Improved financial mechanisms, including access to credit for farmers and incentives for adopting climate-smart practices, are vital for bolstering resilience in the agricultural sector.

Moreover, collaborative efforts that integrate the perspectives and needs of farmers into policy-making can significantly enhance the effectiveness of these strategies. Engaging communities fosters ownership and accountability, ensuring that policies are tailored to local realities and challenges faced by agricultural producers.

Key steps toward effective adaptation and mitigation include strengthening forecasting systems to enhance climate resilience, optimizing land use policies to prevent degradation, and encouraging sustainable livestock practices to lower emissions of greenhouse gases. For the millions of Kenyans who depend on agriculture to make a living, these initiatives not only lessen climate change's effects but also promote food security and rural development.

In conclusion, strengthening agricultural growth in Kenya requires the creation and application of strong public policy alternatives that prioritize mitigation and adaptation to climate change. To guarantee that Kenya's agricultural industry can withstand the impending effects of climate change, policies must prioritize encouraging sustainable farming practices, making investments in necessary infrastructure, and utilizing technological advancements. Kenya can create a resilient agricultural sector that not only satisfies national goals for food security while also assisting regional and international climate aspirations by coordinating these initiatives with local needs and encouraging stakeholder participation throughout the agricultural value chain.

CHAPTER FIVE

5.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents key highlights of results in chapter four, conclusions concerning the objectives alongside the findings' implications for theory, practice, and policy. Further, the chapter provides recommendations and possible areas of focus for future research. Section 5.2 below presents the synopsis of the study finding

5.2 Summary of the Findings

The results of this study show that Kenya has seen both irregular and unpredictable rainfall patterns as well as a notable rise in temperature throughout time. An disturbing pattern of protracted droughts punctuated by irregular and frequently unanticipated floods has been the hallmark of this climatic transition. These sudden changes in weather patterns pose serious problems for Kenya's agricultural industry, which is the foundation of the nation's economy. Not only does agriculture provide a substantial contribution to the nation's GDP, but it is also essential for creating jobs and guaranteeing the population's access to food. It is crucial to fully comprehend how specific climate change policies may both maintain and possibly improve agricultural growth in the face of these obstacles, given the sector's paramount significance.

Through rigorous empirical analysis, the study highlights that climate change's negative impacts are markedly hindering agricultural productivity. This decline in productivity does not just have implications for farmers; it ultimately stifles overall economic growth for the nation. The key findings from the research stress the urgent need to address existing policy gaps related to climate change adaptation strategies, which are essential for bolstering agricultural resilience. A significant concern that has emerged is that many current policies are not only lacking coherence but also lack effective implementation frameworks. This deficiency severely undermines the potential impact these policies could have on supporting farmers and enhancing agricultural output.

In exploring solutions, the study draws on best practices from global examples of climate-smart agriculture. It highlights how important it is to take an integrated approach that synergizes technology, community involvement, and sustainable agricultural practices. Furthermore, the identification of prevailing policy gaps reveals a critical deficit in structured and effective support systems for smallholder farmers, who will be most negatively impacted by the adverse consequences of global warming. Adopting sustainable land management practices, upgrading irrigation systems, and putting in place extensive insurance schemes are all necessary to close these gaps and increase agricultural resilience and capacity. In order to secure Kenya's agricultural sector's future and its vital economic contributions, it is imperative that policymakers take coordinated and proactive steps to enable farmers to adjust to the changing environment.

The study comes to the conclusion that Kenya's agricultural sector's GDP contribution is directly affected by the changing climate, which presents a serious risk to the growth of the industry. The trends of increasing temperatures, decreasing, erratic rainfall, and a rise in severe weather conditions like floods and droughts, call for immediate action. Policy gaps in light of climate change adaptation, emphasize the necessity of comprehensive plans that incorporate local knowledge and address gender equity.

The insufficient financial resources and infrastructure poor to support innovative agricultural practices further complicate the ability to adapt. To increase resilience against the effects of climate change, international collaboration and investment in the agriculture sector are desperately needed.

Climate change has detrimental impacts on Kenyan agriculture, posing clear risks to both economic stability and food security. As temperatures continue to rise and precipitation becomes increasingly unpredictable, the agricultural sector faces significant challenges that directly affect GDP growth. The existing policies are insufficient to withstand these growing challenges, leading to an urgent need for a reevaluation of current strategies in place.

In conclusion, to promote climate change resilience in agriculture,it is essential that Kenya adopts a multi-faceted approach that encompasses policy reform, investment in climate-resilient agricultural practices, and engagement with local communities. Failure to act decisively on these issues may result in compounded economic losses and increasing vulnerability among the rural population, ultimately affecting national stability.

5.3 Conclusion

The study arrives at several key conclusions:

Impact of Climate Change on Agriculture: Climate change has emerged as a significant threat to agricultural productivity in Kenya. Rising temperatures and inconsistent rainfall patterns have led to increased evapotranspiration, reduced soil moisture, and disrupted farming cycles. These factors collectively result in lower crop yields and threaten food security. The dependence on rain-fed agriculture exacerbates vulnerability to climate variability, necessitating urgent attention to adaptive measures to sustain agricultural growth.

Challenges in Policy Implementation: Kenya has established several climate policies, such as the National Climate Change Action Plan (NCCAP) and the Agriculture Sector Transformation and Growth Strategy (ASTGS), which aim to address climate challenges. However, the effectiveness of these policies is hindered by limited financial resources, fragmented implementation, and insufficient capacity at the local levels. The lack of proper operationalization mechanisms leaves smallholder farmers, who form the backbone of Kenya's agricultural sector, particularly vulnerable.

Limited Use of Indigenous Knowledge: A significant gap exists in integrating local and indigenous knowledge into national climate policies. Rural communities in Kenya possess valuable traditional practices and knowledge systems that could enhance climate resilience. Unfortunately, such insights are often overlooked in the development of formal policies, resulting in adaptation strategies that may not align with the socio-cultural contexts and specific needs of these communities.

Neglect of Gender-Sensitive Approaches: Climate change disproportionately affects women in Kenya, given their critical role in agricultural production and household food security. However, most existing climate policies fail to adopt a gender-sensitive approach, neglecting the unique challenges faced by women farmers. This oversight limits their capacity to adapt to climate variability and excludes a significant demographic from accessing resources and opportunities for building resilience.

Lack of Coordinated Efforts: Kenya’s response to climate change in agriculture is often characterized by fragmented efforts across various sectors and stakeholders. Policies are frequently developed in silos, focusing on either mitigation or adaptation without adequately integrating the two. This lack of coordination undermines the potential impact of these initiatives and results in inefficiencies in resource allocation and implementation.

5.4. Recommendations

Increased Funding for Climate-Smart Agriculture: A comprehensive review of existing policies should be conducted to streamline their integration with local needs and ensure adequate funding is directed towards climate change adaptation initiatives. To address the adverse effects of climate change, the government must prioritize investments in climate-smart agriculture. This includes enhancing access to irrigation infrastructure, promoting the adoption of drought-resistant crop varieties, and providing subsidies for climate-resilient farming techniques. Such funding should be targeted at smallholder farmers, who are most vulnerable to climate variability, ensuring that they can adapt and maintain productivity.

Incorporation of Indigenous Knowledge: Policymakers should actively integrate local and indigenous knowledge into climate adaptation strategies. This can be achieved through community consultations, participatory planning processes, and collaboration with local organizations. Leveraging this knowledge ensures that policies are culturally relevant and better suited to the specific climatic challenges faced by different regions within Kenya.

Strengthened Agricultural Research and Development: Increased investment in agricultural research is crucial to develop innovative solutions for climate adaptation. Focus areas should include breeding drought-tolerant and pest-resistant crops, improving soil health, and adopting precision agriculture technologies. Establishing partnerships between research institutions, government agencies, and the private sector can accelerate the development and dissemination of sustainable farming practices.

Gender-Responsive Policies: The government must develop and implement gender-responsive agricultural policies to address the specific challenges faced by women farmers. These policies should aim to improve women's access to financial resources, extension services, and climate-resilient technologies. Empowering women in agriculture not only enhances household food security but also contributes to broader economic development.

Enhanced Multi-Stakeholder Collaboration: Effective climate change mitigation and adaptation require coordinated efforts across sectors and stakeholders. The government should establish mechanisms to facilitate collaboration between public agencies, private entities, NGOs, and local communities. Integrating mitigation and adaptation strategies into a unified framework will maximize resource utilization and ensure that initiatives are complementary rather than duplicative.

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APPENDICES

Appendix I: Research Approval

(6)

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GRADUATE SCHOOL

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Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 810901 Ext. 4150

Internal Memo

FROM: Executive Dean, Graduate School

DATE: 23rd April, 2024

TO: Rachel Wangui Wanjau
C/o Public Policy & Public Administration Dept.

REF: C53/OL/CTY/26734/2014

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your revised Research Proposal as per our recommendations raised by the Graduate School Board of 13th March, 2024 Entitled **"Assessing the Implications of Climate Change Policies on Agricultural Growth in Kenya".**

You may now proceed with your Data Collection, Subject to Clearance with Director General, National Commission for Science, Technology and Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your project before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

ELIJAH MUTUA
FOR: EXECUTIVE DEAN, GRADUATE SCHOOL

C.c. Chairman, Department of Public Policy and Public Administration

Supervisors:

1. Dr. Gabriel Mwenjeri
   C/o Department of Public Policy and Public Administration
   Kenyatta University

EM/lnn

Appendix II: Research Permit from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **471801**

Date of Issue: **08/November/2024**

RESEARCH LICENSE

This is to Certify that Ms.. Rachel Wanjau of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: ASSESSING THE IMPLICATIONS OF CLIMATE CHANGE POLICIES ON AGRICULTURAL GROWTH IN KENYA for the period ending : 08/November/2025.

License No: **NACOSTI/P/24/41704**

471801

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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